DIVISION

OF

ELECTRICAL & ELECTRONICS ENGINEERING

Code No.	Subject Name	Credit
EE101	Basic Electrical Engineering	3:0:0
EE102	Basic Electrical Engineering	2:0:0
EE103	Basic Electrical Engineering	3:1:0
EE201	Electric Circuit Analysis	3:1:0
EE202	Electric Circuits Laboratory and Workshop	0:0:2
EE203	Network Analysis and Synthesis	3:1:0
EE204	Electromagnetic Theory	3:1:0
EE205	Electrical Technology	3:1:0
EE206	Electrical Circuits and Machines Laboratory	0:0:2
EE207	DC Machines And Transformers	3:1:0
EE208	DC Machines And Controls Laboratory	0:0:2
EE209	Synchronous And Induction Machines	3:1:0
EE210	AC Machines Laboratory	0:0:2
EE211	Electrical Machine Design	3:1:0
EE212	Computer Aided Machine Design Lab	0:0:2
EE213	Power Electronics	3:1:0
EE214	Power Electronics Lab	0:0:2
EE215	Electric Drives and Controls	3:1:0
EE216	Power System Analysis	3:1:0
EE217	Computer Aided Power System Analysis Lab	0:0:2
EE218	Transmission And Distribution	3:1:0
EE219	Protection And Switchgear	3:1:0
EE220	Introduction to Electrical Machines and Power Systems	3:1:0
EE221	Introduction to Electrical Machines and Drives	3:0:0
EE222	Electric Circuits and Machines Lab	0:0:1
EE301	Power Electronics-I	3:1:0
EE302	Linear Systems	3:1:0
EE303	Generalised Theory of Electrical Machines	3:1:0
EE304	Power Electronics Lab I	0:0:2
EE305	Power Electronics-II	3:1:0
EE306	Advanced Electric Drives and Control	3:1:0
EE307	Power Electronics Application to Power System	3:1:0
EE308	Simulation of Power Electronic System	3:1:0
EE309	Computer Simulation Lab of Power Electronic System	0:0:2
EE310	Advanced Power Semiconductor Devices	3:1:0
EE311	Industrial Electronics and Instrumentation	3:1:0
EE312	Power Electronics Lab II	0:0:2
EE313	Power Electronics in Wind and Solar Power Conversion	3:1:0
EE314	Embedded Controller Application in Power Electronics	4:1:0
EE315	Digital Instrumentation	4:0:0
EE316	Theory and Design of Neuro-Fuzzy Controllers	4:0:0
EE317	Computer Aided Design of Electrical Machines	3:1:0

Code No.	Subject Name	Credit
EE318	Power Electronics Laboratory	0:0:2
EE319	Signal Processing	4:0:0
EE320	Solid State DC Drives	3:0:0
EE321	Solid State AC Drives	3:0:0
EE322	Power Electronics and Drives Laboratory	0:0:2

EE101 BASIC ELECTRICAL ENGINEERING

Credit 3:0:0
Marks 40 + 60

Unit 1: DC Machines and Circuits

Electrical quantities – Electric current, Electric potential, Electric power, Electrical Energy Resistance, Temperature Co-efficient of Resistance – DC Generators – Principle of DC generator – Parts of DC generator – EMF Equation – Types of generators – Characteristics of generator – Applications of DC generators.

Unit II : AC Machines and Circuits

Generation of alternating EMF – Equation of alternating voltage – Alternating quantity (current or voltage) – Cycle – Time period – Frequency- Maximum value – Average value – Root mean square value – Form factor and peak factor – phase and phase difference – synchronous generator – principle – construction and applications. Transformers – principle – constructional details – parts – types (core and shell type) – applications.

Unit III : Generation, Transmission and Distribution

Generation of Electrical energy – Thermal power generating station – Hydro power generating station – Nuclear power generating station – Transmission of Electrical energy – Classification of Transmission lines – conductors – insulator – underground cables – classification of cables – laying of underground cables – distribution of electrical energy – AC distribution system – DC distribution system – overhead distribution system – underground distribution system.

Unit IV : DC and AC Motors

DC motor – principle of a DC motor – parts of a DC motor – back EMF – types of motor – characteristics of motor – application of DC motor – single phase induction motor – principle of operation of three phase induction motor – constructional details – slip – frequency of rotor current – torque slip characteristics – applications of three phase induction motor – synchronous motor – principle of operation – applications of synchronous motor.

Unit V : Measuring Instruments and Wiring Circuits

Basic principles of indicating instruments – moving iron and moving coil instrument – voltmeters and ammeters – dynamometer type wattmeter – induction type energy meter.

Wiring circuits: Wiring materials and accessories – rating of wiring materials, types of wiring – stair case wiring – fluorescent tube wiring – simple domestic wiring layout – basic principles of earthing.

Text Book

1. T. Thyagarajan, K.P. Sendur Chelvi and T.R. Rangaswamy, "Engineering Basics", 3rd Edition, New Age International Publishers, 2001.

Reference Book

1. T. Thyagarajan, "Fundamentals of Electrical and Electronics Engineering", Scitech Publications (Ind) Pvt. Ltd., Third Edition, October 2000.

EE102 BASIC ELECTRICAL ENGINEERING

Credit 2:0:0
Marks 40 + 60

Unit 1: DC Circuits
Electrical quantities – Ohm's Law – Kirchoff's Laws – resistors –inductors – capacitors – series and parallel circuits – simple problems.

Unit II : AC Circuits
Sinusoidal functions: Phasor representation – RMS Effective values - form and peak factors – RLC circuits, power and power factor – simple problems.

Unit III : DC Machines:
Construction and principle of operation of DC machines – generator/motor characteristics and applications

Unit IV : AC Machines
Construction and principle of operation of AC machines, alternators – three phase and single phase induction motors – synchronous motors and applications, Single phase and three phase transformers and power conditioning equipments.

Unit V : Wiring Circuits, Instruments and Power Conditioning Equipments
Domestic wiring – accessories – types – staircase wiring – fluorescent tube circuits – simple layout – earthing. Voltmeters – Ammeters – Wattmeters – CRO – RPS – UPS.

Text Books

1. T. Thyagarajan, K.P. Sendur Chelvi and T.R. Rangaswamy, "Engineering basics", 3rd ed., New Age international publishers, 2001.
2. Paranjothi S. R , "Electric Circuit analysis", New Age International Ltd,Delhi ,2nd Edition, 2000.
3. Nagrath I.J and Kothari D.P., "Electric Machines ",T.H.H Publishing Co. Ltd., New Delhi, 1990.
4. V.K. Mehta, "Principles of Electronics", S. Chand & Company Ltd, 2000.

Reference Books

1. T. Thyagarajan, "Fundamentals of Electrical and Electronics Engineering", SciTech publications (Ind.) Pvt. Ltd., 3rd Edition, October 2000.
2. Sudhakar A. and Shyam Mohan S.P, "Circuits and Network Analysis and Synthesis", Tata Mc Graw Hill Publishing Co. Ltd., New Delhi, 1994.
3. Theraja B. L and Theraja A. K, "Electrical Technology", Nirja Construction & Development company Pvt. Ltd., New Delhi, Volume II,22nd Edition, 1997.
4. Say M. G, "Alternating Current Machines", ELBS and Pitman, London, 5th Edition, 1992.

EE103 BASIC ELECTRICAL ENGINEERING

Credit 3:1:0
Marks 40 + 60

Unit I : DC Circuits and Magnetic Circuits

Electrical Quantities – Ohm's Law – Kirchoff's Laws- temperature coefficient of resistance – inductors – capacitors – series and parallel circuits – simple problems.

Magnetic circuits – definitions of MMF, flux and reluctance – reluctance in series and parallel – electromagnetic induction – Fleming's rule – Lenz's Law -

Faraday's laws – statically and dynamically induced EMF – self and mutual inductance – coefficient of coupling – hysteresis – eddy currents – analogy of electric and magnetic circuits – simple problems.

Unit II : DC Machines, Domestic Wiring and Computers

Construction and principle of operation of DC Machines, generator/motor action – EMF and torque equations – types of DC generators/motors – characteristics and applications.

Domestic wiring – accessories – types – staircase wiring – fluorescent tube circuit – simple layout – earthing – megger – induction type energy meter.

Computers

Introduction of computer – generation of computers – organization of computers – input and output devices – memory – types of memory.

Unit III : AC Circuits and Machines

Sinusoidal functions - phasor representation – RMS (or) effective values – form and peak factors – RLC circuits, power and power factor – simple problems – polyphase circuits – advantages – star/mesh connections – measurements of power and power factor. Single phase and three phase transformers – three phase and single phase induction motors – constructional details and basic principles – applications.

Unit IV : Basic Components and Sensors

Passive circuit components – resistors – metal film and wire wound resistors and their tolerances – potentiometers – single turn and multiturn potentiometers, capacitors, inductors.

Sensors:

Basic sensors – transducers – active – passive – sensitivity – resolution – strain gauge – load cell – LVDT – photo cell – capacitive – inductive transducers – principles of measurement system.

Basic Electronic circuits:
Basic concepts of PN Junction diodes – zener diode-bipolar junction transistor-junction field effect transistor – thyristor, photoelectric devices, single phase HWR, FWR rectifiers (only working principles) transistor biasing.
Integrated Circuits:
Introduction to fabrication of ICs – operational amplifier – SSI, MSI, LSI, VLSI.

Unit V : Power Conditioning Equipments and Communication systems:
Servo motors – stepper motors – servo stabilizer – CVT – inverters – UPS battery backup, SMPS, principles.
Basic principles of modulation – communication systems – radio – TV – microwave – satellite – RADAR, optical – ISDN and INTERNET – principles – block diagrams.

Text Books

1. Thiyagarajan T, Sendur Chelvi KP & Rangasamy T.R, "Basic Engineering", Revised second edition, New Age International (P) Ltd., 1997
2. Hughes, "Electrical Technology", ELBS
3. Louis M.M, "Elements of Electrical Engineering", Khanna Publishers.
4. Muraleedharan KA, Muthusubramanian R & Salivahanan S, "Basic Electrical & Electroncis and Computer Engineering", Tata McGraw Hill, 1997.

Reference Books

1. Anokh Singh, "Principles of Communication Engineering", S. Chand & Company, 1994
2. Ashok Rah, "Modern Electronic Communication Theory and Systems", Umesh Publications, Vol.I, 1990
3. Morston R.M., "A. Newens Circuits Manual, Power control circuits Manual", 1990, U.K.
4. Rajaraman.V, "Principles of Digital Computers" Eastern Economy Company.
5. Sawhney A.K., "A Course in Electrical and Electronic Measurements and Instrumentation" Dhanpatrai and Sons.

EE201 ELECTRIC CIRCUIT ANALYSIS

Credits 3:1:0
Marks 40+60

Unit I : Basic Circuit Concepts
Lumped circuits -Kirchoffs Laws -VI relationships of R, L and C -independent sources -dependent sources –simple resistive circuits -network reduction -voltage division -current division -source transformation.

Unit II : Sinusoidal Steady State Analysis
Phasor- sinusoidal steady state response -concepts of impedance and admittance -analysis of simple circuits- power and power factor -series resonance and parallel resonance - bandwidth and Q factor. Solution of three-phase balanced circuits -power measurements by two-wattmeter methods - solution of three phase unbalanced circuits.

Unit : III : Mesh-Current And Node-Voltage Methods
Formation of matrix equations and analysis of complex circuits using mesh-current and nodal-voltage methods - mutual inductance- coefficient of coupling -ideal transformer.

Unit IV : Network Theorems And Applications
Superposition theorem -reciprocity theorem –compensation theorem -substitution theorem -maximum power transfer theorem -Thevenin's theorem. -Norton's theorem and Millman's theorem with applications.

Unit V : Transient Analysis
Forced and free response of RL, RC and RLC circuits with D.C. and sinusoidal excitations.

Text Book

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

Reference

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

EE202 ELECTRIC CIRCUITS LABORATORY AND WORKSHOP

Credits 0:0:2
Marks 50 + 50

1. Verification of Kirchoff’s Laws.
2. Verification of Network Theorems (Thevenin, Norton and Superposition Theorems)
3. Introduction to PSPICE analysis of electric circuits.
4. Power Measurement by two wattmeter method
5. Active and Passive filters
6. Power measurement by three ammeter and three voltmeter
7. Study of resonance and circuit transients by Digital Simulation.
8. Study of unbalanced circuits using symmetrical components (balanced circuit with unbalanced source only)
9. Measurement of two port parameters
9. Exercises in house wiring, power wiring and earthing.
10. Winding of AC motors - Single phase and three-phase induction type
11. Trouble shooting in electrical machines equipment and instruments.
12. Assembly and construction of small transformers & chokes

13. PCB fabrication
14. Cable jointing and fault location
15. Transformer Oil testing - dielectric strength & acidity.
16. Use of Earth megger
17. Different types of switches and lamps used in wiring circuit.
18. Study of domestic appliances like mixie, wet grinder, refrigerator, washing machine, microwave oven, table fan, monoblock pump, single phase motor, sewing machines, iron box, water heater, emergency lamp, telephone, PC, printer, stabilizer, domestic power generator.

EE 203 NETWORK ANALYSIS AND SYNTHESIS

Prerequisite : EE201 Electric Circuit Analysis

Credits 3:1:0
Marks 40+60

Unit I : S-Domain Analysis
S-domain network -driving point and transfer impedances and their properties -transform network analysis -poles and zeros of network functions -time response from pole-zero plots.

Unit II : Frequency Domain Analysis
Immittance -loci of RLC network -Frequency 3phase of RLC networks -frequency response from pole-zero- Bode plots.
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Unit III : Network Topology
Network graph, tree and cut-sets -tie set and cut-set schedules -v-shift and I-shift- Primitive impedance and admittance matrices -Application to network solutions.

Unit IV : Two-Port Networks & Filters
Characterization of two-port networks in terms of z, -y, h-and T -parameters- Network Equivalents -Relations between network parameters -Analysis of T, ladder, bridged- T and lattice networks -Transfer function of terminated two-port networks.
Filters and attenuators -Design of constant -k, m-derived and composite filters -qualitative treatment of active filters -Butterworth and Chebyshev filters.

Unit V : Elements Of Network Synthesis
Realisability of one-port network -Hurwitz polynomials and properties -p. r. functions and properties -synthesis of RL, RC and LC one-port networks.

Text Book
1. Kuo. F.F., 'Network Analysis and Synthesis', Wiley International Edition, Second Edition, 1966.

Reference
1. Paranjothi,S.R., 'Electric Circuit Analysis', New age International Publishers, Second Edition, 2000.

2. Van Valkenburg, M.E., 'Network Analysis', Prentice-Hall of India Private Ltd., New Delhi, Third Edition. 1974.
3. Sudhakar, A., and Shyammohan, 'Circuits and Networks Analysis and Synthesis', Tata McGraw Hill Publishing Co. Ltd. New Delhi, 1994.

EE204 ELECTROMAGNETIC FIELDS

Prerequisite: MA201/MA202 Engineering Mathematics I and II

Credits 3:1:0
Marks 40+60

Unit I : General Principles And Electrostatics
Review of vector algebra – the field concept – Sources of electromagnetic fields – charges – Coulomb's Law – Potential – Boundary value problems – Laplace and Poisson's equations – Electro static energy – Dielectrics – Capacitance.

Unit II : Magnetostatic
Current density – Magnetic field – Magnetic flux – Biobsavart's Law – Ampere's Law – Torque – force – Vector Potential – Boundary value problem.

Unit III : Electromagnetic Fields
Faraday's law – Lenz's law – Maxwell's equations – Displacement current – Eddy current – Relation between field theory and circuit theory.

Unit IV : Electromagnetic Waves
Generation – Propagation of waves in dielectrics – Conductors and transmission lines – Poynting vector – Skin effect.

Unit V : Field Modelling And Computation
Problem formulation – Boundary condition – Solutions Analytical methods – Variables separable methods – Conformal transformation – Method of images – Numerical methods – Finite difference method – Finite element method – Charge simulation method.

Text Books

1. John D. Kraus, "Electromagnetics", McGraw Hill Book Co., New York, Third Edition, 1989.
2. William H. Hayt, Jr., "Engineering Electromagnetics", Tata McGraw Hill Edition, New Delhi, 1998.

Reference Books

1. Joseph A. Edminister, "Theory and Problems of Electromagnetics", Schaum's Outline Series, McGraw Hill Book Company, New York, 1986.
2. Gangadhar K.A, "Field Theory", Khanna Publishers, New Delhi, 13^{th} Edition, 1997.
3. David J. Griffith, "Introduction to Electromagnetics", Prentice Hall of India Pvt. Ltd., New Delhi, Second Edition, 1997.

4. Kraus and Fleish, “Electromagnetics with Applications”, McGraw Hill International Editions, Fifth Edition, 1999.

EE205 ELECTRICAL TECHNOLOGY

Credit: 3:1:0
Marks: 40+60

Unit I : DC Machines
Construction, Principles of operation of DC motor and DC generator- Various types of DC motors and generators – Performance characteristics of DC motors and DC generators – Starting and speed control of DC motor.

Unit II : Transformers
Constructional details and principles of operation of single and three phase transformers – losses and efficiency- Special types of transformers – Servo stabilizers

Unit III : Synchronous Machines
Constructional features – Operating principle of three phase alternator and synchronous motor- synchronous motor starting, hunting, synchronizing and parallel operation.

Unit IV : Induction Motors
Constructional features – operating principle of three phase induction motors(squirrel cage and slip ring) – slip torque characteristics – starters – speed control methods.

Unit V : Special Machines
Tachogenerator - AC and DC servomotor – stepper motor – single phase induction motor – linear induction motor – push button switches - contactors – relays – sequential circuits – ladder diagram – selection of motors.

Text Books

1. Albert E Clayton and N N Hancock, “The performance and Design of Direct Current Machines”, Oxford and IBH Publishing Company Pvt. Ltd., New Delhi, 1990.
2. Say, M.G., “Alternating Current Machines”, ELBS & Pitman, London, 5th edition, 1992.
3. Rajput, R.K, “Electrical Machines”, Laxmi publications, New Delhi 1st edition.

Reference Books

1. Nagrath, I.J., “Electric Machines”, Tata McGraw hill Edition, 1997.
2. Theraja, B.L. and Theraja, A.K., “Electrical Technology”, Nirja Construction & Development Company Pvt. LTD, New Delhi, Vol. II, 22nd Edition, 1997.
3. Murugesh Kumar, K, “DC machines and Transformers”, Vikas publishing house Pvt. Ltd., New Delhi 1999.

EE206 ELECTRICAL CIRCUITS AND MACHINES LABORATORY

Credit: 0:0:2
Marks: 50+50

1. Measurement of active and reactive power and phase-shift in AC circuits.
2. Series and parallel resonant circuits.
3. Measurement of time constants (RC/RL)
4. Verification of Network theorems (Superposition, Thevenin, Maximum power transfer)
5. Predetermination of efficiency and regulation of single-phase transformers
6. Load test on single phase/three phase transformers
7. Load characteristics of DC motors (shunt, series and compound)
8. Load characteristics of DC shunt/compound generators.
9. Load test on alternators
10. Synchronous motor characteristics
11. Load test on three phase induction motors
12. Load characteristics of a single phase induction motors.
13. House wiring and earthing.
14. Speed control of DC shunt motor using (a) armature control (b) field control
15. Swinburne's test

EE207 DC MACHINES AND TRANSFORMERS

Prerequisite: EE201 Electric circuit analysis **Credits 3:1: 0**
EE204 Electromagnetic fields **Marks 40+60**

Unit : I
Constructional features of a DC machine - principle of operation of DC generator - EMF equation - methods of excitation - no load and load characteristics of DC generators - commutation - armature reaction- parallel operation of DC generators – applications.

Unit : II
Principle of operation of DC motor - torque equation - speed - torque characteristics of DC motors - starting - speed control – losses and efficiency – testing – brake, Swinburne's, Hopkinson's – applications – Introduction to Micromotors – DC servo motors.

Unit : III
Principle of operation - constructional features of single phase transformer - emf equation - transformer on no load and load - effects of resistance and leakage reactance of the windings - phasor diagram - equivalent circuit – regulation.

Unit : IV
Losses and efficiency - all day efficiency -testing- polarity and voltage ratio tests - open circuit and short circuit tests –Sumpner's test - parallel operation of single phase transformers - autotransformer - comparison with two winding transformers – Introduction to toroidal transformer.

Unit :V

Three phase transformer: constructional features- connections- parallel operations of three phase transformers- instrument transformers: current and potential transformers.

Text Books

1. Albert E Clayton and N N Hancock, “The performance and Design of Direct Current Machines”, Oxford and IBH Publishing Company Pvt. Ltd., New Delhi, 1990.
2. Say, M.G., “Alternating Current Machines”, ELBS & Pitman, London, 5th edition, 1992.
3. Rajput, R.K, “Electrical Machines”, Laxmi publications, New Delhi 1st edition, 1996.

Reference Books

1. Nagrath, I.J., “Electric Machines”, Tata McGraw hill Edition, 1997.
2. Theraja, B.L. and Theraja, A.K., “Electrical Technology”, Nirja Construction & Development Company Pvt. LTD, New Delhi, Vol. II, 22nd Edition, 1997.
3. Murugesh Kumar, K, “DC machines and Transformers”, Vikas publishing house Pvt. Ltd., New Delhi 1999.

EE208 DC MACHINES AND CONTROLS LABORATORY

Credits 0:0:2
Marks 50+50

1. Open Circuit and load characteristics of a separately excited DC Generator.
2. Open Circuit and load characteristics of DC Shunt generator
3. Load characteristics of DC compound generator
4. Load test on DC shunt motor
5. Load test on DC series motor
6. Speed control of DC Shunt motor
7. Swinburne's Test
8. Study of DC motor starters
9. Load test on single phase transformer
10. Open circuit and short circuit test on single phase transformer
11. Separation of no load losses in a single phase transformer
12. Sumpner's Test
13. Three Phase connections
14. Scott connection
15. Transfer function of separately excited DC generator.
16. Transfer function of field controlled DC motor.
17. Transfer function of armature controlled DC motor.

EE209 SYNCHRONOUS AND INDUCTION MACHINES

Credits 3:1:0
Marks 40+60

Prerequisite: EE201 Electric circuit analysis
EE204 Electromagnetic fields

Unit : I

Types - constructional features - armature winding - emf equation - armature reaction - alternators operating by itself - voltage regulation - concept of synchronous reactance - predetermination of regulation by synchronous impedance, mmf and Potier methods - load characteristics.

Unit : II

Synchronizing and synchronizing power - parallel operation - alternators on infinite busbars - two reaction theory of analyzing salient pole synchronous machines - regulation - determination of power/power angle relation.

Unit : III

Synchronous motor - principle of operation - phasor diagram - V curves and inverted V curves - circle diagram -synchronous condenser - hunting and methods of suppression - starting methods.

Unit : IV

Three phase induction motors - principle of operation - constructional details - constant flux operation - torque -slip characteristics-maximum torque-effect of rotor resistance -losses and efficiency -constant voltage operation -equivalent circuit - circle diagram - no load and blocked rotor tests -starters - speed control - induction generators.

Unit : V

Single phase induction motors - split phase induction motor, capacitor start induction run motor - capacitor start & run motor- shaded pole induction motor- principle of operation - double revolving field theory - equivalent circuit-performance calculation - methods of self starting and speed control - universal motor- stepper motor - linear induction motor – AC servo motors.

Text Books

1. Say, M.G., "Alternating Current Machines", ELBS & Pitman, London, 5th edition, 1992.
2. Nagrath, I.J., "Electric Machines", Tata McGraw Hill, II Edition, 1997.
3. Rajput, R.K., "Alternating Current Machines", Laxmi Publications (P) Ltd., 2000.

Reference Books

1. Mukherjee, P.K and Chakravarti,S., "Electrical Machines", Dhanpat Rai & Sons, New Delhi, 2nd Edition, 1993
2. Bhattacharya, S.K, "Electric Machines", Tata McGraw Hill, 1993.
3. Theraja, B.L and Theraja, A.K., "Electrical Technology", Nirja Construction & Development Company Pvt. Limited, New Delhi, Vol. II, 22nd Edition, 1997

EE210 AC MACHINES LABORATORY

Credit: 0:0:2
Marks: 50+50

1. Regulation of alternator by EMF/ MMF methods
2. Operation of alternator on infinite busbar
3. V-curve for synchronous motor
4. Load test on three phase and single-phase induction motor
5. No load and blocked rotor tests on three phase induction motors
6. Speed control of three-phase induction motors
7. Load test on synchronous induction motor
8. Load test on three phase induction generators
9. Study and control of stepper motor
10. Study on brushless alternator.
11. Measurement of transient and sub-transient reactance in direct and quadrature axis.
12. Predetermination of performance characteristics of three-phase induction motor using computer.

EE211 ELECTRICAL MACHINE DESIGN

Credits 3:1:0
Marks 40+60

Pre-requisite : EE207 DC Machines and Transformers
EE209 Synchronous and Induction Machines

Unit I : Basic Considerations

Constructional elements of transformers and rotating machines - classification of design problems - general design procedure - standard specifications - output coefficient- choice of specific electric and magnetic loading - separation of D and L for rotating machines.

Unit II: Magnetic And Electric Circuit Calculations

MMF calculation - magnetization curve - magnetic leakage - MMF for air gap - effect of slot and ventilating ducts - MMF for teeth - leakage reactance - unbalanced magnetic pull - estimation of number of conductors per turn - coil slots - conductor dimension - slot dimension.

Unit III : DC Machines

Armature winding - magnetic circuit - choice of number of poles - length of air gap - field system - interpoles - commutator - brushes

Unit IV : Transformers

Core Section -windings- window dimension - overall dimension - cooling tubes

Unit V : Induction Machines
Choice of L/ τ ratio - air gap length - cage rotor - dispersion coefficient - end ring current - wound rotor - slip rings.
Synchronous Machines: Short circuit ratio - air gap length - salient pole rotor - cylindrical rotor.

Text Book

1. Sawhney, A.K., "A course in Electrical Machine Design", Dhanpat Rai & Sons, New Delhi, 1996.

Reference Books

1. Bhattacharya, S.K, "Electrical Machines", Tata McGraw Hill, 2nd Edition, 1998.
2. Albert E. Clayton and Hancock,N.N, "The performance and Design of Direct Current Machines", Oxford & IBH Publishing Co., Pvt., Ltd., New Delhi, 1990
3. Say, M.G., "Alternating Current Machines", ELBS & Pitman, London, 5th edition, 1992.
4. Rai, H.M., "Principles of Electrical Machine Design", Sathyaprakashan , New Delhi, 4th Edition, 1995.
5. Shanmugasundaram A., "Electrical Machine Design Data Book", Wiley Eastern Ltd, 1989.

EE212 COMPUTER AIDED MACHINE DESIGN LAB

Credit: 0:0:2
Marks: 50+50

1. Study of AutoCAD machine
2. Design of D.C.Machine through computer
3. Design of single and three phase transformer through computer
4. Design of single phase Induction motor through computer
5. Design of synchronous machine through computer
6. Study of circuit breaker operation
7. Testing of different types of relays
8. Effect of airgap variation on induction machines performance
9. Electrical machines cross sectional view using AUTOCAD
10. Study of protective equipment & layout of 230/110KV substation
11. Introduction to ANSYS package

EE213 POWER ELECTRONICS

Prerequisite: EC201 Electron devices **Credits 3:1:0**
Marks 40+60

Unit I: Power Semiconductor Devices
Principle of operation -characteristics and modeling of power diodes, SCR, TRIAC, GTO, power BJT, power MOSFET and IGBT.

Unit II : Phase Controlled Converters
2 pulse, 3 pulse and 6-pulse converters- inverter operation input power factor- effect of source inductance and firing circuits.

Unit III : DC To DC Choppers
Voltage, current and load-commutated choppers -step up chopper and firing circuits.

Unit IV : Inverters
Series inverter- voltage source inverters- current source inverters -PWM inverters.

Unit V : AC Voltage Controllers
Single phase AC voltage controller -multi stage sequence. Control - step up and step down cyclo-converters -three phase to single phase and three phase to three phase cyclo-converters – Switched Mode Power Supply.

Text Book

1. Rashid, M.H., 'Power Electronics -Circuits Devices and Applications', Prentice Hall International, 1995.

Reference

1. Dubey, G.K., Doradla, S.R., Joshi, A. and Sinha, R.M., 'Thyristorised Power Controllers', Wiley Eastern Limited, 1986.
2. Landle, W., Power Electronics', McGraw Hill and Company, Third Edition, 1993

EE214 POWER ELECTRONICS LAB

Credits 0:0:2
Marks 50+50

List of experiments:

1. Characteristics of MOSFET and IGBT.
2. Diode Bridge Rectifier with R and RL Load.
3. Single phase half and fully controlled bridge rectifiers
4. Single-phase series inverter.
5. UJT pulse trigger circuit for SCR.
6. Single phase Cycloconverter.
6. AC regulator / AC phase control, using SCR, Triac and Diac.
7. Speed control of D.C motor using chopper drives.
8. Thyristorised speed control of 3-phase induction motor.
9. Three phase fully controlled Thyristor converter
10. PSPICE simulation of power electronics circuits
11. Single phase PWM inverter.
12. Switched Mode Power Supply.

EE215 ELECTRIC DRIVES AND CONTROLS

Prerequisite: EE213 Power electronics **Credits 3:1:0**
Marks 40+60

Unit I : Characteristics of Electric Drives
Speed -torque characteristics of various types of loads and drive motors -Joint speed-torque characteristics - selection of power rating for drive motors with regard to thermal overloading and load variation factors - load equalization - starting, braking and reversing operations.

Unit II : DC Drives
Speed control of dc motors - Ward- Leonard scheme - drawbacks - thyristor converter fed dc drives: single, two and four quadrant operations – SRM drive – Micromotor drive.
CHOPPER FED DC DRIVES: Time ratio control and current limit control - single, two and four quadrant operations - effect of ripples on the dc motor performance.

Unit III : Three Phase Induction Motor Drives
Speed control of three phase induction motors - stator control - stator voltage and frequency control - Ac chopper, inverter and Cycloconverter fed induction motor drives, rotor control - rotor resistance control and slip power recovery schemes - static control of rotor resistance using dc chopper - static Kramer and Scherbius drives.

Unit IV : Three Phase Synchronous Motor Drives
Speed control of three phase synchronous motors - voltage source and current source inverter fed synchronous motors - commutatorless dc motors - Cycloconverter fed synchronous motors - effects of harmonics on the performance of ac motors - closed loop control of drive motors.

Unit V : Digital Control And Drive Applications
Digital techniques in speed control - advantages and limitations - microprocessor based control of drives - selection of drives and control schemes for steel rolling mills, paper mills, lifts and cranes.

Text Books

1. Pillai, S.K., "A First Course on Electrical Drives", New Age International Publishers, 2nd Edition, 1994.
2. Vedam Subrahmanyam, "Thyristor Control of Electric Drives", Tata McGraw Hill Publishing company Ltd., New Delhi, 1994.

Reference Books

1. Sen, P.C, Thyristor, "DC Drives", John Wiley & Sons, New York, 1981.
2. Bose, B.K, "Power Electronics and AC Drives", Prentice Hall, Englewood cliffs, New Jersey, 1986
3. Ramamoorthy M., "An Introduction to Thyristor and their Application", Affiliated East West Press (P) Ltd, 2nd Edition , 1991.

EE216 POWER SYSTEM ANALYSIS

Credits 3:1:0

Prerequisite : EE218 Transmission and Distribution **Marks 40+60**

Unit I : Introduction

Need for system analysis in planning and operation of power system -distinction between steady state and transient state -per phase analysis of symmetrical three-phase system. General aspects relating to power flow, short circuit and stability analysis -per unit representation.

Unit II : Network Modelling

Primitive network and its matrices - bus impedence matrix - bus admittance and bus impedance matrix formation - equivalent circuit of transformer with off-nominal-tap ratio. Modeling of generator, load, shunt capacitor, transmission line, shunt reactor for short circuit, power flow and stability studies.

Unit III : Short Circuit Analysis

Need for short circuit study. Approximations in modeling - calculation for radial networks. Symmetrical short circuit analysis -symmetrical component transformation -sequence impedances -Z-bus in phase frame and in sequence frame fault matrices -unsymmetrical fault analysis.

Unit IV : Power Flow Analysis

Problem definition -bus classification -derivation of power flow equation -solution by Gauss-Seidel and Newton - Raphson methods- P-V bus adjustments for both methods -computation of slack bus power, transmission loss and line flow.

Unit V : Stability Analysis

Swing equation in state space form -equal area criterion - stability analysis of single machine connected to infinite bus by modified Euler's method using classical machine model -critical clearing angle and time. Multi-machine stability analysis using classical machines model and constant admittance load representation using Runge-Kutta method. Causes of voltage instability -voltage stability proximity indices for two-bus system.

Text Book

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

Reference Books

1. Stagg, G. W. and EI-Abaid, A. H. 'Computer Methods in Power System Analysis', McGraw-Hill International Book Company, 1980.
2. Nagarath, I.J., and Kothari, D.P., 'Modern Power System Analysis', Tata McGraw Hill Publishing Company, 1990.

EE217 COMPUTER AIDED POWER SYSTEM ANALYSIS LAB

Credit: 0:0:2
Marks: 50+50

All the experiments are based on MATLAB and Simulink

1. Short circuit analysis – symmetrical faults
2. Short circuit analysis – unsymmetrical faults
3. Transient stability analysis
4. Power plot – relay co-ordination
5. Harmonic analysis
6. Solution of load flow problem by Gauss-seidal method
7. Solution of load flow problem by Newton-Raphson method
8. Solution of economic load dispatch by Lamda iterative method
9. Simulink
10. Solution of load flow problem by fast decoupled method

EE218 TRANSMISSION AND DISTRIBUTION

Credits 3:1:0
Marks 40+60

Prerequisite : EE203 Network Analysis and Synthesis

Unit I : Introduction
Structure of electric power system -transmission and distribution systems -recent trends in power transmission –EHV AC and HVDC transmission.

Unit II : Transmission Line Parameters
Resistance - inductance and capacitance of single and three phase transmission lines -stranded and bundled conductors - symmetrical and unsymmetrical spacing -transposition - application of self and mutual GMD -skin and proximity effect - inductive interference with neighbouring circuits.

Unit III : Characteristics And Performance Of Transmission Lines
Equivalent circuits for short, medium and long lines -attenuation constant, phase constant, surge impedance - transmission efficiency and voltage regulation - real and reactive power flow in lines - power angle diagram - receiving end power circle diagram - limiting factors of transmission line loadability – shunt and series compensation - Ferranti effect and corona loss.

Unit IV : Insulators And Cables
Insulators: Types of insulators for overhead lines, voltage distribution in string insulator and grading -string efficiency. Underground cables: Constructional features of LT and HT cables -capacitance -dielectric stress and grading –thermal characteristics.

Unit V : General Aspects

Mechanical design of transmission lines -tariff and economic utilization and conservation of energy.

Text Books

1. Wadhwa, C.L., 'Electrical Power Systems', Wiley Eastern Limited India, 1985.
2. Nagarath I.J and Kothari D.P., 'Modern Power System Analysis', Tata McGraw Hill Publishing Company, 1990.

Reference

1. Despande, M.V., 'Electrical Power Systems Design', Tata McGraw Hill Publishing Company, New Delhi, 1990.

EE219 PROTECTION AND SWITCH GEAR

Credits 3:1:0
Marks 40+60

Prerequisite : EE216 Power System Analysis

Unit I : Introduction And Relay Characteristics

Need for protection - essential qualities of protective relays - over current relays -directional, distance and differential, under frequency, negative sequence relays -static relays -microprocessor based relays.

Unit II : Apparatus Protection

Generator and Transformer Protection, Protection of bus bars, transmission lines, CTs & PT's and their application in protective schemes.

Unit III : Theory of Arc Quenching

Theory of arcing and arc quenching -RRRV -current chopping and capacitive current breaking -D.C. circuit breaking.

Unit IV : Circuit Breakers

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

Unit V : Protection Against Over Voltages

Different methods of protection against over voltages -lightning arresters.

Text Books

1. Ravindranath, B and Chander, M, 'Power System Protection and Switch gear', Wiley Eastern Ltd., 1977.
2. Sunil.S.Rao, 'Switch gear and Protection', Khanna Publishers, New Delhi, 1986.

Reference Books

1. Patra, S.P., Basu , S.K. and Chowduri, S., 'Power systems Protection', Oxford and IBH Publishing Co, 1983.
2. Warrington A.R., Van C., ‘Protective Relays Their Theory and Practice Vo.1&2, 1968, Chapman & Hall, London
3. J&P Switchgear Handbook, Prentice Hall International, 1977.

EE220 INTRODUCTION TO ELECTRICAL MACHINES AND POWER SYSTEMS

Credit : 3:1:0
Marks 40+60

UNIT I : D.C Machines and Transformers

Constructional details of dc machines-principle of operation of dc generator-emf equation- -characteristics of different types of generators. Operation of dc motor-torque equation-characteristics of different types of motors-starting-speed control- Constructional details and principles of operation of single phase and three phase transformers- equivalent circuit of single phase transformer-losses, regulation and efficiency. Autotransformers and special transformers

UNIT II : A.C Rotating Machines

Constructional details and operating principle of 3 phase alternator and synchronous motor- -synchronizing and parallel operation. Starting of synchronous motor-V curve and inverted-V curves. Constructional features and operating principle of 3 phase induction motors-slip-torque characteristics-methods of starting-speed control; principle of operation and type of single phase induction motors.

UNIT II : Special Machines

Principle of working and special features of universal motor, repulsion motor, reluctance and hystersis motors, stepper motors, linear induction motor, ac and dc servo motors and tacho generator.

UNIT IV : Power System - Introduction

Schematic representation of a power system – various components and data related to power system – per unit representation – Distinction between steady state and transient state of power system – Recent trends in power transmission – EHV AC and HVDC transmission

UNIT V : Analysis of Power System:

Short circuit analysis – need for short circuit study – symmetrical short circuit analysis -power flow analysis – need for power flow analysis – derivation of power flow equation – Solution by Gauss Seidal method. Stability analysis – Steady state and transient stability -swing equation- stability analysis of single machine infinite bus system.

Text Books

1. Rajput R.K., “A text book of electrical machines” , - Vol-I,II – Lashmi
2. Edward Hughes., “Electrical Technology”, - English language book society.

3. Stagg G.W and El.Abiad A.H."Computer Method in Power System Analysis,",McGraw Hill International Book Company-1980

Reference Books

1. Mukherjee, and Chakravati., "Electrical Machines", - Dhanpat Rai & Sons.
2. Theraja B.L. and Theraja A.K. "Electrical Technology", Nirja Construction and Development Company Pvt. Ltd., New Delhi, Vol. II, 22nd Edition, 1977.

EE 221 INTRODUCTION TO ELECTRICAL MACHINES AND DRIVES

Credit: 3:0:0
Marks: 40+60

UNIT I : DC Machines and Transformers

Construction, Principles of operation of DC motor and DC generator- Various types of DC motors and generators – Performance characteristics of DC motors and DC generators . Constructional details and principles of operation of single and three phase transformers – losses and efficiency.

UNIT II : Synchronous Machines

Constructional features – Operating principle of three phase alternator and synchronous motor - synchronous motor – synchronous motor starting, hunting, synchronizing and parallel operation

UNIT III : Induction Motors

Constructional features – operating principle of three phase induction motors(squirrel cage and slip ring) – slip torque characteristics.– single phase induction motor.

UNIT IV : Special Machines

Tachogenerator - AC and DC servomotor – stepper motor– linear induction motor – push button switches - contactors – relays

UNIT V : Drive and its Application

Drives – Introduction - DC drives and AC drive – microprocessor based control of drives – selection of drives and control schemes for steel rolling mills, paper mills, lifts and cranes.

Text Books

1. Albert E Clayton and N N Hancock, "The performance and Design of Direct Current Machines", Oxford and IBH Publishing Company Pvt. Ltd., New Delhi, 1990.
2. Say, M.G., "Alternating Current Machines", ELBS & Pitman, London, V edition, 1992.
3. Rajput, R.K, "Electrical Machines", Laxmi publications, New Delhi I edition.
4. Pillai.S.K., " A First Course on Electrical Drives", New Age International Publishers, 2nd Edition ,1994.

Reference Books

1. Nagrath, I.J., “Electric Machines”, Tata McGraw hill Edition, 1997.
2. Theraja, B.L. and Theraja, A.K., “Electrical Technology”, Nirja Construction & Development Company Pvt. LTD, New Delhi, Vol. II, 22nd Edition, 1997.
3. Murugesh Kumar, K, “DC machines and Transformers”, Vikas publishing house Pvt. Ltd., New Delhi 1999.

EE222 ELECTRIC CIRCUITS AND MACHINES LAB

Credit: 0:0:1
Marks: 25+25

1. Measurement of active and reactive power and phase-shift in AC circuits.
2. Series and parallel resonant circuits.
3. Measurement of time constants (RC/RL)
4. Verification of Network theorems (Superposition, Thevenin, Maximum power transfer)
5. Predetermination of efficiency and regulation of single-phase transformers
6. Load test on single phase/three phase transformers
7. Load characteristics of DC motors (shunt, series and compound)
8. Load characteristics of DC shunt/compound generators.
9. Load test on alternators
10. Synchronous motor characteristics
11. Load test on three phase induction motors
12. Load characteristics of a single phase induction motors.
13. House wiring and earthing.
14. Speed control of DC shunt motor using (a) armature control (b) field control

EE301 POWER ELECTRONICS - I

Credits 3:1:0
Marks 40+60

Unit I : Single Phase Controlled Rectifiers
Half controlled and fully controlled thyristor bridge converters -R, RL and RLE loads - Continuous and discontinuous current operations- Evaluation of performance parameters- Harmonics, ripple and input power factor.

Unit II : Three Phase Controlled Rectifiers
Half controlled and fully controlled thyristor bridge converters -R, RL and RLE loads - Continuous and discontinuous current operations- Evaluation of performance parameters - Harmonics, ripple and input power factor.

Unit III : Performance
Effects of source inductance- Power factor improvement techniques - twelve pulse converters - Dual converters - Design of converter circuits.

Unit IV : Inverters

Single phase and three phase bridge inverters with R, RL and RLE loads - Voltage control - Harmonic reduction - Rectifier mode of operation - Current source inverters - Inverter Circuit Design.

Unit V : Resonant Pulse Converters

Series and parallel resonant inverters - zero current and Zero voltage switching resonant converters - Two quadrant zero voltage switching resonant converters - Resonant dc link inverters

References

1. Muhammad H. Rashid, "Power Electronics - Circuits, Devices and Applications", Prentice -Hall of India Private Ltd. New Delhi, Second Edition, 1994.
2. Ned Mohan et.al. "Power Electronics- Converters, Applications and Design", John Wiley & Sons (Asia) Private Ltd., Singapore, 1996.
3. Joseph Vithayathil, "Power Electronics - Principles and Applications", McGraw Hill Inc., New York, 1995.
4. Vedam Subrahmanyam, "Power Electronics", New Age International (P) Limited, New Delhi, 1996.

EE302 LINEAR SYSTEMS

Credits 3:1:0
Marks 40+60

Unit I : State Space Analysis

Limitations of conventional control theory - Modern control theory: Concepts of state, state variables and state model - State model for linear time invariant systems: State space representation using physical - Phase and canonical variables - Solution of state equation - State transition matrix.

Unit II : Decomposition Methods

Transfer function from state model - Transfer matrix - Decomposition of transfer functions: Direct, cascade and parallel decomposition techniques.

Unit III : State Space Representation For Discrete System

State space representation of linear time invariant discrete time systems - Solution of discrete time state equation. - Discretization of continuous time state equations .
EIGEN VALUES AND EIGEN VECTORS: Characteristic equation, eigen values, eigen vectors -Invariance of eigen values - Diagonalization - Jordan canonical form .

Unit IV : Concepts of Controllability And Observability

Kalman's and Gilbert's - Controllable and observable phase variable forms - Effect of pole-zero cancellation on controllability & observability.
STATE ESTIMATORS: Pole placement by state feedback - State estimators -Open loop and asymptotic state estimators

Unit V : Liapunov Stability Analysis

Stability in the sense of Liapunov - Definiteness of Scalar Functions - Quadratic forms - Second method of Liapunov - Liapunov stability analysis of linear time invariant system.

References

1. Katsuhiko Ogata, "Modern Control Engineering", Prentice Hall of India Private Ltd., New Delhi, Third Edition, 1998.
2. Nagrath I.J., and Gopal, M., "Control Systems Engineering", Wiley Eastern Limited, New Delhi, 1982.
3. Benjamin C.Kuo. "Automatic Control Systems", Prentice Hall of India private Limited, New Delhi, Fifth Edition, 1987.

EE303 GENERALISED THEORY OF ELECTRICAL MACHINES

Credits 3:1:0
Marks 40+60

Unit I : Generalised Theory

Conversions - Basic two pole machines - Transformer with movable secondary - Transformer voltage and speed voltage - Kron's primitive machine - Analysis of electrical machines.

Unit II : Linear Transformations

Invariance of power - Transformations from displaced brush axis, three phases to two phase, Rotating axes to stationary axes-Transformed impedance matrix - Torque calculations.

Unit III : DC Machines

Generalized representation - Generator and motor operation - Operation with displaced brushes - Steady state and transient analysis - Sudden short circuit - Sudden application of inertia load - Electric braking of DC motors.

Unit IV : Synchronous Machines

Generalized representation - Steady state analysis - Transient analysis - Electromechanical transients.

Induction Machines: Generalized representation-performance equation - steady state analysis - Transient analysis - Double cage machine - Harmonics - Electric braking.

Unit V : Special Machines

Generalized repulsion and steady state analysis of schrage motor - Repulsion motor - Single phase series motor - Single phase Induction motor - Inter connection of machines.

References

1. Bimbhra P.S., "Generalized Circuit Theory of Electrical Machines", Khanna Publishers, Delhi, 5th Edition, 1995.
2. Adkins B., " The General Theory of Electrical Machines", John Wiley Sons, 1957.
3. Seely S., "Electro-Mechanical Energy Conversion", McGraw Hill, 1962.

EE304 POWER ELECTRONICS LAB - I

Credits 0:0:2
Marks 50+50

Ex. No.	**TITLE**
1.	Static and Switching Characteristics of I.G.B.T., POWER MOSFET and TRIAC.
2.	Parallel and Series operation of Thyristors with Static and Dynamic Compensation.
3.	Various Turn-ON methods of Thyristors.
4.	Commutation techniques of Thyristor
5.	Operation of 1-phase Semi converter on R-L and Motor Load.
6.	Operation of 1-phase Full-converter on R-L and Motor Load.
7.	Operation of 3-phase Semi converter on R-L, and Motor Load.
8.	Operation of 3-phase Full converter on R-L, and Motor Load.
9.	Speed control of DC motor using thyristor semi-converter.
10.	Speed control of 3 phase Induction motor using static Inverter.

EE305 POWER ELECTRONICS – II

Credits 3:1:0
Marks 40+60

Unit I : DC Choppers
Step down dc chopper with R, RL and RLE loads - Control strategies - Continuous and discontinuous current operations.

Unit II : Chopper Circuits
Two quadrant and four-quadrant dc chopper - Multiphase dc chopper - Switching mode regulators: Buck, Boost, Buck-Boost and Cuk regulators - Chopper circuit design.

Unit III : AC Voltage Controllers
Principles of on-off control and phase control - single-phase half and full wave controller with R, RL and RLE loads - Three phase half wave and full wave controllers.

Unit IV : Ac Voltage Controllers
Single-phase transformer tap changers - AC voltage controllers with PWM control (AC chopper) - Design of ac voltage controller circuits - Effects of source inductance.

Unit V : Cyclo Converters
Principle of operation - Envelope and phase controlled cyclo converters - Single phase and three phase versions - Circulating current and circulating current free mode of operation - Effect of source inductance - Advantages and disadvantages of cyclo converters.

References

1. Muhammad H. Rashid, "Power Electronics - Circuits, Device and Applications", Prentice - Hall of India Private Ltd., New Delhi, Second Edition, 1994.
2. Ned Mohan et.al. "Power Electronics - Converters, Applications and Design", John Wiley & Sons (Asia) Private Ltd., Singapore 1996.

3. Joseph Vithayathil, "Power Electronics - Principles and Applications", McGraw Hill Inc., New York, 1995.
4. Vedam Subrahmanyam, "Power Electronics", New Age International (P) Ltd., New Delhi, 1996.

EE306 ADVANCED ELECTRIC DRIVES AND CONTROLS

Credits 3:1:0
Marks 40+60

Unit I : Converter Fed DC Drives
Single phase and three phase drives - separately excited and series motor drives - semi converter and full converter fed drives - General analysis - Evaluation of performance parameters - Dual converter fed drives.

Unit II : Chopper Fed DC Drives
Single quadrant chopper controlled drives - evaluation of performance parameters for separately excited and series motor drives - Two quadrant and four quadrant chopper controlled drives.

Unit III : Induction Motor Drives
Stator control: Stator voltage control of 3 phase induction motors, effect of voltage variation on motor performance by ac voltage controllers - Variable frequency square wave VSI drives - Twelve step inverters for induction motors - PWM drives - CSI drives.
Rotor control: Static rotor resistance control - DC equivalent circuit - Torque equation - slip power recovery- static Kramer drive - AC equivalent circuit - Torque expression - static scherbius drive.

Unit IV : Vector Control of Induction Motors
Principle of vector control - rotor flux - oriented control, stator - flux oriented control, Magnetizing flux - oriented control of induction machines.

Unit V : Special Drives
Synchronous Motor Drives: Scalar control - True synchronous and self modes - Vector control - Permanent magnet machine control - Switched reluctance motor and stepper motor drives.
Closed Loop Control: Motor transfer function - P, PI, and PID controllers - Current control - Design procedure - Phase locked loop (PLL) control - Microcomputer control.

References
1. Sen, P.C.,"Thyristor DC Drives", John Wiley & sons, New York, 1981
2. Pillai, S.K.,"Analysis of Thyristor Power Conditioned Motors", University Press, 1992.
3. Gopal K.Dubey, "Fundamentals of Electric Drives", Narosa Publications, 1995.
4. Bimal K.Bose, "Power Electronics and variable Frequency Drives - Technology and Application", IEEE Press, 1997.
5. Peter Vas, "Vector control of Ac machines", Oxford University Press, 1990.

6. Bose, B.K.et.al."Microcomputer control of power electronics and drives", IEEE Press, 1987.
7. Leonard, W,"Control of Electric Drives", Springer Verlag, 1985.

EE307 POWER ELECTRONICS APPLICATIONS TO POWER SYSTEMS

Credits 3:1:0
Marks 40+60

Unit I : Introduction
High power devices for power system controllers - characteristics - converters configurations for large power control-Single and three phase converters: Properties - current and voltage harmonics - effects of source and load impedance - choice of best circuit for power systems.

Unit II : Converter Control
Gate control - Basic means of control - Control characteristics - Stability of control - Reactive power control - Power flow analysis: Component models - Converter model - analysis of converter - Transient and dynamic stability analysis – protection.

Unit III : Wind Energy Conversion System
Basic components - Generator control - Harmonics - Power factor improvement.
PV CONVERSION SYSTEMS: Different schemes - DC and AC power conditioners - Synchronized operation with grid supply.

Unit IV : HVDC Systems
Application of converters in HVDC systems - Static VAR control - sources of reactive power - Harmonics and filters

Unit V : FACTS
Concept of flexible AC Transmission system - Static VAR compensators - Thyristor controlled reactor - Thyristor switched capacitor - Static condenser - Controllable series compensation.

References
1. Padiyar, K.R.,"HVDC Power Transmission Systems", Wiley Eastern Limited, New Delhi, 1992.
2. Rai, G.D.,"Solar Energy Utilisation", Khanna Publishers, New Delhi, 1991.
3. Daniel, Hunt, V.,"Wind Power - A hand book of WECS", Van Nostrand Co., New York, 1981.
4. Rakesh Das Bagamudre, "Extra High Voltage AC Transmission Engineering", Wiley Eastern Ltd., New Delhi, Second Edition, 1990.
5. Kimbark, E.X., “Direct Current Transmission”, Wiley Interscience, New York, 1971.
6. Rao, S.,”EHVAC and HVDC Transmission”, Khanna Publishers, 1991.

EE308 SIMULATION OF POWER ELECTRONIC SYSTEMS

Credits 3:1:0
Marks 40+60

Unit I : Introduction
Need for simulation - Challenges in simulation - Classification of simulation programs - Overview of PSPICE, MATLAB and SIMULINK.
Mathematical Modelling Of Power Electronic Systems: Static and dynamic models of power electronic switches - static and dynamic equations and state space representation of Power Electronic systems.

Unit II : PSPICE
File formats - Description of circuit elements - circuit description - output variables - Dot commands - SPICE models of Diode, Thyristors, Triac, BJT, and Power S-Functions - Converting S-Functions to blocks.

Unit III : MATLAB and Simulink
Toolboxes of MATLAB - Programming and file processing in MATLAB - model definition and model analysis using SIMULINK - S-functions - converting S-functions to blocks.

Unit IV : Simulation of Electronic Circuits using PSPICE, MATLAB and Simulink
Diode rectifiers - controlled rectifiers - AC voltage controllers - DC choppers - PWM inverters - voltage source and current source inverters - Resonant pulse inverters - Zero current switching and zero voltage switching inverters.

Unit V : Simulation of Speed Control Schemes using PSPICE, MATLAB and Simulink
Simulation of speed control schemes for DC and AC motors.

References

1. Rashid, M.H.,"SPICE for Power Electronics and Electric Power". Prentice Hall, New Jersey, 1993.
2. Rashid,M.H.,"SPICE for circuits and electronics using PSPICE", Prentice Hall of India, New Delhi, 1995.
3. Ned Mohan, "Power Electronics, Computer Simulation Analysis and Education using PSPICE", Minnesota Power Electronics Research and Education, USA, 1992
4. Giuseppa Mossobreio, "Semiconductor Device Modelling with SPICE", McGraw Hill Inc, New York, 1993
5. Bimal K.Bose, "Power Electronics and Variable Frequency Drives", IEEE Press, New Jersey, 1996.
6. Chee-Mun-Ong,"Dynamic simulation of Electric Machinery using MATLAB/SIMULINK", Prentice Hall PTR, New Jersey, 1998.
7. "The PSPICE User's Guide", Math works Inc, 1994.
8. "The SIMULINK User's Guide", Math works Inc, 1994

EE309 COMPUTER SIMULATION LAB OF POWER ELECTRONIC SYSTEMS

Credits 0:0:2
Marks 50+50

Ex. No. **TITLE**

1. Solution of transcedental equation by numerical techniques.
2. Computing the conduction angle for selective reduction of harmonics by Newton – Raphson method.
3. Solution of Matrices using Runge Kutta method.
4. Simulation of Solid State Circuits by PSPICE / MATLAB & SIMULINK.
5. Simulation of Controlled rectifiers by PSPICE / MATLAB & SIMULINK.
6. Simulation of Diode rectifiers, using PSPICE / MATLAB & SIMULINK.
7. Simulation of AC voltage controllers using PSPICE / MATLAB & SIMULINK.
8. Simulation of DC voltage controllers using PSPICE / MATLAB & SIMULINK.
9. Simulation of speed control schemes for DC and AC motors.
10. Mathematical modeling of Power Electronic Systems.

EE310 ADVANCED POWER SEMICONDUCTOR DEVICES

Credits 3:1:0
Marks 40+60

Unit I : Introduction
Status of Development of power semiconductor Devices - Types of static switches - Controlled and uncontrolled - Ideal and real switches - Static and dynamic performance - Use of heat sinks - Switching losses.
Power Diodes: Types - Electrical rating - Switching and steady state characteristics - switching aid circuits - Series and parallel operation - Schotky diodes - Fast recovery diodes.

Unit II : Thyristors
Physics of device operation - Electrical rating - Switching and steady state characteristics - Gate circuit requirements - Protection - Series and parallel operation - Driver circuit - types of Thyristors: Asymmetrical Thyristor - Reverse conducting Thyristor - light fired Thyristor - switching losses.

Unit III : Special Types Of Thyristors
TRIACs, GTOs and MCTs: Electrical rating - Switching and steady state characteristics - protection - Gate circuit requirements-Turn ON and Turn OFF methods –Series, Parallel operation of GTO Thyristors.

Unit IV : Power Transistors
Types - ratings - static and switching characteristics - driver circuit - switching aid circuit - Power Darlington.
Power Mosfets: Types - Comparison with BJTs - Structure - Principle of operation - Switching losses - Driver circuit - Switching aid circuit.

Unit V : IGBTs
Comparison with power BJT and MOSFET - Structure, Principle of working - switching characteristics - Gate drive requirements.
Emerging Devices: SITs-characteristics - Power Integrated circuit - Characteristics - Field controlled thyristors - New semiconductor materials for devices - Intelligent power modules.

References

1. Williams, B.W,"Power Electronic Devices, Applications and Passive Components", ELBS Oxford University Press, 1992
2. Joseph, Vithayathil, "Power Electronics Principles and Applications," McGraw Hill, 1995.
3. Mohan, M.et.al."Power Electronics converters, Applications and Design", Second edition, John Wiley and sons, New York, 1995.
4. Rashid, M.H.,"Power Electronic Circuits, Devices and Applications," Second Edition, Prentice Hall of India, New Delhi, 1994.

EE311 INDUSTRIAL ELECTRONICS AND INSTRUMENTATION

Credits 3:1:0
Marks 40+60

Unit I : Review of Conventional Transducers
Review of variable resistance transducers – variable inductance transducers – variable capacitance transducers-piezoelectric transducers.

Unit II : Digital Transducers
Direct digital transducers – absolute and incremental displacement transducers – Moire Fringe transducers – transducers with frequency output for the measurement of force and pressure – IC sensors for measurements of temperature and pressure.

Unit III : Industrial heating & Photoelectric devices
Industrial Heating using high frequency dielectric heating infrared and ultra violet heating – laser heating. Photoelectric devices and their application for industrial measurement and control – Introduction to PLC based industrial control.

Unit IV : Microprocessor based instrumentation
Detection of zero crossing of an alternating waveform – microprocessor based triggering of a Thyristor – Microprocessor based AC voltmeter – Microprocessor based AC Ammeter – Microprocessor based Speed monitoring unit to provide protection against over speed – Microprocessor based phase difference and power factor monitoring unit – Microprocessor based over and under voltage and over current protection.

Unit V : Smart Transducers
Concept of smart/intelligent transducer – comparison with conventional transducers – self diagnosis and calibration features – two win transmitters – measurement of flow, pH with smart transducers.

Text Books:

1. Doebelin E.O, "Measurement Systems" Application and Design", 4th Edition, 1990, McGraw Hill Publishing Co., Ltd., New Delhi.
2. Chapman, P., " Smart Sensors" ISA publication, 1995.
3. Biswas S.N, "Industrial Electroncis", Dhanpat Rai, Second Edition, 1997.

References:

1. B.W. William, " Power Electronics, Devices, Applications and Passive Components, ELBS, 1995.
2. David Buchla and Wayne Mclachlan, " Applied Electronics Instrumentation and Measurement, Prentice Hall International, 1997.
3. Chute G.M. and Chute R.D. Electronics in Industry, V Edition, 1979.
4. Barney G.C, "Intelligent Instrumentation", Prentice Hall of India Pvt., Ltd., New Delhi, 1988.

EE312 POWER ELECTRONICS LAB II

Credits 0:0:2
Marks 50+50

Ex. No. **TITLE**

1. Chopper controlled D.C. Drive.
2. Speed Control of Induction motor by Static Rotor Resistance.
3. Operation of Cycloconverter on R-L and Motor Load.
4. Speed control of Induction motor by variable voltage control.
5. Speed control of Induction motor by operation of Cycloconverter on R-L and Motor Load.
6. AC and DC Power Supply.

EE313 POWER ELECTRONICS IN WIND AND SOLAR POWER CONVERSION

Credits 3:1:0
Marks 40+60

Unit I : Introduction

Trends in energy consumption - world energy scenario - energy sources and their availability - conventional and renewable sources - need to develop new energy technologies.

Photovoltaic Energy Conversion: Solar radiation and measurement - solar cells and their characteristics - influence of insulation and temperature - PV arrays - Electrical storage with batteries - solar energy availability in India - Switching devices for solar energy conversion - Maximum power point tracking.

Unit II : Power Conditioning Schemes

DC Power conditioning converters - maximum power point tracking algorithms - AC power conditioners - Line commutated inverters - synchronized operation with grid supply - Harmonic problem.

PV Applications: Stand alone inverters - Charge controllers - Water pumping, audio visual equipments, street lighting - analysis of PV systems

Unit III : Wind Energy Systems
Basic Principle of wind energy conversion - nature of wind - wind survey in India - Power in the wind - components of a wind energy - conversion system - Performance of induction generators for WECS - classification of WECS.

Unit IV : Self-Excited WECS
Self excited induction generator for isolated power generators - Theory of self-excitation - Capacitance requirements - Power conditioning schemes - controllable DC Power from SEIGs - system performance.
Grid Connected WECS: Grid connectors concepts - wind farm and its accessories - Grid related problems - Generator control - Performance improvements - Different schemes - AC voltage controllers - Harmonics and PF improvement

Unit V : Stand Alone (Remote Area) Power Supply Systems
Wind/solar PV integrated systems - selection of power conversion ratio - Optimization of system components - storage - reliability evolution.

References

1. Rai, G.D. "Non-conventional energy sources", Khanna Publishers, 1993.
2. Rai, G.D.,"Solar energy utilization", Khanna Publishers, 1991.
3. Daniel Hunt, V,"Wind Power-A Handbook of WECS", Van Nostrend Co., New York, 1981.
4. Gray.L.Johnson, "Wind energy systems", Prentice Hall Inc., 1985.

EE314 EMBEDDED CONTROLLER APPLICATION IN POWER ELECTRONICS

Credit: 4:1:0
Marks 40+60

Unit I : Review of Microprocessors
Architecture and Programming of 8085 and 8086, A/D and D/A converters, Interfacing of 8253, 8255, 8155 and other important interfacing ICs.

Unit II : Microprocessor based firing scheme for converters
Firing schemes for single phase and three phase rectifiers - 3-phase AC choppers, Firing at variable frequency environment, Firing scheme for DC choppers, voltage and current commutation, Inverters, types of pulse width modulation techniques, their implementation using microprocessors, Application of these firing schemes to the control of DC drive, induction motors, synchronous motors and other special machines, Application in Electrical Traction.

Unit III : Microprocessors in closed loop control schemes:
Importance of measurement and sensing in closed loop control, Measurement of voltage, current, speed, power and power factor using microprocessors, Implementation of various

types of controllers using microprocessors.

Unit IV : Microprocessors in special applications of Power Electronics:
Static excitation of synchronous generators, Solid State tap-changers for transformers, UPS systems, Induction furnace control.

References

1. Gaonkar; R.S., 'Microprocessor Architecture, Programming and Application with 8080/8085A', WileyEastern Limited, New Delhi, 1991.
2. Hall, D. V: 'Microprocessors and interfacing', McGraw-Hill Publishing Company, New Delhi, 1986.
3. Lecture notes on 'Microprocessor in power Electronics' prepared by power Electronics division, SEEE, College of Engineering, Madras 600 025.

EE315 DIGITAL INSTRUMENTATION

Credit: 4:0:0
Marks 40+60

Unit I : Introduction
Digital codes - memory devices - basic building blocks - gates, FF and counters – discrete data handling - sampling - sampling theorem - aliasing errors -reconstruction - extrapolation - synchronous and asynchronous sampling.

Unit II : Digital methods of Measurements
Review of A/D, D/A techniques –F/V and V/F conversion techniques -digital voltmeters and multimeters-automation and accuracy of digital voltmeters and multimeters - digital phase meters -digital tachometers -digital frequency, period and time measurements-Low frequency measurements -automatic time and frequency scaling - sources of error -noise -inherent errors in digital meters, Hidden errors in conventional ac measurements- RMS detector in digital multimeters- mathematical aspects of RMS.

Unit III : Digital display & recording Devices
Digital storage oscilloscopes -digital printers and plotters -CDROMS -digital magnetic tapes, dot matrix and LCD display CROs, Colour Monitor, Digital Signal Analyser, and Digital Data Acquisition.

Unit IV : Signal Analysis
Amplifiers, filters, transmitter, receiver, wireless base and mobile station test sets, noise figure meters, RF network analyser, and high frequency signal sources.

Unit V : Current trends in digital instrumentation
Introduction to special function add on cards -resistance card -input and output cards -counter, test, and time of card and Digital Equipment construction with modular designing; interfacing to microprocessor, micro-controllers and computers. Computer aided software engineering tools (CASE) -use of CASE tools in design and development of automated measuring systems -interfacing IEEE cards -intelligent and programmable instruments using computers.

References

1. Bouwens, A.J. "Digital instrumentation" McGraw Hill 1984.
2. John Lenk, D. "Handbook of Microcomputer Based Instrumentation and Control"; PH, 1984.
3. Doebelin, Measurement System, Application & Design, IV Ed, McGraw Hill, 1990.
4. Product catalogue, Hewlett Packard, 1996.

EE316 THEORY AND DESIGN OF NEURO-FUZZY CONTROLLERS

Credit: 4:0:0
Marks 40+60

Unit I : Neural Network
Introduction - biological neurons and their artificial models - learning, adaptation and neural network's learning rules - types of neural networks- single layer, multiple layer- feed forward, feedback networks; back propagation -learning and training -Hopfield network.

Unit II : Neural Networks in Control
Neural network. for non-linear systems -schemes of neuro control- system identification forward model and inverse model- indirect learning neural network control applications - case studies.

Unit III : Fuzzy Logic
Fuzzy sets- fuzzy operation -fuzzy arithmetic -fuzzy relations- fuzzy relational equations - fuzzy measure -fuzzy functions -approximate reasoning -fuzzy propositions - fuzzy quantifiers - if-then rules.

Unit IV : Fuzzy logic in Control
Structure of fuzzy logic controller -fuzzification models- data base -rule base –inference engine defuzzification module - Non-linear fuzzy control-PID like FLC- sliding mode FLC - Sugeno FLC -adaptive fuzzy control -fuzzy control applications- case studies.

References

1. Jacek M Zurada, "Introduction to Artificial Neural Systems", Jaico Publishing House, 1999.
2. KOSKO, B. "Neural Networks And Fuzzy Systems", Prentice-Hall of India Pvt. Ltd., 1994
3. KLIR G.J. & FOLGER T.A. "Fuzzy sets, uncertainty and Information", Prentice –Hall of India Pvt. Ltd.,1993.
4. Zimmerman H.J. "Fuzzy set theory -and its Applications" -Kluwer Academic Publishers,1994.
5. Driankov, Hellendroon, "Introduction to Fuzzy Control", Narosa publishers.
6. Farin Wah S.S, Filev, D. Langari, R. "Fuzzy control synthesis and analysis", John Wiley and Sons 2000.

EE317 COMPUTER AIDED DESIGN OF ELECTRICAL MACHINES

Credit: 3:1:0
Marks 40+60

Unit I : Introduction
Conventional design procedures -Limitations -Need for field analysis based design.

Unit II : Mathematical formulation of Field problems
Development of torque/force -Electromagnetic Field Equations -Magnetic Vector/Scalar potential -Electrical Vector/Scalar potential- Stored energy in field problems –Inductances - Laplace and Poisson's Equations -Energy functional- Principle of energy conversion.

Unit III : Philosophy of FEM
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
Elements of a CAD System -Preprocessing -Modelling -Meshing -Material properties - Boundary Conditions -Setting up solution -Postprocessing.

Unit V : Design Applications
Design of Solenoid Actuator -Induction Motor -Switched Reluctance Motor –Synchronous Machines.

References

1. Silvester and Ferrari, "Finite Elements for Electrical Engineers" Cambridge University press, 1983
2. S.R.H.Hoole, Computer- Aided, Analysis and Design of Electromagnetic Devices,Elsevier, New York, Amsterdam, London, 1989.
3. D.A. Lowther and P.P.Silvester, Computer Aided Design in Magnetics, Springer Verlag, New York, 1956.
4. S.J.Salon, "Finite Element Analysis of Electrical Machines" Kluwer Academic Publishers, London,1995.
5. C. W. Trowbridge, "An Introduction to Computer Aided Electromagnetic Analysis"' Vector Field Ltd.
6. User Manuals of MAGNET, MAXWELL & ANSYS. Software Packages.

EE 318 POWER ELECTRONICS LABORATORY

Credit: 0:0:2 **Marks: 50+50**

1. Static switching characteristics of IGBT, MOSFET & TRIAC.
2. Various turn on methods of Thyristors & Triac.
3. Commutation techniques of Thyristors.
4. Operation of 1- phase Semi-Converter on R & R-L load.

5. Operation of 1- phase Full-Converter on R & R-L load.
6. Operation of 1- phase Full-Converter on R-L-E load.
7. Operation of 3- phase Semi-Converter on R & R-L load.
8. Operation of 3- phase Full-Converter on R & R-L load.
9. Operation of 1-phase Cycloconverter on R & R-L load.
10. Operation of Mc-Murray Inverter on R & R-L load.
11. Operation of 3-phase Inverter on R & R-L load.
12. **Electronics Starter and Speed Controller of DC motor.**

EE319 SIGNAL PROCESSING

Credit: 4:0:0 **Marks: 40+60**

Unit I : Review of Discrete time systems
Discrete time Signals-Sequences -Stability and Causality -Frequency domain Representation of Discrete time Systems and Signals -Two-dimensional Sequences and Systems -Z-Transform -Z- Transform Theorems and Properties -Two-dimensional Z- Transform. Structures for discrete time system –direct, cascade and parallel forms -lattice structure.

Unit II : The Discrete Fourier Transform
Representation of Periodic Sequences-the Discrete Fourier Series -Properties of the discrete Fourier series –sampling, Z-transform -discrete Fourier transform –properties of discrete Fourier Transform -Linear Convolution -Decimation -in- Time and Decimation-in- Frequency -FFT Algorithms. -Two-dimensional discrete Fourier Transform –spectral analysis - time, frequency analysis of signals.

Unit III : Digital Filter Design Techniques
Introduction - Design of IIR Digital Filters from Analog Filters -Analog –Digital Transformation -Properties of FIR Digital Filters -Design of FIR Filters Using Windows -A Comparison of IIR and FIR Digital Filters.

Unit IV : Effects of Finite Register Length in Digital Signal Processing
Introduction- Effects of coefficient on Quantization -Quantization in Sampling, Analog Signals- Finite Register Length effects in realizations of Digital Filters, discrete Fourier Transform Computations.

References
1. Alan Oppenheim. V and Ronals W.Schafer, Digital Signal Processing, Prentice Hall of India Pvt. Ltd., New Delhi, 1989.
2. John-H Karl, “An Introduction to digital processing”, Academic Press INC, Harcourt Brace Jovanovich, Publishers, 1989.
3. Douglas F: Elliot, “Handbook of Digital Signal Processing -Engineering Applications”. Academic Press, 1987. King, Robert.
4. King, Robert, “Digital filtering in one and two dimensions, Design and applications” - Plenum Press 1989.

5. V. Oppenheim and Ronald W Schafer," Discrete time signal Processing", Prentice Hall of India Pvt. ltd., New Delhi, 1992.
6. M. Bellanger, "Digital Processing of Signals", John Wiley & Sons,2000.
7. Ralph Chasseing 'Digital Signal Processing Laboratory Experiments using C & TMS320 C31', John Wiley & Sons, 1999

EE320 SOLID STATE DC DRIVES

Credit: 3:0:0 **Marks: 40+60**

Unit I : Review of conventional DC drives

Different techniques of speed control and methods of braking of series and separately excited DC motor, Ward-Leonard Speed control, Inching and jogging, Models and transfer function of series and Separately excited DC motor.

Unit II : Converter control of DC motors

Analysis of series and separately excited DC motor with single phase and Three phase converters operating in different modes and configurations. Problems on DC machines fed by converter supplies.

Unit III : Chopper control of DC motors

Analysis of series and separately excited DC motors fed from different Choppers, effect of saturation in series motor, CLC and TRC strategies.

Unit IV : Design of converter fed DC drives

Speed loop, current loop, armature current reversal, field current reversal-Inching, Digital controller and firing circuits, simulation.

Unit V : Intelligent controller for Dc drive

Microcomputer implementation of control function, Fuzzy, Neuro, Fuzzy neuro controllers.

Text Books

1. Buxbaum, A. Schierau,K. and Staughen, 'A Design of control systems for d.c. Drives',Springer-Verlag, berlin, 1990.
2. Dubey;G.K 'Power semiconductor controlled drives', Prentice Hall International, New Jersey; 1989.

References

1. Sen, P.C. 'Thyristor D. C. Drives', John Wiley & Sons, Newyork, 1981.
2. Subhramanyam, V. 'Electric Drives -Concepts and Applications', Tata-McGraw HillPublishing Co., Ltd., New Delhi, 1994.
3. B. K. Bose, Expert system, fuzzy logic and neural network applications in power electronics and motion control, Proceedings of the IEEE, Special issue on power electronics and motion control, August 1994, pp.1303.

4. T. Thyagarajan, Investigations on intelligent control strategies for air heating systems, Ph.D. Thesis, Anna University, Nov 1999
5. V Senthil Kumar; Investigation on intelligent control strategies for permanent magnet brushless dc Drive, M. E Thesis, Division of Power Electronic and drives, Anna university, Dec'2000.

EE321 SOLID STATE AC DRIVES

Credit: 3:0:0 **Marks: 40+60**

Unit I : Stator voltage control of induction motor

Torque slip characteristics, Operation with different types of loads, Performance, Comparison of different ac power controllers, Speed reversal, Closed loop control.

Unit II : Stator frequency control

Operation of induction motor with non- sinusoidal supply waveforms, variable frequency operation of 3-phase induction motors, Constant flux operation, Current fed operations, Dynamic and regenerative braking of CSI and VSI fed drives, Principle of vector control.

Unit III : Rotor resistance control

Torque-Slip characteristics, Types of rotor choppers, Torque Equations, Constant torque operations, TRC strategy, Combined stator voltage control and rotor resistance control.

Unit IV : Slip power recovery scheme

Torque equation, Torque-slip characteristics-power factor considerations, Sub-synchronous operation and closed loop control.

Unit V : Synchronous motor drives

Need for leading pf operation- open loop VSI fed drive and its characteristics- Self control-torque angle control- Power factor control-Brushless excitation systems-Starting methods-Principles of vector control.

Text Books

1. Murphy; J.M.D, Turnbull, F.G. “Thyristor control of AC motors”, Pergamon press, Oxford, 1988.
2. Sheperd, W. and Hully, L.N."Power Electronics and motor control”, Cambridge university press, Cambridge, 1987.

References

1. Dubey, G.K. “Power Semiconductor controlled drives”, Prentice Hall International, New Jersey; 1989.
2. Dewan, S.B. Slemon, G.R. Straughen, A. “Power semiconductor drives”, John Wiley and Sons, New York, 1984.

EE322 POWER ELECTRONICS AND DRIVES LABORATORY

Credit: 0:0:2 **Marks: 40+60**

1. Performance of Chopper fed D.C. Drive.
2. Operation of a four quadrant Chopper on D.C. Drive
3. Operation of a 1-phase A.C. Voltage controller on motor load.
4. Operation of a 3-phase A.C Voltage controller on a 3- phase Squirrel Cage Induction Motor.
5. Performance & speed control of S.C. Induction motor by Static Rotor Resistance Controller.
6. Performance & speed control of D.C motor by single phase Semi-converter.
7. 2-Quadrant operation of a 1-phase Full Converter using D.C. drive.
8. Performance & speed control of D.C. drive using 3-phase Semi-Converter.
9. Performance & speed control of 3-phase Induction motor using 3-phase PWM Inverter.
10. Performance & speed control of S.C. Induction motor using cyclo-converter.

ADDITIONAL SUBJECTS

Code No	Subject	Credit
EE223	Material Science	4:0:0
EE224	Communication Engineering	4:0:0
EE225	Electronic Circuits	3:1:0
EE226	Energy Systems	4:0:0
EE227	Power Electronics based Power System	4:0:0
EE228	Power System Control	4:0:0
EE229	HVDC Transmission-I	4:0:0
EE230	Advanced Computer Lab	0:0:2
EE231	Neural Networks and Fuzzy Systems	3:1:0
EE232	Special Electrical Machines	3:1:0
EE233	Power System Stability	3:1:0
EE234	Power Electronics Instrumentation	4:0:0
EE235	EHV AC & DC Transmission Engineering	4:0:0
EE323	Flexible AC Transmission Systems	4:0:0
EE324	Special Machines & Controllers	4:0:0
EE325	HVDC Transmission-II	4:0:0

EE223 MATERIAL SCIENCE

Credits: 4: 0:0 **Marks: 40 + 60**

UNIT 1 : Conducting Materials
Classical free electron theory of metals – electrical conductivity expression – drawbacks of classical theory, quantum theory, free electron theory of metals and its importance to density of states – fermi- dirac statistics – calculation of fermi energy and it's importance – elective mass of electron – concept of hole- origin of band gap in solids (qualitative treatment only) conductors, copper and aluminum – high resistivity alloys – super conductors – properties and applications.

UNIT II : Semiconductor Materials
Elemental and compound semiconductors and their properties – carrier concentration in n type and p type semiconductors- variation of carrier concentration with temperature and its influence – Hall effect – experimental arrangement- applications of hall effect.

UNIT III : Magnetic And Dielectric Materials
Different types of magnetic material and their properties – Heisenberg and domain theory of ferromagnetism – hystersis – energy product of a magnetic material – ferrite and their applications – magnetic recording materials – tapes and discs – metallic glasses – active and passive dielectrics and their frequency and temperature dependence – internal field and

deduction of clausius mosotti equation – dielectric loss – different types of dielectric breakdown – classification of insulating materials and their applications .

UNIT IV : Optical Materials

Optical properties of metals, insulators and semiconductors – excitons, traps, colour centers and their importance – phosphorescence and fluorescence – different phosphors used in CRO screens – liquid crystal as display materials- twisted pneumatic display – construction and working of LED – LED materials – thermography and it's applications – photoconductivity and Photo conducting materials.

UNIT V : Modern Engineering Materials

Metallic glasses as transformer core material – nano phase material – shape memory alloys – advanced ceramic materials – polymers – biomaterials – non-linear materials and their applications.

Text Book

1. Arumugam.M, 'Material science', Anuradha Technical book Publishers, Kumbakonam, 1997.

References

1. Pillai S. O, 'Solid state physics', New age Inc, 1998.
2. Van Vlac.L, 'Material science for engineers', Addison Wesley, 1995.
3. Kingery.W.D., Bowen H.K. and Unimann,D.R., 'Introduction to Ceramics', John Wiley and sons. 2nd Ed.1991.
4. Raghavan, V. 'Materials science and Engineering', Prentice Hall of India, New Delhi, 1993.

EE224 COMMUNICATION ENGINEERING

Credit: 4:0:0 **Marks: 40 + 60**

Unit I: Radio Communication Systems

Frequency spectrum – Principle of AM and FM – AM and FM transmitters and receivers – introduction to Micro Wave communication systems – Principle of Satellite communication.

Unit II: Pulse Communication Systems

PAM, PPM, PDM, PCM – delta modulation – differential PCM – merits and demerits – comparison of pulse modulation schemes.

Unit III : Data Transmission

Base band signal receiver – error probability – optimum and matched filter techniques – coherent reception – digital modulation systems – FS, PSK-comparison of data transmission systems.

Unit IV : Transmission Medium

Characteristics of cables – optical fibers – effects of EM radiation – band width and noise restrictions – statistical measurement of random noise – concept of multiplexing – FDM and TDM.

Unit V : Television
Scanning methods – B/W and Color systems – camera and picture tubes – synchronization – transmitters and receivers.

Text Book

1. Roody and Coolen, "Electronic Communication", Prentice Hall of India Ltd., 4th Edition, 1999.

References

1. Kennedy G, "Electronic Communication Systems", McGraw-Hill, 4th Edition, 1987.
2. Simon Haykins, "Communication Systems", 3rd Edition, John Wiley, Inc., 1995.
3. Bruce Carlson. A, "Communication Systems", 3rd Edition, Tata McGraw-Hill, 1986.
4. Taub and Schilling, "Principles of Communication Systems", Second Edition, McGraw-Hill, 1987.

EE225 ELECTRONIC CIRCUITS

Credits: 3:1:0 **Marks: 40 + 60**

UNIT I : Rectifiers and Power Suppliers
Single and polyphase rectifiers and analysis of filters circuits – design of zener and transistor series voltage regulators- switched mode power suppliers.

UNIT II : Amplifiers
Biasing circuits for transistors – FET and their analysis – CE, CC and CB amplifiers – FET amplifiers – frequency response – cascade and Darlington connections – analysis of Class A and B power amplifiers – complementary symmetry amplifiers – Class C power amplifiers.

UNIT III : Differential and Tuned Amplifiers
Differential amplifiers – common mode and difference mode analysis – Drift compensation – FET input stages – Chopper stabilizer amplifiers – introduction to tuned amplifiers.

UNIT IV : Feedback Amplifiers and Oscillators
Advantages of negative feedback – voltage /current, series /shunt feedback – positive feedback – condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts and crystal oscillators.

UNIT V : Pulse Circuits
RC wave shaping circuits – diode clampers and clippers – multivibrators – Schmitt triggers- UJT and transistor sawtooth oscillators.

Text Book

1. Albert Paul malvino, 'Electronic Principles,' Tata McGraw-Hill, 6th Edition, 1995.

References

1. Millman and Halkias, 'Integrated Electronics', McGraw-Hill, ISE, 1990.
2. Millman and Taub, Pulse, 'Digital and Switching Waves forms', McGraw-Hill, 1991.
3. David Bell, 'Electronic Devices and Circuits', Prentice Hall of India Ltd., 4th Edition, 2004.

EE226 ENERGY SYSTEMS

Credits:4:0:0 **Marks: 40 + 60**

UNIT I : Generation of Electrical Power

Layout and working of Hydro, Thermal, Nuclear – Gas turbine and diesel power plant – Introduction to non-conventional energy sources – Load and load duration curve – Load, demand and diversity factors – Plant capacity and plant use factors – Cost of energy generated – Tariffs.

UNIT II : Illumination, Electric Heating & Welding

Lighting calculations -determination of MHCP and schemes -polar curves of different types of sources -Rousseau's construction -photometers -lighting schemes -design of lighting schemes -factory & flood lighting -electric lamps- gaseous discharge construction and application –control equipment, efficiency and losses -resistance heating, induction heating -furnaces -high frequency dielectric heating, resistance welding, arc welding.

UNIT III : Electric Traction

Requirements of traction system -Systems of traction -speed time curves - tractive effort calculations -power of traction motor -specific energy consumption- series, parallel control of D.C. motors, open circuited, shunt and bridge transition - A.C. traction -recent trends in electric traction -electric braking.

UNIT IV : Generation of High Voltages and Currents and its measurements

Generation of high DC voltage using voltage multiplier circuits -Van de Graff generator -generation of high alternating voltages using cascade transformers - High DC voltage measurement techniques -methods of measurement for power frequency AC voltage -sphere gap measurement technique - use of CRO for impulse voltage and current measurements.

UNIT V : High Voltage Testing

Tests on insulators - testing of bushings -testing of isolators and circuit breakers -cable testing -testing of transformers- surge divertor testing -radio interference measurement -use of I.S.S. for testing.

Text Books

1. Uppal S.L., "Electric Power", Khanna Publishers, 13th Edition, 1996.
2. Naidu M.S. and Kamaraju V., "High Voltage Engineering", Tata McGraw Hill, 2nd Edition, 1998.

Reference Books

1. Kuffel. E and Abdullah. M, "High Voltage Engineering", Pergamon Press, 1970.
2. Soni, Bhatnagar & Gupta. A, "Course in Electric Power", Dhanpat Rai & Sons, 9th Edition., 1995.
3. Suryanarayana N. V.,"Utilization of Electrical Power", New Age International (P) Ltd., New Delhi, 1996.
4. E.O. Taylor, "Utilization of Electrical Energy", Orient Longman Ltd., S.I. Edition, 1971
5. Wadhwa C.L.,"High Voltage Engineering", New Age International (P) Ltd Publishers.,1995.

EE227 POWER ELECTRONICS BASED POWER SYSTEMS

Credits : 4:0:0 **Marks: 40 + 60**

Unit I : Introduction

High power devices for power system controllers – characteristics of converters – Single and three phase converters – Choice of best circuit for power systems.

Unit II : Converter Control

Basic means of control – Control characterisitics – Stability of control – Reactive power control – Power Flow analysis : Component models – converter model – protection.

Unit III – Wind and Solar Energy Conversion System

Basic components – Generator control – Harmonics – Power factor improvement.

Unit IV – HVDC Systems

Application of converters in HVDC systems – Static VAR control – Source of reactive power – Harmonics and filters.

Unit V – FACTS

Concept of flexible AC transmission system – Static VAR compensators – Thyristor controlled reactor – Thyristor switched capacitor – Static condenser – Controllable series compensation.

Text Books

1. Padiyar K. R, " HVDC Power Transmission Systems", Wiley Eastern Limited Ltd., New Delhi, 1992.
2. Daniel Hunt V., "Wind Power – A handbook of WECS", Van Nostrand Co., New York, 1981.

References

1. Rai. G. D, "Solar Energy Utilization", Khanna Publishers, New Delhi, 1991.
2. Rakesh Das Bagamudre, " Extra High Voltage AC transmission Engineering", Wiley Eastern Ltd., New Delhi, 2nd Edition, 1990.\
3. Kimbark. E. X, " Direct Current Transmission", Wiley Interscience, New York 1971.

4. Rao. S, "EHV-AC and HVDC Transmission and Distribution Engineering", Khanna Publishers, III Edition, 1999.

EE228 POWER SYSTEM CONTROL

Credits: 4:0:0 **Marks: 40 + 60**

UNIT I : Introduction

Need for voltage and frequency regulation in power system - system load characteristics - basic P-f and Q-v control loops - cross coupling between control loops - plant level and system level controls - recent trends of real-time control of power systems.

UNIT II : Real Power And Frequency Control

Fundamentals of speed governing mechanisms and modeling – speed – load characteristics - regulation of two synchronous machines in parallel – control areas – LFC control of a single area – static and dynamic analysis of uncontrolled and controlled cases - multi-area systems – two area system modeling - static analysis -uncontrolled case - tie line with frequency bias control of two-area and multi-area system – steady state instabilities.

UNIT III : Reactive Power – Voltage Control

Typical excitation system – modeling – static and dynamic analysis – stability compensation - effect of generator loading - static shunt capacitor/reactor VAR compensator, synchronous condenser, tap-changing transformer - static VAR system - modeling – system level voltage control

UNIT IV : Computer Control of Power System

Energy control center functions – system hardware configuration SCADA system – functional aspects – security monitoring and control – system states and their transition - various controls for secure operation.

UNIT V : Economic Dispatch Control

Incremental cost curve – co-ordination equations with loss and without losses, solution by iteration method. (No derivation of loss coefficients). Base point and participation factors. Economic controller added to LFC control.

Text Books

1. Olle I.Elgerd, 'Electric Energy and System Theory – An Introduction', Tata McGraw Hill Publishing Company, New Delhi, 1983.
2. Kundur, 'Power System Stability and Control', McGraw Hill Publishing Company, 1994

References

1. Kirchmayer .L.K. 'Economic operation of power system', John wiley & Sons, 1953
2. Allen J.Wood, Bruce F.Woolenbarg, 'Power Generation Operation and Control', John Wiley and Sons, 1984.
3. Mahalanbis, A.K., Kothari, D.P and Ahson, S.I., 'Computer Aided Power System Analysis and Control', Tata McGraw Hill Publishing Company, New Delhi, 1990.

EE229 HVDC TRANSMISSION - I

Credits: 4:0:0 **Marks: 40 + 60**

UNIT I : General Aspects
Historical development HVAC and DC links – kinds of DC links-HVDC projects in India and abroad – advantages and disadvantages of HVDC transmission – principal applications of DC transmission – economic factors – development of power devices for HVDC transmission – thyristors – light activated thyristors – MOS controlled thyristors (MCTs) – Switching and steady state characteristics.

UNIT II: Thyristor Converters
Three phase fully controlled thyristor bridge converters – operation as rectifiers and line commutated inverters – converter equivalent circuits – parameters and characteristics of rectifiers and inverters – series and parallel arrangement of thyristors – multibridge converters.

UNIT III: Control Of Converters
Gate control – basic means of control – power reversal – desired features of control – control characteristics – constant current control – constant extinction angle control – stability of control – tap changer control – power control and current limits.

UNIT IV : Protection
Basics of protection of HVDC systems – DC reactors – voltage and current oscillations – DC line oscillations – clearing line faults and re-energizing the line – circuit breakers – over voltage protections.

UNIT V: Harmonics, Filters And Ground Return
Characteristics and uncharacteristic harmonics – troubles caused by harmonics – means of reducing harmonics – telephone interference – harmonic filters – ground return – current fields – compatibility with other services – electrodes.

Text Books

1. Kimbark E.X., "Direct Current Transmission", Vol. I, Wiley Interscience, Newyork 1971.

Reference Books

1. Hcolin Adamson and Hingorani N.G., "High Voltage Direct Current Power Transmission", Garraway ltd., England, 1960.
2. Kory(ed) B. J., " High Voltage Direct Current Converters and Systems". Macdonald & Co, London 1995.
3. Weedy B.M., "Electric Power Systems", John Wiley & Sons, London,1979.
4. Padiyar K.R., "HVDC Power Transmission System Technology and System Interactions", Wiley Eastern Ltd., 1991.

EE230 ADVANCED COMPUTER LAB

Credits: 0:0:2 **Marks: 50 + 50**

12 experiments will be notified by HOD from time to time

EE231 NEURAL NETWORKS AND FUZZY SYSTEMS

Credits: 3:1:0 **Marks: 40 + 60**

UNIT : I
Introduction: The biological neural networks -The human brain organization -computer & human brain. Fundamentals of artificial neural networks -artificial neuron- activation function~ -single and multilayer networks -perceptron representation -linear separability -learning -training algorithm.

UNIT : II
Backpropagation -training algorithm -applications -counter propagation networks -network structure -applications -statistical methods - Boltzmann training.

UNIT : III
Hopfield nets -associative memory -bi-directional associative memories- BAM structure-continuous BAM-adaptive and competitive BAM -applications.

UNIT : IV
Adaptive Resonance Theory -overview architecture -ART implementation - training -characteristics of ART. Cognition and neocognition -structure & training.
Applications: Pattern recognition -traveling salesman problem -image compression.

UNIT :V
Fuzzy Sets and Relations: Crisp set- Vagueness -Uncertainty and Imprecision -Fuzziness -Basic definitions -Basic set theoretic operations for fuzzy sets -Types -Qperations -Properties -Crisp versus fuzzy relation - Fuzzy relation -Cardinality operations, Properties- fuzzy Cartesian Product and composition -Non interactive Fuzzy sets -Tolerance and Equivalence Relations -Fuzzy ordering relations -Fuzzy morphism -Composition of Fuzzy relations.

Text Books

1. Laurence Fausett, "Fundamentals of Neural Networks: Architecture, Algorithm and Applications”, Englewood Cliffs, NJ, Prentice Hall, 1994
2. Zimmerman H.J., “Fuzzy Set Theory and Its Applications", Allied Publishers, New Delhi, 1996.

Reference Books:

1. Limin, Fu., " Neural Networks in Computer Intelligence", McGraw Hill, 1994.
2. Kishan M., Mohan C.K and Sanjay, "Elements of Artificial Neural Networks" Penram International 1997.
3. Bose,N.K, &.Liang,P, "Neural Network Fundamentals", Tata McGraw Hill, 1998.
4. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", McGraw Hill International Edn., USA, 1997.
5. Philip. D. Wasserman, " Neural Computing", Van Nostrand Reinhold, New York, 1989.
6. Kosco B.,"Neural Networks and Fuzzy Systems", A dynamic approach to machine intelligence, Prentice Hall of India, 1995.

EE232 SPECIAL ELECTRICAL MACHINE

Credits: 3:1:0 **Marks: 40 + 60**

UNIT I : Synchronous Reluctance Motors

Constructional features – types – axial and radial air gap motors – operating principle – reluctance – phasor diagram - characteristics – Vernier motor.

UNIT II : Stepping Motors

Constructional features – principle of operation – variable reluctance motor – Hybrid motor – single and Multi stack configurations – theory of torque predictions – linear and non-linear analysis – characteristics – drive circuits.

UNIT III : Switched Reluctance Motors

Constructional features – principle of operation – torque prediction – power controllers – Nonlinear analysis – Microprocessor based control - characteristics – computer control.

UNIT IV : Permanent Magnet Brushless D.C. Motors

Principle of operation – types – magnetic circuit analysis – EMF and Torque equations – Power Controllers – Motor characteristics and control.

UNIT V : Permanent Magnet Synchronous Motors

Principle of operation – EMF and torque equations – reactance – phasor diagram – power controllers - converter - volt-ampere requirements – torque speed characteristics - microprocessor based control.

Text Book

1. Miller, T.J.E., "Brushless Permanent Magnet and Reluctance Motor Drives", Clarendon Press, Oxford, 1989.

References

1. Kenjo, T., 'Stepping Motors and their Microprocessor Controls', Clarendon Press London, 1984.
2. Kenjo, T., and Nagamori, S., 'Permanent Magnet and Brushless DC Motors', Clarendon Press, London, 1988.
3. Aearnley, P.P., 'Stepping Motors – A Guide to Motor Theory and Practice', Peter Perengrinus, London, 1982.

EE233 POWER SYSTEM STABILITY

Credits: 3:1:0 **Marks: 40 + 60**

UNIT : I

Concept and importance of stability in power system operation and design - Steady state, transient and dynamic stability - The swing equation of machines connected to an infinite bus bar and two machines connected together.

UNIT: II
Swing curves - solution by point by point and Euler's method - Qualitative treatment of stability studies on network analyzers and digital computers.

UNIT : III
Equal area criterion, calculation of critical clearing angle by equal area criterion of various fault conditions - Effect of enclosures - Factors affecting transient stability and its improvement.

UNIT :IV
Types of excitation systems, AVR, calculation of exciter response by graphical integration and step-by-step methods - Effect of speed governing system, inertia and damping on steady state and transient stability.

UNIT : V
Significance of steady state stability - power limit of transmission systems - Clarke's diagram of two machine systems with and without losses - Steady state stability of one machine connected to an infinite bus bar.

Text Books

1. Gangadhar, K.A., "Analysis and Stability of Electric Power System", Khanna Publishers, 2nd edition, 1993.
2. Pai M.A., "Power System Stability Analysis by the direct method of Lyapunov";, North Holland, System and Control Services, Vol. 3, 1981.

Reference Books

1. Taylor, C. W., "Power System Voltage Stability", Mcgraw hill, 1994.
2. Kimbark, E.M., "Power System Stability", John Wiley & sons, Vol. I & II, 1950.

EE234 POWER ELECTRONIC INSTRUMENTATION

Credits: 4:0:0 **Marks: 40 + 60**

UNIT I : Introduction
Importance of measurement and sensing - measurement techniques for thyristorised DC and AC circuits - measurement of voltage, current, power, power factor and speed.

UNIT II : Analog Systems
Introduction to various Analog systems - characteristics of operational amplifiers - fundamental circuits using OPAMPs - 555 timer and applications - PLL.

UNIT III : Digital Systems
Need for Digital systems – Boolean algebra – combinational and sequential logic circuits – analysis, design using memories, multiplexers, PLAs and PAL.

UNIT IV : Measurement Techniques
Application of analog circuits measurement and sensing of voltage, current, frequency, speed, power and power factor - isolation techniques - Sensing and measurement of voltage, current, frequency, speed, power and power factor using digital circuits - Study of digital storage oscilloscope.

UNIT V : Control Of Power Electronic Converters Using Analog and Digital Circuits
Firing Schemes for DC chopper – PWM techniques employed in converters and inverters - use of ADCs and DACs in sensing schemes in power electronic systems – closed loop current and speed control schemes.

Text Book
1. Dubey, G.K. et.al. 'Thyristorised Power Controllers', New Age International, New Delhi, 1996.

References

1. Roth, C.H. 'Fundamentals of Logic Design', McGraw Hill Publishing Co., New York.
2. Sidney Socloff, 'Applications of Analog Integrated Circuits', Prentice Hall of India, New Delhi, 1990.
3. Sen, P.C. 'Thyristor DC Drives', John Wiley and Sons, New York, 1981.

EE235 EHV AC AND DC TRANSMISSION ENGINEERING

Credits: 4:0:0 **Marks: 40 + 60**

UNIT I : Transmission Engineering
Transmission line trends – standard transmission voltages – Power handling capacity and line losses – cost of transmission lines and equipment – Mechanical consideration – Transmission Engineering principles.

UNIT II : Line Parameters
Calculation of Line and ground parameters – Resistance, Capacitance and inductance calculation – Bundle conductors – Modes of propagation – Effect of earth.

UNIT III : Power Control
Power Frequency and Voltage control – Over voltages – Power Circle diagram – Voltage control using shunt and series compensation – static VAR compensation – higher phase order system – FACTS.

UNIT IV : EHV AC Transmission
Design of EHV lines based on steady state limits and transient over voltages - Design of extra HV cable transmission – XLPE cables – Gas insulated cable Corona and RIV.

UNIT V : HVDC Transmission

HVDC transmission principles – Comparison of HVAC and HVDC Transmission - Economics – Types of converters – HVDC Links – HVDC Control – Harmonics – Filters – Multi terminal DC system – HVDC cables and HVDC circuit breakers.

Text Books

1. Rakosh Das Bagamudre, 'Extra High Voltage and AC Transmission Engineering', Wiley Eastern Ltd., New Delhi, 2nd Edition, 1990.
2. Padiyar, K.R. 'HVDC Power Transmission Systems', Wiley Eastern Ltd., Madras 1993.

References

1. Allan Greenwood, 'Electrical Transients in Power Systems', John Wiley and Sons New York, 1992
2. Arrilaga, J., 'HVDC Transmission', Peter Peregrines Ltd., London 1983.

EE323 FLEXIBLE AC TRANSMISSION SYSTEMS

Credits: 4:0:0 **Marks: 40 + 60**

Unit I : Introduction

FACTS-a toolkit, Basic concepts of Static VAR compensator, Resonance damper, Thyristor controlled series capacitor, Static condenser, Phase angle regulator, and other controllers.

Unit II : Series Compensation Schemes

Sub-Synchronous resonance, Torsional interaction, torsional torque, Compensation of conventional ASC, NGH damping schemes, Modelling and control of thyristor controlled series compensators.

Unit III : Unified Power Flow Control

Introduction, Implementation of power flow control using conventional thyristors, Unified power flow concept, Implementation of unified power flow controller.

Unit IV : Design of Facts Controllers

Approximate multi-model decomposition, Variable structure FACTS controllers for Power system transient stability, Non-linear variable-structure control, variable structure series capacitor control, variable structure resistor control.

Unit V : Static Var Compensation

Basic concepts, Thyristor controlled reactor (TCR), Thyristors switched reactor (TSR), Thyristor switched capacitor(TSC), satured reactor (SR) , and fixed capacitor (FC)

Text Books

1. Barain G. Hingorani, "Understanding Facts", IEEE Press, New York 2000
2. Yong Hua Sung and Allan T. John (ed), "Flexible AC Transmission System (FACTS)", The Institution of Electrical Engineering, London 1999.

References

1. Narin G.Hingorani, "Flexible AC Transmission", IEEE Spectrum, April 1993, pp 40-45.
2. Narin G. Hingorani, "High Power Electronics and Flexible AC Transmission Systems", IEEE Power Engineering Review, 1998.
3. Narin G.Hingorani, "Power Electronics in Electric Utilities: Role of Power Electronics in future power systems", Proc. of IEEE, Vol.76, no.4, April 1988.
4. Einar V.Larsen, Juan J. Sanchez-Gasca, Joe H.Chow, "Concepts for design of FACTS Controllers to damp power swings", IEEE Trans On Power Systems, Vol.10, No.2, May 1995.
5. Gyugyi L., "Unified power flow control concept for flexible AC transmission", IEEE Proc-C Vol.139, No.4, July 1992.

EE324 SPECIAL MACHINES AND CONTROLLERS

Credits: 4:0:0 **Marks: 40 + 60**

Unit I : Stepping Motors

Constructional features, principle of operation, modes of excitation torque production in Variable Reluctance (VR) stepping motor, Dynamic characteristics, Drive systems and circuit for open loop control, Closed loop control of stepping motor.

Unit II : Switched Reluctance Motors

Constructional features, principle of operation. Torque equation, Power controllers, Characteristics and control Microprocessors based controller.

Unit III : Permanent Magnet Brushless DC Motors

Commutation in DC motors, Difference between mechanical and electronic commutators, Hall sensors, Optical sensors, Multiphase Brush less motor, Square wave permanent magnet brushless motor drives, Torque and emf equation, Torque-speed characteristics, Controllers-Microprocessors based controller.

Unit IV : Permanent Magnet Synchronous Motors

Principle of operation, EMF, power input and torque expressions, Phasor diagram, Power controllers, Torque speed characteristics, Self control, Vector control, Current control schemes.

Text Books

1. Miller, T.J.E. "Brushless Permanent Magnet and Reluctance Motor Drives", Clarendon Press, Oxford, 1989.

Reference Books

1. Kenjo, T and Naganori, S "Permanent Magnet and brushless DC motors", Clarendon Press, Oxford, 1989.
2. Kenjo, T, "Stepping motors and their microprocessor control", Clarendon Press, Oxford, 1989.

EE325 HVDC TRANSMISSION-II

Credits: 4:0:0 **Marks: 40 + 60**

Unit 1 : DC Power Transmission Technology

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.

Unit II : Analysis of HVDC Converters

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

Unit III : Converter And HVDC System Control

General principles of DC link control-converter control characteristics –system control hierarchy – firing angle control-current and extinction angle control-starting and stopping of DC link – power control-higher level controllers – telecommunication requirements.

Unit IV : Harmonics and Filters

Introduction-generation of harmonics-design of AC filters-DC filters-carrier frequency and RI noise.

Unit V : Simulation of HVDC Systems

Introduction-system simulation: Philosophy and tools-HVDC system simulation-modelling of HVDC systems for digital dynamic simulation.

Text Book

1. Kimbark E.X., "Direct Current Transmission", Vol. I, Wiley Interscience, New York, 1971.

References

1. Padiyar, K.R., HVDC Power transmission system, Wiley Eastern Limited, New Delhi, 1990.
2. Edward Wilson Kimbark, Direct Current Transmission, Vol.1, Wiley Interscience, New York, London, Sydney, 1971.
3. Rakosh Das Begamudre, Extra high voltage AC transmission engineering Wiley Eastern Ltd., New Delhi, 1990.
4. Adamson, C.and Hingorani.N.G., High Voltage Direct Current Power Transmission, GarrawayLimited, London, 1960.
5. www.abb.se/pow/hvdc.htm
6. www.pwrgen.westinghouse.com/energy/facts.htm
7. www.hvdc.ca

ADDITIONAL SUBJECTS

Code No.	Subject Name	Credit
EE236	Electric Circuits and Networks	3:1:0
EE237	Control Systems	3:1:0
EE238	Microprocessors and Microcontrollers	3:1:0
EE239	Measurements and Computer Aided Machine Design Lab	0:0:2
EE240	Data Structures and Algorithms	3:1:0
EE241	Data Structures and Algorithms Lab	0:0:2
EE242	Object Oriented Programming	3:1:0
EE243	Object Oriented Programming Lab	0:0:2
EE244	Solid State Drives	3:1:0

EE236 ELECTRIC CIRCUITS AND NETWORKS

Credit : 3:1:0 **Marks : 40 + 60**

Unit I: Circuit Analysis
Network graph - tree and cut sets - Cut set and tie set schedule- dual network – Kirchoff's laws - Matrix representation and solution of AC and DC networks, Node and Loop basis analysis of AC and DC networks.

Unit II : Network Theorems and Transformations
Voltage and current source transformations - star and delta transformations - superposition, reciprocity, substitution, Thevenin, Norton, Tellegen, Millman and maximum power transfer theorems - statement and applications.

Unit III : Response of Electric Circuits
Concept of complex frequency - pole-zero plots - transient response of RL, RC and RLC series and parallel circuits - free response - step and sinusoidal responses - natural frequency, damped frequency, damping factor and logarithmic decrement - finding transient response of simple electrical circuits using PSpice.

Unit IV: Coupled and Three Phase Circuits
Coupled circuits – coefficient of coupling – self and mutual inductances – analysis of coupled circuits – single and double tuned coupled circuits – Three phase circuits - balanced circuits - star and delta connected loads - phase sequence - unbalanced circuits - solution of unbalanced star and delta connected loads – power measurement by two wattmeter method.

Unit V: Two Port Networks and Filters
Driving point and transfer impedance/admittance - voltage and current ratios of two port networks - admittance, impedance, hybrid, transmission and image parameters for two port networks – impedance matching – equivalent pi and T networks – passive filters as a two

port network – characteristics of ideal filter – low pass and high pass filters.

Text Books:

1. Joseph Edminister, “Electric Circuits”, Schaums Outline Series, Vol. III, 1996.
2. Sudhakar, A. & Shyammohan, S.P., “Circuits and Networks”, Tata McGraw Hill, 1994.

Reference Books:

1. Arumugam, M and Premkumar, N, “Electric Circuit Theory”, Khanna publishers, New Delhi, IV edition, 1998
2. W.H.Hayt, W.H. & Kemmerley, J.E., “Engineering Circuit Analysis”, McGraw Hill, New York, 1993.

EE237 CONTROL SYSTEMS

Credit : 3:1:0 **Marks : 40 + 60**

Unit I: Introduction

Open loop and closed loop systems – translational and rotational mechanical systems and analogous electrical systems – Basic components of control systems – potentiometer – synchros – tachogenerator – a.c and d.c servo motor - Mathematical representation, block diagram, signal flow graph and transfer function of electrical systems.

Unit II : Time Response Analysis

Time response – step response of first order and second order systems – time domain specification – type and order of a system – steady state error – static error and generalized error coefficient – Stability – Routh Hurwitz stability – P, PI and PID controllers.

Unit III : Frequency Response Analysis

Frequency domain parameters – Analysis and stability using Bode plots – Polar plot, Nichols chart – Gain margin – Phase margin.

Unit IV : Root Locus

Characteristic equation – Rules for constructing root locus – Nyquist stability criterion.

Unit V : State Space Analysis

Concepts of State – State variable and state models – State equation – State transition matrix – Solution of state equation by classical and Laplace transformation method – Controllability and Observability.

Text Book

1. Nagrath and Gopal, “Control Systems Engineering”, II Edition, New Age International Publishers, 1996.

Reference Books

1. M. Gopal, “Control Systems”, Tata McGraw Hill, 1997.

2. Benjamin C Kuo, “Automatic Control Systems”, 7th Edition, Prentice Hall, U.S.A., 1995.
3. Franus Raven, “Automatic Control Engineering”, Mcgraw Hill, 1995.
4. Ogata K, “Modern Control Engineering”, Prentice Hall, U.S.A., 3rd Edition, 1996.

EE238 MICROPROCESSORS AND MICROCONTROLLERS

Credit : 3:1:0 **Marks : 40 + 60**

Unit I: 8085 Microprocessor
Organisation of 8085 microprocessor – Instruction set – Addressing modes – Assembly language programming – machine cycles – Read, Write – Bus cycles – states – Wait state – HALT and HOLD state.

Unit II: 8086 Microprocessor
Organisation of 8086 microprocessor – memory segmentation – Addressing bytes and words – Address formation – Address modes in 8086 – Assembly language programming – minimum mode and maximum mode.

Unit III: Microprocessor Interfacing Techniques
Data transfer – Programmable parallel ports – 8255 PPI – Serial Communication – Asynchronous - Synchronous – 8251A Programmable communication interface – DMA – 8257 - 8237 – Programmable DMA controller – 8259A Programmable interrupt controller.

Unit IV: Interfacing Memory and I/O Devices and Microprocessor Applications
Memory interface – Input / Output Interface – Keyboard/display interfacing – A/D and D/A interface – applications – Temperature controller – Stepper motor controller – DC Motor Controller – Traffic light controller.

Unit V: 8031 / 8051 Microcontroller
Organisation of 8031 and 8051 Microcontroller – I/O Ports – External memory – Counters and timers – serial data input and output – interrupts – instruction set – addressing modes – assembly language programming – simple applications.

Text Books:
1. Ramesh. S.Gaonkar, “Microprocessor Architecture, Programming & Applications with 8085/8080a”, Penram International, Fifth Edition, 1999.
2. Rafiquzzaman M., “Microprocessor Theory and Application - Intel And Motorola”, PHI, 2002.
3. Kenneth J. Ayala, “The 8051 Microcontroller Architecture Programming and Applications”, Penram International, 2nd Edition, 2004.

References:

1. D.V Hall, "Microprocessor and Interfacing Programming and Hardware", McGraw Hill Publishing Company, 2nd Edition, 1990.
2. YuCheng Liu & Glenn A Gibson, "Microcomputer System, 8086/8088 Family", 2nd Edition, PHI, 2003.
3. Ajit Pal, "Microprocessor Principles and Applications", Tata McGraw Hill, 1st Reprint, 2003.
4. Avatar Singh and Walter A.Tribel, "The 8088 and 8086 Microprocessor, Architecture, Software and Interface Techniques", PHI, 1985.

EE239 MEASUREMENTS AND COMPUTER AIDED MACHINE DESIGN LAB

Credit : 0:0:2 **Marks : 50 + 50**

12 Experiments will be notified by the HOD from time to time.

EE240 DATA STRUCTURES AND ALGORITHMS

Credit : 3:1:0 **Marks : 40 + 60**

Unit I: Introduction to Data Structures
Abstract data types - Sequences as value definitions - Data types in C - Pointers in C - Data structures in C - Arrays in C - Array as ADT - One dimensional array - Implementing one dimensional array - Array as parameters - Two dimensional array - Structures in C - Implementing structures - Unions in C - Implementation of unions - Structure parameters - Allocation of storage and scope of variables.

Unit II : Recursive Function, Stack and Queue
Recursive definition and processes: factorial function - fibonacci sequence - recursion in C - efficiency of recursion
Stack definition and examples – primitive operations – example - representing stacks in C - push and pop operation implementation.
Queue as ADT - C implementation of queues - insert operation - priority queue - array implementation of priority queue.

Unit III : Linked List
Inserting and removing nodes from a list - linked implementation of stack, queue and priority queue - Other list structures - Circular lists: Stack and queue as circular list - Primitive operations on circular lists. Header nodes - Doubly linked lists - Addition of long positive integers on circular and doubly linked list.

Unit IV : Trees
Binary trees: operations on binary trees - applications of binary trees - binary tree representation - node representation of binary trees - implicit array representation of binary

tree – binary tree traversal in C - threaded binary tree - representing list as binary tree - finding the k^{th} element - deleting an element.
Trees and their applications: C representation of trees - tree traversals - evaluating an expression tree - constructing a tree.

Unit V: Sorting and Searching
General background of sorting: Efficiency considerations, Notations, Efficiency of sorting. Exchange sorts: Bubble sort; Quick sort; Selection sort; Binary tree sort; Heap sort. Heap as a priority queue - Sorting using a heap-heap sort procedure - Insertion sorts: Simple insertion - Shell sort - Address calculation sort - Merge sort - Radix sort.
Sequential search: Indexed sequential search - Binary search - Interpolation search.

Text Book

1. Aaron M. Tenenbaum, Yeedidyah Langsam, Moshe J. Augenstein, “Data structures using C”, Pearson Education, 2004 / PHI.

Reference Books:

1. E. Balagurusamy, “Programming in Ansi C”, Second Edition, Tata McGraw Hill Publication, 2003.
2. Robert L. Kruse, Bruce P. Leung Clovis L.Tondo, “Data Structures and Program Design in C”, Pearson Education, 2000 / PHI.

EE241 DATA STRUCTURES AND ALGORITHMS LABORATORY

Credit : 0:0:2 **Marks : 50 + 50**

12 Experiments will be notified by the HOD from time to time.

EE242 OBJECT ORIENTED PROGRAMMING

Credit : 3:1:0 **Marks : 40 + 60**

Unit I : Object Oriented Programming and Basics of C++
Software crisis – Software evolution – A look at procedure oriented programming – Object oriented programming paradigm – Basic concepts of object oriented programming – Benefits of OOP – Object-oriented languages – Applications of OOP - What is C++? – A simple C++ program – More C++ statements – Structure of C++ Program.

Unit II : Structure of C++ Program
Tokens – keywords – identifiers and constants – basic data types – user defined data types – derived data types – symbolic constants – declaration of variables – dynamic initialization of variables – reference variables – operators in C++ – scope resolution operator – manipulators – type cast operator – expressions and their types – special assignment expressions – control structures - the main function – function prototyping – call by reference – return by reference – inline functions – default arguments – function overloading.

Unit III : Classes and Objects
Specifying a class – Defining member functions – Private member functions –Arrays within a class – Memory allocation for objects – Static data members – Static member functions – Arrays of objects – Objects as function arguments –Friendly functions – Returning objects.

Constructors: Parameterized constructors – Multiple constructors in a class – Constructors with default arguments – Dynamic initialization of objects – Copy constructor – Dynamic constructors – Destructors.

Unit IV : Operator Overloading, Inheritance and Polymorphism
Defining operator overloading: Overloading unary, binary operators. Manipulation of strings using operators – Rules for overloading operators – Type Conversions - Defining derived classes – Single inheritance – Multilevel inheritance – Multiple inheritance – Hierarchical inheritance – Hybrid inheritance – Virtual base classes – Abstract classes - Introduction to pointers to objects: This pointer – Pointers to derived classes – Virtual functions – Pure virtual functions.

Unit V: Java Evolution, Constants, Variables, Data Types, Operators, Classes, Objects, Methods, Arrays and Strings
Java features: How Java differs from C and C++ - Simple Java program – Java program structures – Java tokens – Java statements – Implementing a Java program – Java virtual machine – Command line arguments - Constants – Variables – Data types – Scope of variables – Operators in Java.
Defining a class – Adding variables and methods – Creating objects – Accessing class members – Constructors – Method overloading – Static members – Inheritance: Extending a class – Overriding methods – Final variables and methods – Final classes – Abstract methods and classes – Visibility control - Arrays – One dimensional array – Creating an array – Two-dimensional arrays – Strings – Vectors.

Text Books

1. E.Balagurusamy, “Object Oriented Programming with C++”, Second edition, Tata McGraw Hill, 2003.
2. E.Balagurusamy, “Programming with JAVA – A Primer”, Second edition, Tata McGraw Hill, 2003.

Reference Books

1. Herbert Schildt, “C++ - The Complete Reference”, Tata McGraw Hill, 1997.
2. Bjarne Stroustrup, “The C++ Programming Language”, Addison Wesley, 2000.
3. John .R .Hubbard, “Schaums Outline Programming with C++”, Tata McGraw Hill, 2003.
4. Kris Jasma, “Java Programming – A Complete Reference”, Galgotia publication, 1994.

EE243 OBJECT ORIENTED PROGRAMMING LABORATORY

Credit : 0:0:2 **Marks : 50 + 50**

12 Experiments will be notified by the HOD from time to time.

EE244 SOLID STATE DRIVES

Credit : 3:1:0 **Marks : 40 + 60**

Unit I: Drive Characteristics

Equations governing motor load dynamics - Equilibrium operating point and its steady state stability - Mathematical condition for steady state stability and problems - Multi quadrant dynamics in the speed torque plane - Basics of regenerative braking - Typical load torque characteristics - Acceleration, deceleration, starting and stopping.

Unit II : Converter / Chopper Fed DC Motor Drive

Steady state analysis of the single and three phase fully controlled converter fed separately excited D.C motor drive: Continuous and discontinuous conduction mode - Chopper fed D.C drive: Time ratio control and current limit control - Operation of four quadrant chopper.

Unit III : Induction Motor Drives

Stator voltage control - Slip-power recovery drives - Adjustable frequency drives: v/f control, constant slip-speed control and constant air-gap flux control – Basics of voltage/current fed inverters - Block diagram of closed loop drive.

Unit IV : Synchronous Motor Drives

Open loop volts/hertz control and self-control of synchronous motor: Marginal angle control and power factor control - Permanent magnet synchronous motor.

Unit V : Design of Controllers for Drives

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.

Text Books

1. R. Krishnan, ‘Electric Motor & Drives: Modelling, Analysis and Control’, Prentice Hall of India, 2001.
2. Bimal K. Bose. ‘Modern Power Electronics and AC Drives’, Pearson Education, 2002.

Reference Books

1. G.K. Dubey, ‘Power Semi-conductor Controlled Drives’, Prentice Hall of India, 1989.
2. S.K. Pillai, ‘A First Course on Electrical Drives’, Wiley Eastern Limited, 1993.

ADDITIONAL SUBJECTS

Subject	Subject	Credits
EE326	Solid State DC Drives	4:0:0
EE327	Solid State AC Drives	4:0:0

EE326 SOLID STATE DC DRIVES

Credit: 4:0:0 **Marks: 40+60**

Unit I: Review of Conventional DC Drives
Different techniques of speed control - Methods of braking of series and separately excited DC motor - Ward-Leonard Speed control - Models and transfer function of series and separately excited DC motor.

Unit II: Converter Control of DC Motors
Motor and input supply performance parameters - Analysis of series and separately excited DC motor with single phase and three phase converters operating in different modes and configurations – Power factor improvement – Dual converters – Reversible Drives – Braking in phase-controlled drives - Problems on DC machines fed by converter supplies.

Unit III: Chopper Control of DC motors
Analysis of series and separately excited DC motors fed from different Choppers – Effect of saturation in series motor – Input filter - CLC and TRC strategies – Voltage, Current and Load commutation of a chopper – Multiphase Chopper – Braking in chopper drives.

Unit IV: Design of Converter Fed DC drives
Closed Loop Speed Control - Current Control - Load Torque Disturbance - Phase-Locked-Loop Control – Harmonics and associated problems - Digital controller and Firing circuits, Simulation.

Unit V: Intelligent controller for DC drive
Microcomputer implementation of control function – Fuzzy – Neuro – Neuro-Fuzzy controllers – Introduction to PSIM.

Text Books
1. Sen, P.C., “Thyristor D. C. Drives”, John Wiley & Sons, New York, 1981.
2. Krishnan, R., “Electric Motor Drives – Modeling, Analysis and Control”, Prentice Hall of India Private Ltd., New Delhi, 2003.
3. Vedam Subrahmanyam, “Electric Drives – Concepts and Applications”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2001.

References
1. Leonhard Werner, “Control of Electircal Drives”, Third Edition, Springer – Verlag, 2003.
2. Dubey G.K., Doradla.S.R, Joshi.A, Sinha RMK., “Thyristorised Power Controllers” New Age International (P) Limited Publishers, 2005.

3. Vedam Subrahmanyam, “Thyristor Control of Electric Drives”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2003.
4. Dubey G.K, “Fundamentals of Electrical Drives”, Narosa Publishing House, 2001.
5. Mohamed. A, El. Sharkawi, “Fundamentals of Electric Drives”, Brooks / Cole Publishing Company, 2000.

EE327 SOLID STATE AC DRIVES

Credit: 4:0:0 **Marks: 40+60**

Unit I: Stator Voltage Control of Induction Motor
Adjustable speed drives – Torque-Slip characteristics - Operation with different types of loads – Performance – Equivalent circuit of IM, Closed loop speed control & Speed reversal – NEMA classification & Design of SQIM – Load characteristics – Transient Stability – Choice of drives - Comparison of different AC power controllers – Production of Stator Flux (RMF).

Unit II: Stator Frequency Control
Operation of Induction Motor with non- sinusoidal supply waveforms – Air gap MMF harmonics – Harmonic behaviour of IM – Constant volt and variable frequency operation of 3-phase Induction Motors - Constant flux operation - Current fed operations – Constant torque, constant power, high speed motoring – Stator current control - Dynamic and regenerative braking of CSI and VSI fed drives - Principle of vector control.

Unit III: Rotor Resistance Control
Torque-Slip characteristics with mechanical rotor resistance control – Static rotor resistance control - Torque Equations - Closed loop operation -Constant torque operations – TRC strategy - Combined stator voltage control and rotor resistance control.

Unit IV: Slip Power Recovery Scheme
Torque equation - Torque-Slip characteristics - Power Factor considerations, Sub-synchronous and Super-synchronous operation - Closed loop control – Static Kramer and Scherbius Drive – Four-quadrant sub-synchronous cascade with DC dynamic braking.

Unit V: Synchronous Motor Drives
Need for leading pf operation - Open loop VSI fed drive and its characteristics – Load Commutated drive - Self control - Torque angle control - Power factor control - Brushless excitation systems - Starting methods - Principles of vector control – Introduction to PSIM.

Text Books
1. Dubey, G.K., “Fundamentals of Electrical Drives”, Narosa Publishing House, New Delhi, 2nd Edition, 2001.
2. Sheperd, W. and Hully, L.N., Liang, "Power Electronics and Motor Control”, Cambridge University Press, Cambridge, 2nd Edition, 1998.
3. Subrahmanyam, V., “Thyristor Control of Electric Drives”, Tata McGraw Hill Publishing Co. Ltd., New Delhi, New Edition, 2003.

References

1. Dubey, G.K., "Power Semiconductor Controlled Drives", Prentice Hall International, New Jersey, 1989.
2. Gnanavadivel.J, Karthikeyan and Santhi, "Solid State Drives", Anuradha Agencies, 2004.
3. Bimbhra, P.S., "Power Electronics", Khanna Publishers, Delhi 1999.
4. Subrahmanyam, V., "Electric Drives", Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1994.
5. Singh M.D., Khanchandani, K.B., "Power Electronics", Tata McGraw Hill Publishing Co. Ltd., New Delhi, New Edition, 2004.

ADDITIONAL NEW SUBJECTS

Code	Subject Name	Credits
EE245	Electric Circuits	3:1:0
EE246	Network Theory	3:1:0
EE247	Electron Devices	3:1:0
EE248	Electromagnetic Fields	3:1:0
EE249	Electronic Circuits	3:1:0
EE250	DC Machines and Transformers	3:1:0
EE251	Induction and Synchronous Machines	3:1:0
EE252	Electrical Machine Design	3:1:0
EE253	Generation, Transmission and Distribution	3:1:0
EE254	Power Electronics	3:0:0
EE255	Power System Analysis	3:1:0
EE256	Power System Protection and Switchgears	3:0:0
EE257	Digital Electronics	3:1:0
EE258	Linear Integrated Circuits	3:1:0
EE259	Control Systems	3:1:0
EE260	Digital Signal Processing	3:1:0
EE261	C++ and Data Structures	3:0:0
EE262	Measurements and Instrumentation	3:0:0
EE263	Microprocessors and Microcontrollers	3:1:0
EE264	Mobile Communication	4:0:0
EE265	Biomedical Instrumentation	4:0:0
EE266	VLSI Design	4:0:0
EE267	Embedded system	4:0:0
EE268	Operating Systems	3:0:0
EE269	Computer Communication	3:0:0
EE270	Virtual Instrumentation	3:0:0
EE271	High Voltage Engineering	3:0:0
EE272	Computer Architecture	3:0:0
EE273	Electric Drives and Control	3:0:0
EE274	Power System Stability	3:1:0
EE275	Power System Control	4:0:0
EE276	Material Science	3:0:0
EE277	Microprocessors and Microcontrollers Laboratory	0:0:2
EE278	C++ and Data Structures Laboratory	0:0:2
EE279	Electronic Circuits Laboratory	0:0:2
EE280	Linear and Digital IC Laboratory	0:0:2
EE281	DC Machines and Transformers Lab	0:0:1
EE282	AC Machines and Controls Lab	0:0:1
EE283	Power Electronics Lab	0:0:1
EE284	Computer Aided Electrical Machine Design Lab	0:0:1
EE285	Computer Aided Power Systems Analysis Lab	0:0:1
EE286	Circuits and Devices Lab	0:0:1
EE287	Linear ICS and Measurements Lab	0:0:1

EE288	Electrical Workshop Practice	0:0:1
EE289	Electronic Circuits and Digital Lab	0:0:1
EE290	Design Lab	0:0:1
EE291	Digital Signal Processing Lab	0:0:1
EE292	Microprocessors and Microcontrollers Lab	0:0:1
EE293	Illumination Engineering	4:0:0
EE294	Automotive Electronics	4:0:0
EE295	Network Analysis and Synthesis	3:1:0
EE296	Electrical Engineering	3:1:0
EE328	Power Semiconductor Devices	4:0:0
EE329	Power Electronics-I	3:1:0
EE330	Power Electronics – II	3:1:0
EE331	Linear Systems	3:1:0
EE332	Solid State DC Drives	3:1:0
EE333	Solid State AC Drives	3:1:0
EE334	Advanced Digital Signal Processing	4:0:0
EE335	Simulation of Power Electronics Systems	3:1:0
EE336	Power Electronics Application to Power Systems	3:1:0
EE337	Neuro-Fuzzy Controllers for Electric Drives	4:0:0
EE338	Generalised Theory of Electrical Machines	3:1:0
EE339	Computer Aided Design of Electrical Machines	3:1:0
EE340	Advanced Electric Drives and Controls	3:1:0
EE341	Special Machines and Controllers	4:0:0
EE342	Power Electronics in Wind and Solar Power Conversion	3:1:0
EE343	Embedded Controller Applications in Power Electronics	3:1:0
EE344	HVDC Transmission	4:0:0
EE345	Advanced Topics in Power Electronics	4:0:0
EE346	Optimization Techniques	4:0:0
EE347	Virtual Instrumentation Systems	3:1:0
EE348	Robotics and Factory Automation	4:0:0
EE349	Microcontrollers and Applications	4:0:0
EE350	Computer Numerical Control	4:0:0
EE351	Embedded Systems	4:0:0
EE352	SCADA and DCS	4:0:0
EE353	Power Quality Management	3:1:0
EE354	Flexible AC Transmission Systems	4:0:0
EE355	Power Electronics Laboratory	0:0:2
EE356	Electric Drives and Control Laboratory	0:0:2
EE357	Power Systems and Power Electronics Simulation Lab	0:0:2

EE245 ELECTRIC CIRCUITS

Credits 3:1:0

Unit I: Introduction

System of Units-Electrical Quantities-Circuit elements-Independent and Dependent sources-Ohm's Law-Kirchoff's Laws-Analysis of circuits using Kirchoff's law-Circuits with dependent sources –Network reduction , Wye-Delta transformation.

Unit II Ac Circuits

Introduction to time varying and alternating quantities-Average and RMS (effective) values-Form Factor- Phasor Relationships for circuit elements-Steady state using Phasor algebra – Analysis using Kirchoff's laws – Power triangle – Power factor.

Unit IIIMesh and Nodal Analysis

Loop analysis – mesh equations for circuits with independent current sources-mesh equations for circuits with dependent sources –Nodal Analysis: Node equations for circuits with independent voltage sources-node equation for circuits with dependent sources.

Unit IV Network Theorems

Superposition theorem-Source transformation-Thevenin's and Norton's theorem – Maximum Power transfer theorem.

Unit V: Resonance

Resonance in Series and Parallel RLC circuits – Bandwidth – Quality Factor – Selectivity.

Text Books

1. Navhi and Edminister J A, " Theory and Problems of Electric circuits" Tata McGraw- Hill Publishing Company Limited, New Delhi, 4th Edition, 2007.
2. Sudhakar and Shyammohan S Palli, " Circuits and Networks – Analysis and Synthesis", Tata McGraw- Hill Publishing Company Limited, New Delhi, 3rd Edition, 2007.

References

1. Charles K Alexander and Mathew N O Sadiku, "Fundamentals of Electric Circuits", Tata Mc Graw -Hill Publishing Company Limited, New Delhi, 3rd Edition, 2007.
2. Jack E Kemmerly, Steven M Durbin and William H Hayt Jr, " Engineering Circuit Analysis", Tata Mc Graw- Hill Publishing Company Limited, New Delhi, 7th Edition, 2006.
3. Sivanandam.S.N., "Electric Circuit Analysis", Vikas Publishing House Private Limited, New Delhi, 2001.

EE246 NETWORK THEORY

Credits 3:1:0
Prerequisite: Electric Circuits

Unit I: Three Phase Circuits

Phase sequence-line and phase quantities-phasor diagram – Balanced and unbalanced Wye, Delta loads-Analysis of balanced load-Analysis of unbalanced load – Neutral shift method - Power measurements in three phase circuits – single and two wattmeter methods – Balanced and unbalanced wye, delta loads – power factor calculation – Reactive power measurements.

Unit II: Magnetically Coupled Circuits
Mutual inductance – Co-efficient of coupling – Dot convention-analysis of coupled circuits, Ideal transformer, Ideal auto transformer – Analysis of single tuned and double tuned circuits

Unit III: Network Transients
Transient Concepts – Singularity functions-unit step, unit impulse-transient response of simple RL, RC and RLC series and parallel circuits for step input and sinusoidal excitation-Laplace transform application to the solution of RL, RC & RLC circuits: initial and final value theorem and applications – Concept of complex frequency – Driving point and transfer impedances – Poles and zeros of network function.

Unit IV: Two Port Network, Filters and Attenuators
Two port network parameters-interconnection of two port networks: series, parallel and cascade – T and π equivalent networks - Low pass filter, Band pass filter, Band stop filter – Constant K and m-derived filter – attenuators - T and π type, lattice attenuator

Unit V: Network Synthesis
Reliability concept – Hurwitz property – positive realness – properties of positive real functions- Synthesis of RL, RC and LC driving point impedance functions using simple canonical networks – Foster and Cauer forms.

Text Books

Navhi and Edminister J A, "Theory and Problems of Electric circuits" Tata Mc Graw-Hill Publishing Company Limited, New Delhi, 4th Edition, 2007.

Sudhakar and Shyammohan S palli, "Circuits and Networks – Analysis and Synthesis", Tata Mc Graw -Hill Publishing Company Limited, New Delhi, 3rd Edition, 2007.

References

1. Charles K Alexander and Mathew N O Sadiku, "Fundamentals of Electric Circuits", Tata Mc Graw - Hill Publishing Company Limited, New Delhi, 3rd Edition, 2007.
2. Jack E Kemmerly, Steven M Durbin and William H Hayt Jr, " Engineering Circuit Analysis", Tata Mc Graw - Hill Publishing Company Limited, New Delhi, 7th Edition, 2006.
3. Sivanandam.S.N., "Electric Circuit Analysis", Vikas Publishing House Private Limited, New Delhi, 2001.

EE247 ELECTRON DEVICES

Credits 3:1:0

Unit I: P-N Junction Diode
V-I characteristics - Static and Dynamic resistance, Temperature dependence of characteristics, diffusion and transition capacitances, Diode as a circuit element, small signal and large signal models. Elementary applications - Clippers and clampers, Diode

switching times, PN junction diode ratings. Breakdown phenomena in diodes - Zener diodes. Metal - semiconductor junction - Schottky barrier diodes.

Unit II: Bipolar Junction Transistor (Bjt)
Physical behaviour of a BJT – Ebers - Moll model, large signal current gains, Modes of transistor operation - Common Base, Common Emitter and Common Collector configurations, Input and output characteristics, Early effect, regions of operation, AC and DC load lines - Need for stability of Q-Point, Bias stability – fixed bias, collector to base bias, self bias. Transistor switching times - Transistor as a switch and an amplifier, High frequency effects, BJT ratings. Introduction to photo transistors.

Unit III: Junction Field Effect Transistor (Jfet)
JFET operation - V-I characteristics, transfer characteristics, regions of operation. DC analysis - JFET biasing. Small signal JFET model, JFET as a switch, Voltage variable resistor and an amplifier.

Unit IV: Metal Oxide Semiconductor Field Effect Transistor (Mosfet)
Constructional details - Operation of Enhancement and Depletion type MOSFETs , V-I characteristics, Transfer characteristics, analytic expression for drain current, Comparison of PMOS and NMOS devices - MOSFET biasing, MOSFET as a switch, resistor and amplifier, Introduction to CMOS devices.

Unit V: Integrated Circuit (Ic) Fabrication
Monolithic IC technology - Planar processes, Epitaxial growth, Oxidation, Photolithography, Diffusion, Ion implantation, Metallization. BJT fabrication - need for buried layer, Junction and Dielectric isolation, Fabrication of PNP multiple emitter transistors, Monolithic diodes, Fabrication of FETs, NMOS enhancement and depletion MOSFETs, Self isolation, CMOS technology. Monolithic IC Resistors: sheet resistance - Diffused, Ion implanted, Epitaxial, pinch, MOS and thin film resistors, Monolithic IC capacitors - Junction, MOS and thin film capacitors, IC packaging, Micro-electronic circuit layout.

Text Books

1. Millman J and Grabiel A, "Microelectronics", Tata McGraw-Hill Publishing Company Limited, New Delhi, 3rd Edition, 2000.
2. Boylestead L R and Nashelsky L, "Electronic Devices and Circuit Theory", Pearson Education India Series, New Delhi, 9th Edition, 2006.

References

Adel S Sedra and Kenneth C Smith, "Microelectronic Circuits", Oxford University Press, London, 4th Edition, 1998.
Thomas L. Floyd, "Electronic Devices", Pearson Education India Series, New Delhi, 7th Edition, 2007.
David A Bell, "Electronic Devices and Circuits", Prentice Hall of India, New Delhi, 4th Edition 2000.

EE248 ELECTROMAGNETIC FIELDS

Credits 3:1:0

Unit I : General Principles

Review of vector algebra-Coordinate systems-Rectangular, Cylindrical and Spherical Coordinate Systems- Coordinate transformation-Differential Line, Surface and Volume Elements-Line, Surface and Volume Integrals- Gradient, Divergence and Curl Operators-Divergence Theorem- Stokes' Theorem.

Unit II: Electrostatic Fields

Field concept – Charge Distributions – Coulomb's Law –Electric Field Intensity-Determination of Electric Field due to Discrete, Line, Surface and Volume Charges-Electric Potential- Relationship between Electric Field Intensity and Electric Potential–Potential due to Electrical Dipole-Potential due to an Infinite Uniformly Charged Line-Electric Flux and Flux Density- Gauss' Law- Relation Between Electric Flux and Electric Field Intensity- Electrostatic Energy- Laplace's and Poisson's Equations – Dielectrics – Capacitance-Boundary Conditions at the Interface of Two Dielectrics.

Unit III: Magnetostatic Fields

Current density – Magnetic Flux –Magnetic Flux Density- Magnetic Field Intensity – Relationship between Magnetic Field Intensity and Magnetic Flux density- Biot-Savart Law –Determination of Magnetic Field due to Infinitely Long Straight Conductor, Circular Current Loop and Rectangular Current Loop- Ampere's Law – Determination of Magnetic Field due to a Co-axial Cable using Ampere's Law- Force and Torque in Magnetic Field- Boundary Conditions at the Interface of Two Magnetic Materials-Self and Mutual Inductances-Inductance of a Solenoid and a Toroid.

Unit IV: Etromagnetic fields

Displacement current – Eddy current -Faraday's Law – Lenz's Law – Transformer and Motional emfs, Maxwell's Equations.

Unit V : Electromagnetic Waves

Generation – Propagation of Waves in Dielectrics – Conductors and Transmission lines – Skin effect.-Power and the Poynting Vector.

Text Books

1 Joseph. A.Edminister, "Theory and Problems of Electro Magnetics", 2nd Edition, Schaum's Outline Series, Tata Mc Graw- Hill Publishing Company Limited, New Delhi, 2005.

2. William H.Hayt Jr., John A.Buck, "Engineering Electro Magnetics", Tata McGraw-Hill Publishing Company Limited, New Delhi, 3rd Edition,2007.

References

1. Matthew N.O. Sadiku, "Elements of Electromagnetics', Oxford University Press, London, 3 rd Edition 2005.

2. Gangadhar, K.A., "Field Theory", Khanna Publishers Limited, New Delhi, 15th Edition, Third Reprint 2004.

EE249 ELECTRONIC CIRCUITS

Credits 3:1:0

Pre requisite: Electron Devices

Unit I: Power Supplies

Rectifiers – Half wave and Full wave rectifiers, Average and RMS value, Ripple factor, Regulation, Rectification efficiency, Transformer Utility Factor, Filters – Inductor, Capacitor, L type and π type, Ripple Factor and Regulation, Need for voltage regulators – Series and Shunt regulators, Comparison, Current limiting and protection circuits – Introduction to Switched Mode Power Supplies

Unit II Wave Shaping

Response of High pass and Low pass RC circuit for sinusoidal, step, pulse, square, ramp and exponential inputs. Linear wave shaping – Integrator, Differentiator. Non-linear wave shaping–Clipping and clamping circuits, clamping circuit theorem and applications, Attenuator and compensated attenuator. Introduction to pulse transformers and applications.

Unit III Voltage Amplifiers

BJT and JFET amplifiers – RC coupled amplifiers, Cascaded BJT amplifiers, Analysis at low, medium and high frequencies BIFET amplifiers, DC amplifiers – Problems in DC Amplifiers, Differential and Common mode gain, CMRR, Cascade and Darlington Amplifiers. Chopper Amplifiers.

Unit IV Power Amplifiers and Feedback Amplifiers

Power amplifiers– Classification, Class A/B/C, Single ended and Push-pull Configuration, Power dissipation and output power, Conversion efficiency, Complementary symmetry power amplifiers, Class AB operation. Basic concepts of feedback amplifiers – Effect of negative feedback on input and output resistances, gain, gain stability, distortion and bandwidth, Voltage and current feedback circuits.

Unit V: Oscillators and Multivibrators

Oscillators – Barkhausen criteria, RC and LC oscillators using BJT – RC Phase Shift, Wien bridge oscillators, Hartley and Colpitt's oscillators, Frequency stability of oscillators. Crystal Oscillators, Non-sinusoidal oscillators – Multivibrators – Bistable, Monostable, Astable Multivibrators and Schmitt Trigger using BJT.

Textbooks

1. Millman J. and Halkias C., "Electronic Devices & Circuits", Tata McGraw-Hill Publishing Company Limited, New Delhi, 27th Reprint, 2002.
2. Millman J. and Grabel A., "Microelectronics", Tata Mc Graw-Hill Publishing Company Limited, New Delhi, 2nd Edition,1999.
3. Millman J. and Taub H., Mothiki S Prakash Rao, "Pulse, Digital and Switching Waveforms", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2nd Edition, 2007.

References

1. David A. Bell., "Electronic Devices and Circuits", Oxford University Press, London, 5th Edition, 2007.

2. Boylestad R.L. and Nashelsky L., "Electronic Devices and Circuit Theory", Pearson Education India Series, New Delhi, 9^{th} Edition 2005.
3. Floyd, " Electronic Devices", Pearson Education India Series, New Delhi, 8^{th} Edition, 2003.
4. Bogart, "Electronic Devices & Circuits", Prentice Hall of India, New Delhi, 6^{th} Edition, 2003.

EE250 DC MACHINES AND TRANSFORMERS

Credits 3:1:0

Unit I: Dc Generators

Laws of magnetic circuit – Principle of operation, Constructional details, Armature Windings, EMF equation, Methods of Excitation, Separate, Shunt, Series and Compound excitations - No load characteristics – Armature reaction, Commutation, Inter poles, Compensating windings, Load characteristics of various types of DC Generators.

Unit II: Dc Motors

Principle of operation – Torque equation, Electrical and Mechanical characteristics of DC Shunt, Series and Compound motors, Starters – Speed control – Armature and Field control – Braking.- Losses and efficiency – Swinburne's test – Separation of losses, Hopkinson's test.

Unit III: Transformers

Principle of operation – Constructional features, Classification of Transformers, EMF equation, Transformation ratio, Transformer on no load and load, Phasor diagrams - Equivalent circuit - Voltage regulation, Regulation curve, Losses, Efficiency, All Day efficiency

Unit IV Test on Transformer

Phasing out, Polarity and Voltage ratio tests – Open circuit and Short circuit tests, Sumpner's test, Separation of losses – Parallel operation, Auto transformer – Principle of operation – Saving of copper – Phasor diagram – Equivalent circuit.

Unit V: Three Phase Transformer

Constructional features- Connections- Parallel operations of Three phase transformers- Instrument Transformers: Current and Potential transformers.

Textbooks

1. Murugesh Kumar, K., "DC Machines and Transformers", Vikas Publishing House Private Limited., New Delhi, 2^{nd} Edition, 2004.
2. Arthur Eugene Fitzgerald, Charles Kingsley Jr, Stephen D. Umans , " Electric Machinery", Mc Graw – Hill Professional Series , New York, 6^{th} Edition, 2002.

References

1. Cotton, H., "Advanced Electrical Technology", A H Wheeler and Company Publications, London, 1990.
2. Gupta, B.R., and Vandana, Singhal, "Fundamentals of Electrical Machines", New Age International Publishers Limited, 1996.
3. Sen, P.C., "Principles of Electrical Machines and Power Electronics" John Wiley & Sons, Inc., Singapore, 2^{nd} Edition, 1997.

EE251 INDUCTION AND SYNCHRONOUS MACHINES

Credits 3:1:0

Pre requisite: DC Machines and Transformers

Unit I: Three-Phase Induction Motors

Principle of Operation – Construction and types of Rotor – Torque equation – Torque-Slip characteristics – Maximum torque – Effect of rotor resistance, Equivalent circuit – Phasor diagram – Performance calculation from circle diagram - Induction Generators – Testing, Automatic Starters – DOL, Autotransformer, Star-Delta and Rotor resistance starters – Speed control – Crawling and Cogging – Electrical Braking.

Unit II Single-Phase Induction Motors

Principle of operation – Double revolving field theory – Equivalent circuit – Performance calculations – Methods of self starting – Types of Single Phase Induction Motor - Magnetic Levitation-Linear Induction Motor.

Unit III: Synchronous Generators

Types - Constructional features – 3-phase windings – Winding factors – EMF equation – Armature reaction – Voltage regulation – Predetermination of regulation by Synchronous Impedance, MMF, and Potier reactance methods, Load characteristics – Power expression – Parallel operation – Synchronizing Current and Synchronizing power – Active and Reactive power sharing – Alternator on infinite Bus bar – General load diagram.

Unit IV: Synchronous Motors

Principle of operation – Methods of starting – Phasor diagrams – V-curves and Inverted V-curves - Power/Power-angle relations – Synchronous Condensers – Hunting and methods of Suppression.

Unit V: Two Reaction Theory

Salient Pole machine analysis – Phasor diagrams – Voltage regulation – Power / Power angle relation – Determination of X_d and X_q.

Textbooks

1. Murugesh Kumar, K, "Induction and Synchronous Machines", Vikas Publishing House Limited, New Delhi, 2000.
2. Arthur Eugene Fitzgerald, Charles Kingsley, Stephen D. Umans , " Electric Machinery", Mc Graw – Hill Professional Series , New York, 6th Edition, 2002.

References

1. Alexander, S. Langsdorf., "Theory of Alternating Current Machinery", Tata McGraw - Hill Publishing Company Limited, New Delhi, 1990.
2. Gupta, B.R., and Vandana, Singhal., "Fundamentals of Electric Machines", New Age International Publishers Limited, New Delhi, 1996.

EE252 ELECTRICAL MACHINE DESIGN

Credits 3:1:0

Pre requisite: DC Machines and Transformers
Induction and Synchronous Machines

Unit I: General Aspects
Major considerations – Limitations - Main dimension- Output equation - Choice of specific electric and magnetic loadings - Separation of D and L for rotating machines. MMF for air gap - Effects of slots, ventilating ducts and saliency - MMF for teeth -Total MMF calculation - Leakage reactance, Estimation of number of conductors / turns - Coils - Slots - Conductor dimension - Slot dimension.

Unit II: Dc Machines
Choice of number of poles - Length of Air gap - Design of field system, Inter poles, Commutator and Brushes.

Unit III: Transformers
Classification – output equation - Core section - Window dimensions - Yoke dimension - Overall dimension - No load current calculation – Temperature rise of Transformers- Design of tanks and cooling tubes.

Unit IV: Three Phase Induction Machines
Length of air gap - Cage rotor - End ring current - Wound rotor - Dispersion coefficient. No-load current calculation - Stator and rotor resistance - Losses and efficiency

Unit V: Synchronous Machines
Short circuit ratio – Air gap length –Salient pole machine -Design of field winding- Turbo-alternator – Damper winding.

Text Books

1. Sawhney A.K. and Chakrabarti A., "A Course in Electrical Machine Design", Dhanpat Rai & Sons Company Limited, New Delhi, 6th Edition, 2006.
2. Mittle V.N. and Mittle A., "Design of Electrical Machines", Standard Publications and Distributors, New Delhi, 2002.

References

1. Sen, S.K, "Principles of Electric Machine Design with Computer Programmes", Oxford & IBH Publishing Company Private Limited, 2001, Reprint 2004.
2. Agarwal R.K., "Principles of Electrical Machine Design", S.K.Kataria and Sons, New Delhi, 2002.
3. Shanmugasundaram, A., Gangadharan G. and Palani R., "Electrical Machine Design Data Book", New Age International Publishers Private Limited., 1st Edition 1979, Reprint 2005.

EE253 GENERATION ,TRANSMISSION AND DISTRIBUTION

Credits 3:1:0

Unit I: Power Generation
Generation, Transmission & Distribution Scenario of India - Types of generation: Conventional and Non-conventional, Thermal Power Plant, Hydro Power Plant, Gas Power Plant, Nuclear Power Plant, Non-conventional Energy Sources - Load capacity factor - Connected load factor - Load duration curve - Selection of units.

Unit II: Power Transmission Systems
Various systems of transmission – Advantages of high transmission voltages - Comparison of conductor materials required for various overhead systems - Overhead Lines Parameters **:** Electrical constants - Resistance, Inductance and capacitance of Single and 3 Phase lines - Effects of earth on capacitance - Skin effect - Proximity effect - Transposition - Bundled conductors - Line supports-Performance**:** Short and Medium transmission lines - Phasor diagrams - Nominal T and π methods - Line regulation - Efficiency. Rigorous solution for long line - ABCD constants - Ferranti effect - Tuned power lines - Surge impedance and surge impedance loading.

Unit III: Line Insulators
Types - Potential distribution over a string of suspension insulators - Methods of increasing string efficiency. Corona – Factors affecting corona - Stress and Sag Calculation – Effect of wind and ice - supports at different levels – Stringing chart.

Unit IV: Underground Cables
Types - Capacitance and insulation resistance - Sheath effects - Grading - Stresses - Loss angle - Breakdown voltage - Optimum cable length -Comparison between Overhead lines and Underground cables.

Unit V: Distribution Systems
Feeders, Distributors and Service mains - Radial and ring main systems - Calculation of voltage in distributors with concentrated and distributed loads, A.C. single phase and three phase distribution systems.

Text Books
1. Mehta, V.K., Rohit Mehta , "Principles of Power Systems", S.Chand & Company Private Limited, New Delhi, 2004.
2. Singh S.N, "Electric Power Generation, Transmission and Distribution", Prentice Hall of India Private Limited, New Delhi, 2003.

References
1. Soni, M.L., Gupta, P.V., Bhatnagar U.S. and Chakrabarthi A., "A Text Book on Power System Engineering", Dhanpat Rai & Sons Company Private Limited, New Delhi, 1997.
2. Uppal, S.L., "Electrical Power", Khanna Publishers Limited, New Delhi, 13th Edition, 1995.
3. Wadhwa, C.L., "Electrical Power Systems", New Age International Publishers Limited, New Delhi, 2006, 4th Edition, Reprint Aug, 2007.
4. Weedy B.M., Cory B.J., " Electric Power Systems", John Wiley & Sons Limited, England, 4th Edition, Reprint, November 2001.

EE254 POWER ELECTRONICS

Credits 3:0:0

Unit I: Power Semiconductor Devices

Introduction - Power Diodes - Power Transistors - Power MOSFETs - IGBTs - Thyristor family : SCRs, Triacs, GTOs and IGCT - Static and Dynamic characteristics - Protection circuits - Series and parallel connections, MCT.

Unit II: Ac to Dc Converters

Diode rectifiers: Single phase and Three phase diode bridge rectifiers with R, RL and RLE load - Estimation of average load voltage and average load current - Free wheeling diode, Controlled rectifiers: Single phase and three phase half wave Thyristor converters. Estimation of average load voltage and average load current - Single phase Half controlled and Fully Controlled Thyristor Bridge Converters - Estimation of average load voltage and load current for continuous current operation - Input power factor estimation for ripple free load current - Three phase Half and Fully Controlled Thyristor Converters (no analysis) - Dual Converters.

Unit III: Ac to Ac and Dc to Dc Converters

AC to AC Converter: Single phase Full Wave controller with R and RL load - Estimation of RMS load voltage, RMS load current and input power factor - Three phase AC voltage controllers (No analysis) - Single phase to Single phase Cyclo converters- DC to DC Converter**:** Principle of step up and step down operation - Single quadrant DC chopper with R, RL and RLE load - Time ratio control - Estimation of average load voltage and load current for continuous current operation - Two quadrant and Four quadrant DC choppers.

Unit IV: Dc to Ac Converters

Types - Voltage source and Current source inverters - Single phase bridge inverters - Three phase bridge inverters - Control of AC output voltage - Harmonic reduction – Single phase Series Inverters.

Unit V: Control Circuits & Applications

Functional requirements of the switching control circuits - Generation of control signals for single phase AC to DC converters - Cosine wave crossing control, Ramp comparator approach. Generation of timing pulses for DC choppers - PWM techniques for DC to AC converters - Introduction to power converter control using Microprocessors, Microcontrollers and DSP-Applications: Motor drive applications: DC Motor Drives using Phase Controlled Thyristor Converters and DC Choppers - AC voltage controller and inverter fed induction motor drives - UPS - HVDC systems - Tap changing of Transformers.

Text Books

1. Rashid, M.H., "Power Electronics – Circuits, Devices and Applications", Pearson Education India Series Private Limited, New Delhi, 2004.
2. Ned Mohan, Undeland and Robbins, "Power Electronics - Converters, Applications and Design", John Wiley & Sons (Asia) Private Limited, Singapore, 2003.
3. Vedam Subrahmanyam, "Power Electronics", Tata Mc Graw- Hill Publishing Company Limited, New Delhi, 1996.

References
1. Philip T. Krein, " Elements of Power Electronics", Oxford University Press, Inc., New York, 2003.
2. Joseph Vithayathil., "Power Electronics", Mc-Graw Hill series in Electrical and Computer
Engineering, USA, 1995.

EE255 POWER SYSTEM ANALYSIS

Credits 3:1:0

Pre requisite: Generation, Transmission and Distribution

Unit I: Introduction

Need for System analysis in planning and operation of power system- One line diagram- Per unit representation - Symmetrical components - Short circuits analysis for fault on machine terminals.

Unit II: Network Formulation & Modelling, Short Circuit Studies

Primitive network and its representation – bus incidence matrix – Formation of Bus admittance matrix and bus impedance matrices.- modeling of synchronous machines , transformers, loads, π-equivalent circuit of transformer with off-nominal tap ratio- Short Circuit Studies**:** Types of faults - Algorithms for fault calculations - Sequence Impedance matrices - Symmetrical and Unsymmetrical fault analysis using Z_{bus}.

Unit III: Load Flow Studies

Formulation of load flow problem - bus classification – Solution by Gauss - Seidal , Newton - Raphson and Fast decoupled methods - Comparison -. Computation of slack bus power, transmission loss and line flow.

Unit IV: Economical Operation of Generating Stations

Optimal operation of generators – Economical scheduling of thermal plant with and without transmission losses – Loss formula derivation- Unit commitment - Elementary idea of optimal load scheduling of Hydro - Thermal plants.

Unit V: Stability Studies

Steady state and Transient stability - Swing equation and its solution by Modified Euler and Runge-Kutta methods - Equal area criterion - Factors affecting stability and methods of improving stability- Causes of voltage instability – voltage stability proximity indices for two-bus system

Text Books

1. Hadi Saadat, "Power System Analysis", Tata Mc Graw-Hill Publishing Company Limited, New Delhi, 2002, 11th Reprint 2007.
2. Gupta, B.R., "Power System Analysis and Design", S.Chand & Company Limited., New Delhi, 2005.

References
1. Weedy B.M., Cory B.J., " Electric Power Systems", John Wiley & Sons Limited, England, 4th Edition, Reprint, November 2001.

2. Wadhwa C. L., "Electrical Power Systems", New Age International Private Limited, New Delhi, 3rd Edition, Reprint 2003.
3. Nagsarkar T.K., Sukhija M.S., "Power system Analysis" Oxford University Press, London, 2007.

EE256 POWER SYSTEM PROTECTION AND SWITCHGEARS

Credits 3:0:0

Pre requisite: Power System Analysis

Unit I: Introduction
Principles and need for protective schemes – Nature and cause of faults – types of fault – per unit representation - Analysis of Symmetrical fault – Current limiting reactors. CTs and PTs and their applications in their protection schemes.

Unit II: Protective Relays & Apparatus & Line Protection
Definition - Requirement of relays - Universal torque equation - Non directional and directional over current relays – Earth fault relays - Distance relays - Impedance, Mho and Reactance relays - Differential relays - Negative sequence relays - Pilot (Translay) relay - Carrier and Microwave pilot relays – Under frequency relays - Introduction to static relays - Microprocessor and computer based protective relaying.
Apparatus and Line Protection: Alternator, transformer, Busbar and motor protection using relays – Feeder Protection – radial and ring main system. Microprocessor based protective schemes.

Unit III: Circuit Breakers
Functions of switchgear - Elementary principles of arc extinction - Arc control devices - Recovery voltage and restriking voltage - current chopping and capacitance current breaking - Bulk oil, low oil, air break, air blast, and sulphur hexafluoride and vacuum circuit breakers - HVDC breakers - Rating - Testing of circuit breakers.

Unit IV: Surge and Surge Protection
Switching surges - Lightning phenomenon – Traveling waves on transmission lines - Over voltage due to lightning - Protections against lightning - Lightning arresters – Types - Lightning arrester selection - Surge absorbers.

Unit V: Earthing and Insulation Co-Ordination
Solid, resistance and reactance Earthing - Arc suppression coil - Earthing transformers – Earth wires - Earthing of appliances- Insulation co-ordination: Definition - Determination of line insulation - Insulation levels of sub-station equipment - Co-ordination amongst items of substation equipment - Introduction to Indian Electricity rules.

Text Books

1. Badri ram and Vishwakarma D N ., "Power System Protection and Switchgear" Tata McGraw Hill Publishing House Limited, New Delhi , 1995.
2. Ravindranath, B., and Chander, M., "Power System Protection and Switchgear", New Age International Private Limited., New Delhi, 1977.
3. Wadhwa, C.L., "Electrical Power Systems", New Age International Publishers Limited, New Delhi, 2006, 4th Edition, Reprint: August, 2007.

References

1. Paithankar Y. G., Bhide S. R., “Fundamentals of Power System Protection” Prentice Hall of India Limited, New Delhi , 2003.
2. Soni, M.L., Gupta, P.V., Bhatnagar, U.S. and Chakrabarti, A., “A Text Book on Power Systems Engineering”, Dhanpat Rai & Sons Company Limited, New Delhi, 2003.
3. Sunil, S.Rao., “Switchgear Protection and Power Systems”, Khanna Publishers Limited, New Delhi, 11th Edition, 1999.

EE257 DIGITAL ELECTRONICS

Credits 3:1:0

Unit I: Number Systems, Boolean Algebra

Review of Number Systems – Number representation : Signed, Unsigned, Fixed point, Floating point. Computer codes – BCD, Gray code, Excess 3 code, Error detection and correction codes, Parity, Hamming codes. Boolean algebra – Basic Postulates and theorems, Switching functions, Canonical forms, Logic gates.

Unit II: Digital Logic Families

Characteristics of Digital ICs – Voltage and current ratings, Noise margin, Propagation delay, Power dissipation. TTL logic family – Totem pole, Open collector and tri-state outputs, Wired output operations, LS, ALS and Fast sub families. MOS transistor switches –NMOS Inverter / Logic gates, CMOS logic, Inverter / logic gates. Multiplexers – High speed CMOS (74HC, 74HCT, 74AHC, 74AHCT logic sub-families) and ECL logic families – Comparison of performance of various logic families. Interfacing TTL and CMOS devices.

Unit III :Combinational Logic Design

Standard representation of logic functions – Incompletely specified functions, Simplification of logic functions through K – maps and Quine-McClusky method, Implementation using logic gates. Decoders, Encoders, Multiplexers and De-multiplexers. Implementation of Combinational circuits using Multiplexers and De-multiplexers. Arthimetic Circuits: Binary / BCD adders and Subtractors, Carry look ahead adder, Magnitude comparator.

Unit IV: Sequential Devices & Design of Sequential Circuit

General model of sequential circuits – Latch, Flip Flops, Level triggering, Edge triggering, Master slave configuration. Binary counters, Shift register, Ring counter, Johnson counter, Timing diagram. Mealy/Moore models – Concept of state, State diagram, State table, State Reduction procedures using Partitioning and Implication chart. Minimal flip flop / one-hot realization. Design of Synchronous sequential circuits – Up-down / Modulus counters, Serial adder, Parity checker, Sequence detector. Introduction to Asynchronous Sequential Circuits – Fundamental mode and Pulse mode circuits.

Unit V: Programmable Logic Devices & Vhdl

Semi custom design. Introduction to PLDs – ROM, PAL, PLA, FPLA, FPLS. Architecture of PLDs – PAL 22V10, PLS 100/101, Implementation of digital functions-VHDL**:** Digital design process flow- Software tools-Hardware Description Language – Data Objects-Operators-Entities and Architecture – Component declaration - Component instantiation – Concurrent statements-Sequential statements- Behavioral, Dataflow and Structural modeling-Simple VHDL codes.

Text Books

1. Tocci, R.J , Widmer.N.S and Moss G.L, “Digital Systems : Principles and Applications”, Pearson Education Private Limited, Singapore, 9^{th} Edition, 2007.
2. Donald Givone, “ Digital Principles and Design”, Tata Mc Graw-Hill Publishing Company Limited, New Delhi, 2002.
3. Roth C.H., “Digital Systems Design using VHDL,” Thomson Asia, 2006.

References

1. Leach D.P., Malvino A.P. and Goutam Saha, “Digital Principles and Applications”, Tata Mc Graw – Hill Publishing Company Limited, New Delhi, 6^{th} Edition,2006.
2. Anand Kumar, “Fundamentals of Digital Circuits” Prentice Hall of India, Private Limited, New Delhi, 2004.

EE258 LINEAR INTEGRATED CIRCUITS

Credits 3:1:0

Pre requisite: EE247 Electron Devices

Unit I: Operational Amplifier Characteristics

Functional Block Diagram – Symbol, Characteristics of an Ideal Operational Amplifier, Circuit schematic of μA 741, Open loop gain, CMRR-input bias and offset currents, input and output offset voltages, offset compensation techniques. Frequency response characteristics – stability, limitations, frequency compensation, slew rate. Transfer characteristics.

Unit II: Linear Applications of Operational Amplifiers

Inverting and Non-inverting amplifiers – Voltage follower, Summing amplifier, Differential amplifier, Instrumentation amplifier. Integrator and Differentiator – Practical considerations. Voltage to Current and Current to Voltage converters, Phase changers. Sinusoidal oscillators. Active filters – Design of Low pass, High pass, Wide band pass and Band stop Butterworth filters, Narrow band pass and Notch filters.

Unit IIi: Non Linear Applications of Operational Amplifiers:

Comparator – Regenerative comparator, Zero crossing detector, Window detector, Sample and hold circuit, Precision diode, Half and Full wave rectifiers, Active peak detector, Clipper and Clamper, Logarithmic and Exponential amplifiers, Multiplier and Divider, Square and Triangular waveform generators. Voltage Regulators: Need for Single power supply operational amplifiers – LM324, AC Inverting and Non-Inverting amplifiers. Norton Amplifiers – Various configurations.

Unit IV: IC Voltage Regulators & Special Function ICS:

Block diagram of 723 General purpose voltage regulator – Circuit configurations, Current limiting schemes, Output current boosting , Fixed and adjustable three terminal regulators, Switching regulators- SPECIAL FUNCTION ICs**:** 555 Timer Functional block diagram and description – Monostable and Astable operation, Applications, IC566 Voltage Controlled Oscillator, Analog Multiplier, Comparator ICs, PLL Functional Block diagram – Principle of operation, Building blocks of PLL, Characteristics, Derivations of expressions for Lock and Capture ranges, Applications: Frequency synthesis, AM and FM detection, FSK demodulator, Motor speed control.

Unit V: A-D and D-A Converters
Digital to Analog Converters: Binary weighted and R-2R Ladder types – Analog to digital converters: Continuous, Counter ramp, Successive approximation, Single slope, Dual slope and Parallel types – DAC/ADC performance characteristics.

Text Books

1. Sedra and Smith, " Microelectronic Circuits", Oxford University Press, London, 5th Edition, 2004.
2. Gayakwad, A.R., "OP-Amps and Linear Integrated circuits", Pearson Education India Series, New Delhi, 4th Edition, 2004.

References

1. Coughlin, F.R., and Driscoll, F.F., "Operational Amplifiers and Linear Integrated Circuits", Prentice Hall of India, New Delhi, 4th Edition, 1997.
2. Roy Choudhury, and Shail Jain, "Linear Integrated Circuits", New Age International Limited, 2nd Edition, 2003
3. Michael Jacob, J, "Applications and Design with Analog Integrated Circuits", Prentice Hall of India, New Delhi, 2nd Edition, 1996.
4. David A Bell, "Operational Amplifiers and Linear ICs", Prentice Hall of India, New Delhi,2nd Edition, 1997.

EE259 CONTROL SYSTEMS

Credits 3:1:0

Unit I: Introduction
Open loop and Closed loop systems – Examples, Control system components. Transfer function of physical systems– Mechanical systems, Translational and Rotational systems, Electrical network, Thermal and hydraulic systems. Transfer function of DC Generator, DC servomotor, AC servomotor and Synchros , Transfer function of overall systems. Impulse Transfer function. Block diagram - reduction techniques. Signal flow graphs – Mason' gain formula.

Unit II: Time Response Analysis
Standard Test signals –Time response of zero, first and second order system, Performance criteria, Type of systems. Steady state error constants – position, velocity and acceleration error constants. Generalized error series – Feedback characteristics of control systems. Controllers – P, PI and PID control modes.

Unit III: Frequency Response Analysis
Frequency domain specifications – peak resonance, resonant frequency, bandwidth and cut-off rate, correlation between time and frequency responses for second order systems. Polar plot, Bode plot – Gain Margin and Phase Margin.

Unit IV: Stability of Systems
Characteristic equation – Location of roots of characteristic equation – Absolute stability and Relative stability. Routh Hurwitz criterion of stability – Necessary and sufficient

conditions. Nyquist Stability- Principle of argument – Nyquist path – Nyquist stability criterion – Determination of Nyquist stability – Assessment of relative stability. Bode Plot – Assessment of stability. Root locus concept, Rules for construction of root loci, problems, stability analysis.

Unit V: State Variable Analysis
Introduction to state space analysis – Physical variable, Phase variable and Canonical variables forms. Transfer function from state space representation.

Text Books

1. Gopal, M, "Control Systems – Principles and Design" Tata McGraw-Hill Company Limited., New Delhi, 2002.
2. Ogata K., "Modern Control Engineering", Prentice-Hall of India Private Limited., New Delhi, 4th Edition, 2002.

References

1. Nagrath I.J, & Gopal M, "Control System Engineering", New Age International Publishers Limited, New Delhi, 5th Edition, 2007
2. Benjamin C. Kuo, "Automatic Control Systems", John Wiley & Sons, Inc.,New Jersey, 8th Edition, 2003.
3. Norman S.Nise, "Control System Engineering", John Wiley & Sons Inc., New Jersey, 8th Edition, 2007.
4. Sivanandam S.N., Deepa S.N., "Control System Engineering using MATLAB", Vikas Publishing House Private Limited, New Delhi, 2nd Edition, 2006.

EE260 DIGITAL SIGNAL PROCESSING

Credits 3:1:0

Pre requisite: Signals and Systems

Unit I: Discrete-Time Signals and Systems
Need and benefits of Digital Signal Processing – signal classification and basic operations on them – Properties of DT system: linear, time invariance, causal, stable, passive and lossless – LTI system: convolution sum- interconnection schemes- I/O relationship-determination of impulse response and step response -anti aliasing and anti imaging filtering-Typical DSP system: ADC/DAC – sampling, quantization, and encoding.

Unit II: Discrete Transforms
Discrete Fourier Transform (DFT): Properties – DIT FFT and DIF FFT algorithms- linear filtering via circular convolution-inverse FFT- Wavelet Transform: MRA by the wavelet method.

Unit III: Design of Digital Filters
Characteristics of IIR and FIR filters -Design techniques for analog filters-frequency transformation-FIR filter design: windowing, frequency sampling and optimal methods-IIR filter design: impulse invariant and bilinear Z transform-Realization structures of filters: direct form, cascade, parallel, and lattice and ladder realization.

Unit IV: Finite Word Length Effects

Finite word length effects in IIR and FIR filters –A/D quantization noise – Co-efficient quantization – overflow errors – Product round off errors-limit cycle due to product round off errors – Finite word length effects in FFT implementation.

Unit V: General-Purpose Digital Signal Processors

Computer architectures for signal processing – Van Neumann and Harvard architectures-pipelining-hardware multiplier-accumulator-special instructions-replication-on-chip memory-extended parallelism: SIMD, VLIW, and super scalar processing -selecting digital signal processors.

Text Books

1. Emmanuel C.Ifeachor.,Barrie W.Jervis, "Digital Signal Processing , A Practical approach", Pearson Education India Series, New Delhi, 2nd Edition, 2004.
2. Lonnie C.Ludeman, "Fundamental of Digital Signal Processing", John Wiley & Sons, New Jersey, 2003.

References

1. Oppenheim, A.V.and Schaffer, R.W. "Discrete Time Signal Processing", Prentice Hall of India, New Delhi,2001.
2. Sanjit K.Mitra,"Digital Signal Processing, A Computer based Approach", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2nd Edition, 5th Reprint, 2004.
3. John. G. Proakis and Dimitris .G. Manolakis," Digital Signal Processing : Principles, Algorithms & Applications", Prentice Hall of India, New Delhi , 4th Edition,2007.

EE261 C++ AND DATA STRUCTURES

Credits 3:0:0

Unit I: Introduction to Data Structures

Linked list, Single linked list, Doubly linked list, Circular Linked list, Stack, Queue, Trees

Unit II: Sorting and Searching Techniques

Sorting, Bubble sort, Insertion Sort, Selection Sort, Quick Sort, Heap Sort, Merge Sort. Searching, Binary Tree Search, Linear Search, Binary Search.

Unit III: Objects and Classes

A Simple class, C++ objects as physical objects, C++ Objects and Data types, Object as function argument, constructors, as function argument, Overloaded Constructors, Copy Constructors, Returning objects from functions, structures and classes, Static class data, const and classes, Arrays and Strings.

Unit IV: Operator Overloading

Overloading Unary and Binary Operator, data conversion, and Pitfalls, Inheritance: derived class and base class, derived class constructors, Overloading member functions, class hierarchies, public and private inheritance, level of inheritance, multiple inheritance. Pointers: address and pointers, pointers and arrays, pointer and c-type strings, new and delete operator, pointers to pointer.

Unit V: Virtual Functions

Virtual functions, Friend functions, Static functions, this pointer. Streams and files: stream classes, stream errors, disk file I/O with streams, file pointers, error handling in file I/O. Templates and exception: function templates, class templates, exceptions.

Text Books

1. Robert Lafore, "Object Oriented Programming in C++", Third Edition, Galgotia Publsihers, Pune 1999.
2. Jean-Paul Tremblay and Paul G Sorenson, "An Introduction to Data Structures with Applications", Mc Graw- Hill Publishing Company Limited, New Delhi, 2nd Edition, 1994

References

1. Herbert Schmidt, " C++, The Complete Reference" , Mc Graw-Hill Publishing Company Limited, New Delhi, 3rd Edition, 1999
2. Sartaj Sahni, "Data Structures, Algorithms and Applications in C++", Mc Graw-Hill Publishing Company Limited, New York, 3rd Edition, 1998.

EE262 MEASUREMENTS AND INSTRUMENTATION

Credits 3:0:0

Unit I: Standards and Indicating Instruments

SI units – units for charge, voltage, current, power, energy, flux. Standards – brief Introduction. D'Arsonval Galvanometer. Moving iron: attraction and repulsion type instruments, errors. Moving coil instruments – Permanent magnet moving coil instruments, Dynamometer type moving coil Instruments, Torque equations and errors. Extension of ranges, use of shunts and Instrument Transformers.

Unit II: Measurement of Power and Energy

Dynamometer type wattmeter – Torque expression, Errors. Energy meters, Calibration of energy meters. Measurement of power using Instrument Transformers. Maximum demand indicator, Power factor meter.

Unit III: Measurement of R-L-C

Resistance measurement – Kelvin double bridge, Wheatstone bridge, substitution method, Loss of charge method, Guard Wire method. Measurement of inductance and capacitance – Maxwell, Anderson, Hay's and Schering bridges. Measurement of Earth resistance.

Unit IV: Measurement of Non-Electrical Quantities

Transducers – Classifications, Principle of operation of Resistance potentiometer, Inductive and capacitive transducers, LVDT, Strain Gauge and Piezo-electric transducers. Encoders. Hall effect sensors and photo sensors. Measurement of Pressure – High Pressure and low pressure measurement. Measurement of Temperature - Resistance thermometers, thermistors and thermocouples. Speed measurement- contact and non-contact type.

Unit V: Electronic Laboratory Instruments

Electronic voltmeter – Digital voltmeter of ramp and integrating types. Digital Multimeter – block diagram. Block diagram of dual channel oscilloscope. Spectrum Analyzer. Pulse, signal and function generators. Harmonic distortion analyzer. Strip chart and X-Y recorders, Field Bus Instrumentation.

Text Book

1. Sawhney.A.K., "A Course in Electrical & Electronic Measurement and Instrumentation", Dhanpat Rai & Company Private Limited, New Delhi, 18th Edition, 2007.

References

1. Helfrick A.D., "Modern Electronic Instrumentation & Measurements", Prentice – Hall India Private Limited, New Delhi, 2007.
2. Doeblin,E.O., "Measurement Systems : Application And Design", 5th Edition, Tata Mc-Graw Hill Publishing Company Limited , New Delhi, 2004.
3. Golding,E.W., and Widdis,F.C., "Electrical Measurements and Measuring Instruments", A H Wheeler & Company, Calcutta, 5th edition, 2003.
4. Rangan,C.S., Sharma, G.R., Mani, V.S., "Instrumentation Devices and Systems", Tata McGraw- Hill Publishing Company, New Delhi, 2nd Edition, 2002.

EE263 MICROPROCESSORS AND MICROCONTROLLERS

Credits 3:1:0

Unit I: Architecture & Programming of 8085 Microprocessor:

Functional Block Diagram – Registers, ALU, Bus systems – Timing and control signals- Programming of 8085: Instruction formats – Addressing modes – Instruction set – Need for Assembly language – Development of Assembly language programs – Machine cycles and Timing diagrams

Unit II: Memory & I/O Interfacing

Interface requirements – Address space partitioning – Buffering of Buses – Timing constraints – Memory control signals – Read and write cycles –Typical EPROM and RAM Interfacing- I/O Interfacing: Memory mapped I/O scheme – I/O mapped I/O scheme – Input and Output cycles – Simple I/O ports – Programmable peripheral interface (8255). Data transfer schemes – Interfacing simple keyboards and LED displays.

Unit III: Interrupts and Dma

Interrupt feature – Need for interrupts - Characteristics of Interrupts – Types of Interrupts – Interrupt structure – Methods of servicing interrupts - Development of Interrupt service subroutines – Multiple interrupt requests and their handling – Need for Direct Memory Access – Devices for handling DMA – Typical DMA Controller features.

Unit IV: Applications

Multiplexed seven segment LED Display systems – Stepper motor control – Measurement of frequency, phase angle and power factor – Interfacing ADC0801 A/D Converter – DAC 0800 D/A Converter – Waveform generators.

Unit V: Intel 8051 Microcontroller

Architecture – Memory Organization – Addressing modes – Instruction set – Boolean processing – Simple programs - 8051 Peripherals **:** Interrupt structure – Timer, Serial ports and Power control : Features and Modes – Interfacing – Instruction set – Boolean processing – Simple programs – Typical Applications – MCS 51 family features 8031/ 8051/ 8751.

Text Books

1. Ramesh S.Goankar, "Microprocessor Architecture: Programming and Applications with the 8085", Penram International Publishing (India) Private Limited, 5^{th} Edition, 2002.
2. Mazidi Muhammed Ali, Mazidi Janice Gillispie, "The 8051 Microcontroller and Embedded Systems", Pearson Education India Series, New Delhi, 2000.

References

1. Kenneth L Short, "Microprocessors and Programmed Logic, Prentice Hall of India , New Delhi, 2^{nd} Indian Reprint, 2004.
2. The MCS – 80 / 85 Family User's Manual, INTEL Corporation, USA.
3. "8-bit Embedded Controllers", User's Manual, Intel Corporation, USA,1990.

EE264 MOBILE COMMUNICATION

Credits 4:0:0

Unit I: Wireless Transmission

Frequencies for radio transmission, Signals, Antennas, Signal Propagation, Multiplexing, Modulation, Spread Spectrum, Cellular Systems-Medium Access Control: Motivation, SDMA, FDMA, TDMA, CDMA - Comparison

Unit II: Telecommunication Systems

GSM, DECT, TETRA, UMTS and IMT- 2000- Satellite Systems: Basics - Routing - Localization - Handover

Unit III: Broadcast Systems

Cyclic repetition of data - Digital Audio Broadcasting, Digital Video Broadcasting Wireless LAN: Infrared VS Radio transmission, Infrastructure and AD-HOC networks, IEEE 802.11, Hyper LAN, Bluetooth.

Unit IV: Wireless Atm

Motivation, Working group, WATM services, reference model, functions, radio access layer, handover, location management, addressing, quality of service, access point control protocol - Mobile Network Layer: Mobile IP, Dynamic host configuration protocol, AD-HOC networks

Unit V: Mobile Transport Layer

Traditional TCP, indirect TCP , snooping TCP , mobile TCP, fast retransmission/ fast recovery, selective retransmission, transaction oriented TCP - Support for Mobility: File systems, World Wide Web, Wireless application protocol

Text Books

1. Jochen Schiller, "Mobile Communications", Addison Wesley Publishers, 2000.
2. Lee W.C.Y., "Mobile communications Engineering: Theory And Applications", McGraw- Hill,New York.1998.

References

1. Yi-Bing Lin and Imrich Chlamtac, "Wireless and Mobile Network Architecture", John Wiley and Sons, New Delhi, 2nd Edition, 2001.
2. Feher K., "Wireless Digital Communications", Prentice Hall of India, New Delhi,1995
3. Rappaport T.S., "Wireless Digital Communications; Principles and Practice" ,Prentice Hall,New Jersey,1996.

EE265 BIOMEDICAL INSTRUMENTATION

Credits 4:0:0

Unit I: Electrophysiology and Biopotential Recorders
Neuron – Axon – Axon potential – Electro physiology of Cardiovascular system – ECG – Phonocardiography – Neurophysiology – Central nervous system – EEG – Respiratory system – Muscular system - EMG, - Eye – ERG

Unit II : Measurement and Physiological Parameters
Physiological Transducers - Measurement of Blood pressure – Blood flow - Cardiac output measurement – Heart rate – Respiration rate – Measurement of lung volume – Oxi-meters – Audiometer.

Unit III: Therapeutic and Surgical Equipments
Electro Surgical unit – Short wave & Microwave Diathermy – Laser surgical unit – Anesthesia machine – Pacemakers – Total artificial heart (TAH) – Dialyser – Heart lung machine – Defibrillators – Ventilators – Nerve stimulators – Laparoscopy - Centralized and Bedside patient monitoring system – Nerve stimulators.

Unit IV: Biomedical Equipments and Patient Safety
Flame photometer – spectrophotometer – Chromatography – PH, PCO_2, analysis – Sterilizers – Physiological effects of Electric Current – Shock Hazards from Electrical Equipments – Electrical accidents and its preventions.

Unit V: Imaging Systems and Telemetry
Computerized Tomography (CT) – MRI instrumentation – Ultrasound scanner – X-ray machine – Fluoroscopic techniques – angiography – Cardiac Catherisation lab – Echo cardiograph – Vector cardiograph – Biotelemetry.

Text Books

1. Richard Aston , "Principles of Biomedical Instrumentation and Measurement", Merrill (Mac Millan) Publishing Company, Princeton, 1990.
2. Arumugam, M., "Biomedical Instrumentation", Anuradha Agencies, Publishers, Kumbakonam, 1992.

References

1. Geddes, L.A., and Baker, L.E.,: " Principles of Applied Biomedical Instrumentation", John Wiley & Sons Limited, New Delhi, 1989.
2. Kandpur, R.S, "Handbook of Biomedical Instrumentation", Tata Mc-Graw Hill Publishing Company Limited, New Delhi, 1987.

EE266 VLSI DESIGN

Credits 4:0:0

Unit I: Introduction to Mos Technology

MOS technology & VLSI – Basic MOS transistor – depletion & enhancement type – NMOS & CMOS Transistors fabrications – electrical properties of MOS circuits – characteristics – threshold voltage – Trans conductance – pass transistors – NMOS Inverter – pull-up pull-down ratio for NMOS Inverter driven by NMOS Inverter & through one or more pass transistors – CMOS Inverter – latch-up-sheet-resistance & capacitance calculation – delay calculation – super buffer – HMOS & native transistors.

Unit II: Layout Design

MOS & CMOS Layers – Stick diagram – design rules & layout – subsystems design: Switch logic – gate logic – other forms of logic – Combinational Logic design example: Passing generator – Bus Arbitration Logic Multiplexers – Gray to Binary code converter –Sequential circuit example: Two Phase clocking – Dynamic Register element – Dynamic Shift Register – Pre charged bus concept – Scaling circuits.

Unit III: Design of System

PLA – Finite state machine – PLA based finite state machine design – design of 4-bit shifter – design of ALU subsystem: Adders – Multiplexers – Memory: Dynamic Shift register – dynamic RAM cells – one transistor dynamic memory cell – 4*4 bit register array – RAM array.

Unit IV: Tools for Design

Grounds rules for successful design – Design styles & Philosophy – CAD tools for design & simulation: Textual entry layout language – Graphical entry layout – Design verification – Design rule checkers – simulators – tests & testability.

Unit V: Cmos Design Projects & Fast Vlsi Circuits

Incremental/Decremental – Left/Right – Serial/Parallel shift register – Comparator – GaAs device – Layout design for GaAs devices.

Text Books

1. Pucknell D.A., & Eshraghian K., "Basic VLSI Design", Prentice Hall of India, New Delhi, 1994.
2. Neil,Weste H. E. and Kamran Eshraghian., "Principle of CMOS VLSI Design: A System Perspective", Pearson Education, 2nd Edition, 2004.

References

1. Geiger R.L., Allen P.H., & Starder N.R., "VLSI Design Techniques For Analog & Digital Circuits", Mc Graw- Hill International Edition, New York, 1990.
2. Jan M Rabaey, Chandrakasan A, Nikolic B, " Digital Integrated Circuits", Pearson Education, New
3. Delhi, 3rd Indian Reprint, 2004.
4. Amar Mukherjee, "Introduction to nMOS and CMOS VLSI System Design", Prentice Hall, USA, 1986.
5. Wayne Wolf, "Modern VLSI Design: Systems on Silicon", Pearson Education Indian Reprint, New Delhi, 3rd Edition 2006.

6. Eugene D Fabricus, “Introduction to VLSI Design”, McGraw Hill International Edition, 1990.

EE267 EMBEDDED SYSTEM

Credits 4:0:0

Unit I: Introduction to Embedded Systems
An Embedded System – Processor in the System – Other hardware units – Software embedded into a System – Exemplary Embedded Systems - Embedded System On Chip and in VLSI circuit.

Unit II: Real Time Systems
Introduction – Issues in Real time Computing – Structure of a Real Time System – Architecture of Real Time Systems – Performance measures for Real Time Systems – Properties of Performance Measures – Traditional Performance Measures – Performability – Cost Functions and Hard Deadlines – Estimating Program Runtimes

Unit III: Real Time Operating Systems
Task and Task States, tasks and data, semaphores and shared Data Operating system Services- Application of Semaphores -Message queues-Timer Function-Events – Memory management – Real time and Embedded System Operating Systems - Interrupt Routines in RTOS Environment.

Unit IV: Programming Languages and Tools
Language features-Programming environments-Introduction to-assembler-compiler-cross compilers and Integrated Development Environment (IDE). Debugging strategies, Simulators, Emulators- RTOS Programming Tools : Micro C/ OS-II and VxWorks

Unit V: Programming Concepts and Embedded Programming In C And C++
Software programming in Assembly Language and in High level language – C Program Elements – Queues – Stacks – lists and ordered lists – Embedded programming in C++.

Text Books

1. Jonathan W. Valvano, Thomson Brooks/cole, “Embedded Microcomputer Systems – Real Time Interfacing”, Thomas Learning, 1st Edtion, 2002
2. Jane W.S. Liu, “Real Time Systems”, Pearson International Edition, Singapore, 1st Indian Reprint, 2001.

References

1. C.M. Krishna, Kang G. Shin, “Real Time systems”, McGraw Hill Publishing Company, New York, 1st Edition, 1997.
2. Raj Kamal, “Embedded System: Architecture, Programming and Design” Mc Graw-Hill International Inc., New York, 2005.

EE268 OPERATING SYSTEMS

Credits 3:0:0

Unit I: Introduction
Operating system – Function – Evolutions of Operating System- Serial processing- Batch Processing- Multiprocessing-Time sharing, Advanced Operating Systems –Need for

advanced OS-Distributed OS – Multiprocessor OS – Database operating system – Real time OS.

Unit II: Memory Management
Single contiguous allocation – Partitioned allocation – Paging – Virtual memory concepts – Swapping – Demand paging – Page replacement algorithms – Segmentation – Segmentation with paging.

Unit III: Process Management
Introduction to processes –Scheduling objectives- Scheduling Criteria- Types of scheduling algorithms – Performance comparison – Inter process communications- Synchronization – Semaphores – Deadlock-Prevention, Recovery, Detection – Avoidance.

Unit IV: Device and File Management
Principles of I/O hardware – I/O software – Disks – Disk Scheduling Algorithms–File Systems – Files-Directories- File system implementation – Allocation methods -Security – Protection mechanisms.

Unit V: case studies:
LINUX – History – Design Principles – Kernel modules – Process Management – Scheduling – Memory Management – File Systems – Input and Output – Inter process Communication – Network Structure – Security. WINDOWS 2000 – History – Design Principles – System Components – Environmental Subsystems – File System – Networking – Programmer Interface.

Text Books

1. Silberschatz A, Galvin. P, G.Gagne " Operating Systems Concepts", John Wiley & Sons, Singapore, 6th Edition, 2004.
2. Achyut Godbole, "Operating Systems", Tata Mc Graw -Hill Publishing Company Limited, New Delhi, 15th Reprint 2003.

References

1. Andrew S Tanenbaum, Albert S. Woodhull," The MINIX book Operating Systems: Design and Implementation", Pearson Education India Private Limited, New Delhi, 3rd Edition, 2006.
2. Deitel H M.," An Introduction to Operating Systems", Pearson Education Private Limited, New Delhi, 2nd Edition, 2005.
3. Mukesh Singhal and Niranjan G.Shivaratis, "Advanced Concepts in Operating Systems", Mc Graw -Hill Inc. Limited, New York, 2004.

EE269 COMPUTER COMMUNICATION

Credits 3:0:0

Unit I: Introduction
Computer Networks – A perspective – Goals – Applications – Switching techniques – Circuit switching –Message switching – Packet switching – Network components existing network – ARPANET – Concepts of network protocol – OSI reference model – Basics of Queuing theory – Queuing models – Poisson Statistics – M/M/1 queue.

Unit II: Local Area Networks
Topologies – Star – Ring, Bus – Ethernet – Transmission media – LAN Access Techniques – Polling Contention – ALOHA – CSMA – CSMA/CD - Token Bus and Token Ring protocols – Delay throughput Characteristics – Token Ring and CSMA/CD Bus – performance.

Unit III: Data Communication Techniques
Asynchronous and synchronous communication – BISYNC , SDLC , HDLC – X.2.5 protocols – Error control coding.

Unit IV : Inter – Networking
Routing Algorithms – Congestion Control Algorithms – Internetworking – TCP/IP - IP Protocol – IP Address.

Unit V: Broadband Networks
ISDN – User Access – Transmission structure - ISDN Protocol – Limitations – B – ISDN – ATM concepts and principles – Introduction to VSAT networks.

Text Books

1. Andrew Tannenbaum., "Computer Networks", Prentice Hall of India, New Delhi, 4th Edition, 2003
2. Forouzan, "Introduction to Data Communication and Networking", Tata McGraw - Hill Publishing Company Limited, New Delhi, 4th Edition, 2004.

References

1. William, Stallings, "Data and Computer Communication", Prentice Hall of India, New Delhi, 7th Edition, 2003.
2. Keiser, G.E., "Local Area Networks", Galgotia Publications, Pune, 2nd Edition, 2002.
3. Uyless, Black., "Computer Networks, Protocols, Standards and Interfaces", Prentice Hall International Edition, 2nd Edition, 2002

EE270 VIRTUAL INSTRUMENTATION

Credits 3:0:0

Unit I: Review of Virtual Instrumentation
Historical perspective, advantages, Block diagram and Architecture of a Virtual Instrument, Data Flow Techniques, Graphical programming in data flow, comparison with Conventional programming.

Unit II: Vi Programming Techniques
VIS and sub-VIS, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O

Unit III: Data Acquisition Basics
ADC, DAC, DIO, counters & timers, PC Hardware structure, timing, Interrupts, DMA, software and hardware installation.

Unit IV: Common Instrument Interfaces

Current loop, RS 232C/ RS485, GPIB, System buses, interface buses: USB, PCMCIA, VXI,SCXI, PXI, etc., Networking basics for office & Industrial applications, VISA and IVI, Image Acquisition and Processing. Motion control.

Unit V: Use of Analysis Tools
Fourier transforms, power spectrum, correlation methods, windowing & filtering. VI applications in various fields.

Textbooks

1. Gary W. Johnson, "LabVIEW Graphical Programming" , McGraw- Hill Publishing Company Limited, New York, 2nd Edition, 1998.
2. Lisa K. Wells & Jeffrey Travis, " LabVIEW for Everyone", Prentice Hall of India, New Jersey, 1997.

Reference

1. Leonard Sokoloff, "Basic concepts of Labview 4", Prentice Hall of India, New Jersey, 1998.
2. LabVIEW: Basics I & II Manual, National Instruments, 2005.
3. Sanjay Gupta and Joseph John, " Virtual Instrumentation using LabVIEW", Tata Mc Graw – Hill Publishing Company Limited, New Delhi, 1st Edition, 2005.

EE271 HIGH VOLTAGE ENGINEERING

Credits 3:0:0

Unit I: Ionization and Decay Process
Introduction- Ionization process- Types of ionization - Electron collision - Photo ionization - Thermal ionization - Electron detachment and recombination - Mobility of gaseous ions and Decay by diffusion - Cathode process.

Unit II: Electric Breakdown in Gases, Solids and Liquids
Properties of insulating gases - Townsend's criterion for break down - Mechanism of spark - Breakdown voltage characteristics in uniform and non uniform fields - Penning effect - Time lag for breakdown - Corona discharges - Paschen's law - Electric Breakdown In Solids: Intrinsic breakdown - Electromechanical breakdown - Stream breakdown - Thermal breakdown - Erosion breakdown - Breakdown of composite insulation - Solid dielectrics used in practice. Electric Breakdown In Liquids: Electronic breakdown - Cavitation breakdown - Suspended particle mechanism - Conduction and breakdown in pure and commercial liquids.

Unit III: Generation of High Voltage and High Currents
Generation of high DC voltages - Cockroft - Walton voltage multiplier circuit - Electrostatic generator - Vande groaf generator - Generation of high AC voltages, Transformers in cascade - Construction of Impulse generator - Generation of Impulse voltages and currents - Tripping and control of Impulse generators.

Unit IV: Measurement of High Voltages and Currents & Non Destructive Testing of Materials and Electrical Apparatus
Measurement of high DC voltages - Measurement of High AC voltages - Electrostatic voltmeters - Impulse voltage measurements using voltage dividers - Measurement of High DC, AC and Impulse currents - Surge test oscilloscope-Destructive Testing Of

Materials And Electrical Apparatus: Measurement of resistivity - High voltage dielectric loss measurement - Schering bridge - Measurement of large capacitance - Inductively coupled ratio - Arm bridge- Loss measurement on complete equipment - Discharge measurement - Recurrent surge generator.

Unit V: High Voltage Testing

Testing of overhead line insulators- Testing of isolators and circuit breakers - Testing of surge diverters - Testing of cables - Testing of bushings - Testing of power capacitors and transformers - Radio interference measurements.

Text Books

1. Naidu M. S. and Kamaraju V., "High Voltage Engineering", Tata McGraw- Hill Publishing Company Limited, 3rd Edition, 2004.
2. Wadhwa C.L., "High Voltage Engineering", New Age International Private Limited., New Delhi, Reprint, 2002.

Reference Books

1. Ravindra Arora and Wolfgang Mosch, "High Voltage - Insulation Engineering", New Age International Publishers Limited, New Delhi, Repint 2002.
2. Kuffel, E., Zaengl W.S., Kuffel J., "High Voltage Engineering : Fundamentals" Butterworth-Heinmann (A division of Reed Educatonal & Profession Publishing Limited), 2nd Edition, 2000.
3. Rakosh Das Begamudre, "Extra High Voltage AC Transmission Engineering",Wiley Eastern Limited., New Delhi, 1986.

EE272 COMPUTER ARCHITECTURE

Credits 3:0:0

Unit I: Introduction

Register transfer language-register, bus and memory transfers–Arithmetic logic and shift micro operations.

Basic Computer Organisation**:** Instruction codes – Instructions – Timing and Control – Instruction Cycle – Fetch and Decode – Execution – Typical register and memory sequence instructions – Input, Output and Interrupt – Design stages.

Unit II: Central Processor Organization

General register organization – Stack organization – Instruction formats – Addressing modes – Data transfer and manipulation – Program control – Control memory – Address sequencer – Data path structure - CISC characteristics, RISC Characteristics, RISC pipeline.

Unit III: Arithmetic Processing

Introduction – Addition, Subtraction, Multiplication and Division algorithms – Floating point Arithmetic operations.

Unit IV: Memory and Input/Output Organization

Basic concepts – Memory Hierarchy – Main memory – Auxiliary memory – Associative memory – Cache and Virtual memory concepts – Input – Output interface –

Asynchronous Data transfer – Modes of transfer – Direct memory access – I/O processor.

Unit V: Introduction to Parallel Processing
Parallelism in Uni-processor systems – Taxonomy of architectures – SISD, SIMD, MISD, MIMD modes of Memory access - shared memory, distributed memory – typical applications.

Textbooks

1. Morris Mano, M., "Computer System Architecture", Prentice Hall of India , New Delhi, 3rd Edition, 2000.
2. Hwang K., and .Briggs F.A., "Computer Architecture and Parallel Processing", McGraw–Hill Publishing Company Limited , New Delhi, 1989.
3. Stallings W., "Computer Organization and Architecture", Pearson Education, New Delhi, 7th edition, 2006.

References

1. Carl Hamacher, V., Vranesic, Z.G., and Zaky, S.G., "Computer Organisation", Mc Graw- Hill International Edition, New York, 5th Edition, 2002.
2. Kai Hwang., and Briggs, F.A., "Computer Architecture and Parallel Processing", McGraw-Hill International Edition, New York, 1985.

EE273 ELECTRIC DRIVES AND CONTROL

Credit 3: 0: 0

Pre requisite: EE245 Power Electronics, EE250 DC Machines and Transformers, EE251 Induction and Synchronous Machines

Unit I: Introduction to Electric Drives
History and development of Electric Drives, Classification of Electric Drives, Basic elements & advantages of variable speed drives- Joint Speed-Torque characteristics of various types of loads and drive motors- Modes of operation, closed loop control of drives - Selection of power rating for drive motors with regard to thermal overloading and load variation-Load Equalization.

Unit II: Dc Drives
Speed control of DC motors - Ward - Leonard scheme - drawbacks - Thyristor converter fed dc drives: Single, two and four quadrant operations - Chopper fed DC drives : - Time ratio control and current limit control - Single, two and four quadrant operations - Effect of ripples on the motor performance.

Unit III: Three Phase Induction Motor Drives
Speed control of 3 phase Induction Motors - Stator control: PWM &V/f control, rotor control: Rotor resistance control - Static control of rotor resistance using DC chopper - Static Krammer and Scherbius drives – Introduction to Vector Controlled Induction Motor Drives.

Unit IV: Drives for Special Machines
Speed control of 3 phase Synchronous Motors - True synchronous and self controlled modes of operations - DC servo drives principle of operation AC servo drives principle

of operation - Principle and control of Stepper motor and Switched Reluctance Motor drives.

Unit V: Digital Control and Drive Applications
Digital techniques in speed control - Advantages and limitations - Microprocessor/Microcontroller and PLC based control of drives, networking of drives - Selection of drives and control schemes for Steel rolling mills, Paper mills, Cement mills, Machine tools, Lifts and Cranes. Solar and battery powered drives.

Text Books

1. Dubey, G.K., "Fundamentals of Electrical Drives", Narosa Publishing House, New Delhi, 2003.
2. Bose, B.K., "Modern Power Electronics and AC Drives", Pearson Education (Singapore) Private Limited, New Delhi, 2003

References

1. Ion Boldea and Nasar S. A., "Electric Drives", CRC Press LLC, New York, 2nd Edition, 2006.
2. Krishnan R, "Electric Motor Drives: Modelling, Analysis and Control, Prentice Hall of India, Private Limited, New Delhi, 2002
3. Vedam Subramanyam, "Electric Drives: Concepts and Applications", Tata McGraw Hill Publishing Company Limited, New Delhi, 2004.

EE274 POWER SYSTEM STABILITY

Credits 3:1:0

Unit I: Introduction to Stability
Concept of Power system stability - Importance of Stability studies - Steady state and Transient state – Modeling of Synchronous machines for stability studies.

Unit II: Steady State Stability
Models used – power flow equations – steady state stability including composite loads – two machine system and Clarke diagram – multi machine system and stability criteria – factors influencing stability limit.

Unit III: Transient Stability
Single and two machine systems – Swing equation – Solution of swing equation by Modified Euler and Runge-kutta method – Equal area criterion and its application – Graphical integration – state space representation – phase plane method – stability of multi machine system.

Unit IV: Improving Transient Stability
Factor affecting transient stability – Methods of improving stability – Lyapunov method – effect of excitation and speed governing system on transient stability – effect of inertia and damping.

Unit V: Computer Applications
Application of analog computers for stability studies – Digital simulation methods for transient stability studies.

Text Book

1. Kundur P., "Power System Stability and Control", EPRI Power System Engineering Series, Mc Graw- Hill Publishing Company Limited, New York, 1st Edition, 1994.

References

1. Padiyar K.R., " Power System Dynamics, Stability and Control", BS Publications, Hyderabad, 2002.
2. Peter W., Saucer, Pai M.A., " Power System Dynamics and Stability, Pearson Education (Singapore), 2nd Indian Reprint, 2003.
3. Kothari D.P., "Modern Power System Analysis", Tata Mc Graw – Hill Publishing Company Limited, New Delhi, 3rd Edition, 2003
4. Elgerd O.I., "Electric Energy System Theory: An Introduction", Tata Mc Graw – Hill Publishing Company Limited, New Delhi, 23rd Reprint, 2004.
5. Arrillaga J, Watson N.R., " Computer Modeling of Electrical Power Systems", John Wiley & Sons Limited, New Jersey, 2003.

EE275 POWER SYSTEM CONTROL

Credits 4:0:0

Unit I: Introduction

Need for voltage and frequency regulation in power system - System load characteristics - Basic P-F and Q-V control loops -Real power and Reactive Power improvement methods .

Unit II: Real Power and Frequency Control

Fundamentals of Speed governing mechanisms and Modeling – Speed – Load characteristics - Control areas – LFC control of a single area – Static and dynamic analysis of uncontrolled and controlled cases - Multi-area systems – Two area system modeling - Static analysis -uncontrolled case - tie line with frequency bias control of two-area and multi-area system – Steady state instabilities.

Unit III: Reactive Power and Voltage Control

Typical excitation system – Modeling – Static and Dynamic analysis – Stability Compensation - Effect of Generator loading - Static Shunt Capacitor/reactor VAR compensator, Synchronous Condenser, Tap-changing transformer - Static VAR system - Modeling – System level voltage control

Unit IV: Computer Control of Power System

Energy control center functions – System hardware configuration SCADA system – Functional aspects – Security monitoring and control – System states and their transition - Various controls for secure operation.

Unit V: Economic Dispatch Control

Incremental cost curve – co-ordination equations with loss and without losses - Solution by iteration method. (No derivation of loss coefficients). Base point and participation factors - Economic controller added to LFC control.

Text Books

1. Olle I.Elgerd, “Electric Energy System Theory, An Introduction”, Tata Mc Graw-Hill Publishing Company Limited, New Delhi, 1983.
2. Kundur P., “Power System Stability and Control”, EPRI Power System Engineering Series, Mc Graw- Hill Publishing Company Limited, New York, 1st Edition, 1994.

References
1. Kirchmayer .L.K. “Economic Operation of Power System”, John Wiley & Sons Inc., New Jersey, 1953.
2. Allen J.Wood, Bruce F.Woolenbarg, “Power Generation, Operation and Control”, John Wiley & Sons Inc., New Jersey, 2nd Edition, 1996.
3. Mahalanbis, A.K., Kothari, D.P and Ahson, S.I., “Computer Aided Power System Analysis and Control”, Tata Mc Graw -Hill Publishing Company Limited, New Delhi, 1990.

EE276 MATERIAL SCIENCE

Credits 3:0:0

Unit I: Crystallography, Metals and Alloys
Crystallography: Crystal systems, Lattice parameters, Bravais lattice, packing factors of cubic and HCP crystal systems, Miller indices. Linear and planar density of atoms, Debye – Scherrer method of crystal structure. Crystal imperfections-points, line and surface defects and their role in electrical, mechanical and optical properties of materials.

Metals and Alloys: Drude Lorentz theory of electrical conduction, Wiede mann Franz law, Band theory of solids, factors affecting resistivity of metals – temperature, alloying, magnetic field and strain. Applications of conductors – strain gauges, transmission lines, conducting materials, precision resistors, heating elements and resistance thermometer.

Unit II: Semi-Conducting Materials and Devices
Elemental and Compound semiconductors, Intrinsic and Extrinsic semiconductors-Properties, carrier concentration in intrinsic semiconductors. Carrier concentration in n type and p type semiconductors, Material preparation – Czochralski’s technique and zone refining technique, Hall effect – Hall coefficient in extrinsic semiconductors, experimental determination of hall coefficient, Application of hall effect, Semiconductor devices – LDR, LED, photodiode, Solar cells and LCD.

Unit III: Dielectric Materials and Devices
Qualitative study of various polarization, Electric dipole moment determination, Effect of temperature and frequency on dielectric constant, Dielectric loss, Ferroelectric materials classification – $BaTiO_3$ and PZT-Piezoelectric materials, Applications of ferroelectric and piezoelectric materials, Breakdown mechanism, Classification of insulating materials on temperature basis.

Unit IV: Magnetic Materials and Devices
Ferro and Ferri magnetic materials – properties , Helesenberg and domain theory of ferromagnetism, Hystersis ferrite- structure and properties , Applications – floppy disks, CD ROM, Magnetic optical recording.

Unit V: Advanced Materials

Nano phase materials - Synthesis techniques, properties, applications, Shape memory alloys-Characteristics, properties of NiTi alloy, applications in MEMs, Superconductivity, Types of superconductors – High Tc superconductors, Comparison with low Tc superconductors, Application of superconductors, Metallic glasses – preparation , properties, applications.

Textbooks

1. William D Callister Jr, " Material Science and Engineering", John Wiley and Son, New York 2006.
2. Leonid V Azaroff and James J Brophy, "Electronic Processors in Materials", McGraw Hill Company Limited, New York, 1991.

References

1. Jayakumar S, "Material Science", R.K. Publishers, Coimbatore 2007
2. Palanisamy P K, "Material Science", SCITECH Publications, Chennai 2002.
3. Srivatsava J.P, "Elements of Solid State Physics", Prentice Hall of India, New Delhi, 2001.

EE277 MICROPROCESSORS AND MICROCONTROLLERS LABORATORY

Credit: 0:0:2

12 Experiments will be notified by the HOD from time to time

EE278 C++ AND DATA STRUCTURES LABORATORY

Credits 0:0:2

12 Experiments will be notified by the HOD from time to time

EE279 ELECTRONIC CIRCUITS LABORATORY

Credit: 0:0:2

12 Experiments will be notified by the HOD from time to time.

EE280 LINEAR AND DIGITAL IC LABORATORY

Credit: 0:0:2

12 Experiments will be notified by the HOD from time to time.

EE 281 DC MACHINES AND TRANSFORMERS LABORATORY

Credit 0: 0: 1

10 Experiments will be notified by the HOD from time to time.

EE282 AC MACHINES AND CONTROLS LABORATORY

Credit 0: 0: 1

10 Experiments will be notified by the HOD from time to time.

EE 283 POWER ELECTRONICS LABORATORY

Credit 0: 0: 1

10 Experiments will be notified by the HOD from time to time.

EE 284 COMPUTER AIDED ELECTRICAL MACHINE DESIGN LAB

Credit 0: 0: 1

10 Experiments will be notified by the HOD from time to time.

EE 285 COMPUTER AIDED POWER SYSTEMS ANALYSIS LABORATORY

Credit 0: 0: 1

10 Experiments will be notified by the HOD from time to time.

EE 286 CIRCUITS AND DEVICES LAB

Credit 0: 0: 1

10 Experiments will be notified by the HOD from time to time.

EE 287 LINEAR ICS AND MEASUREMENTS LABORATORY

Credit 0: 0: 1

10 Experiments will be notified by the HOD from time to time.

EE 288 ELECTRICAL WORKSHOP PRACTICE

Credit 0: 0: 1

10 Experiments will be notified by the HOD from time to time.

EE 289 LECTRONIC CIRCUITS AND DIGITAL LABORATORY

Credit 0: 0: 1

10 Experiments will be notified by the HOD from time to time.

EE 290 DESIGN LABORATORY

Credit 0: 0: 1

10 Experiments will be notified by HOD from time to time.

EE 291 DIGITAL SIGNAL PROCESSING LABORATORY

Credit 0: 0: 1

10 Experiments will be notified by HOD from time to time.

EE 292 MICROPROCESSORS AND MICROCONTROLLERS LABORATORY

Credit 0: 0: 1

10 Experiments will be notified by HOD from time to time.

EE293 ILLUMINATION ENGINEERING

Credits 4:0:0

Pre requisite: Basic Electrical Engineering

Unit I: Language of Light & Lighting
Eye & vision, Light & Lighting, Light & Vision, Light & Color , Basic Concepts and Units, Photometry and Measurement, Quantity and Quality of Lighting.

Unit II: Accessories
Light sources: Daylight, Incandescent, Electric discharge, Fluorescent, Arc lamps, Lasers, Neon signs, LED-LCD displays, Luminaries, Wiring, Switching & Control circuits.

Unit III: Calculation and Measurement
Polar curves, Effect of voltage variation on efficiency and life of lamps, Lighting calculations, Solid angle, Inverse square and cosine laws, Illumination from point, line and surface sources. Photometry and Spectro -photometry, photocells.

Unit IV: Interior Lighting
Lighting design procedure for Industrial, Residential, Office, Departmental stores, Indoor stadium, Theaters and Hospitals.

Unit V: Exterior Lighting
Environment and glare, Lighting Design procedure for Flood, Street, Aviation and Transport lighting, Lighting for Displays and Signaling.

Text Books

1. Joseph B. Murdoch, "Illumination Engineering From Edison's Lamp to the Laser", Visions Communications , Washington DC, USA, 2nd Edition, 1994.
2. Jack L. Lindsey, "Applied Illumination Engineering", Prentice Hall of India, New Delhi, 2nd Sub Edition, May 1997.

References

1. Marc Schiler, "Simplified Design of Building Lighting", John Wiley and Sons, 1992
2. IES Lighting Handbook, 8th Edition, 1993

EE294 AUTOMOTIVE ELECTRONICS

Credits 4:0:0

Pre Requisites: Basic Electrical Engineering
Basic Electronics

Unit I: Sensors and Actuators
Introduction, Basic sensor arrangement, types of sensors such as - oxygen sensors, Crank angle position sensors - Fuel metering / vehicle speed sensor and detonation sensor - Altitude sensor, flow sensor. Throttle position sensors, Solenoids, Stepper motors, Relays.

Unit II: Starting System
Condition at Starting, Behavior of starter during starting. Series motor and its Characteristics. Principle & construction of starter motor. Working of different starter drive units, care & maintenance of starter motor. Starter switches.

Unit III: Electronic Fuel Injection and Ignition Systems
Introduction, Feed back carburetor systems (FBC) Throttle body injection and multi port or point fuel injection, Fuel injection systems, injection system controls. Advantages of electronic ignition systems. Types of solid state ignition systems and their principle of operation, Contact less electronic ignition system, Electronic spark timing control.

Unit IV: Lighting System & Accessories
Insulated & earth return systems. Positive & negative earth systems. Details of Head light & Side light. Head light dazzling & preventive methods. Electrical Fuel Pump, Speedometer, Fuel, Oil & Temperature gauges, Horn, Wiper system, Trafficator.

Unit V: Digital Control Systems
Current trends in modern Automobiles- Open loop and closed loop control systems - Engine cranking and warm up control - Acceleration enrichment - Deceleration leaning and idle speed control. Distributor less ignition - Integrated engine control system, Exhaust emission control engineering. Advanced suspension, electronically controlled electric power steering, 4-wheel steering and electronically controlled electric brakes.

Text Books

1. Judge. A.W., " Modern Electrical Equipment of Automobiles", Chapman & Hall, London, 1992.
2. Young. A.P. and Griffiths.L., " Automobile Electrical Equipment", English Languages Book Society & New Press, 1990.

References

1. William B.Ribbens, "Understanding Automotive Electronics", Butterworth, Heinemann Woburn, 6th Edition, 2003.
2. James D. Halderman and Chase D. Mitchell "Diagnosis and Troubleshooting of Automotive

Electric, Electronic, and Computer Systems" ,4th Edition, Prentice Hall ,2006.
3. James D. Halderman and Chase D. Mitchell, "Automotive Electricity and Electronics", Prentice Hall of India, New Delhi ,2004.

EE 295 NETWORK ANALYSIS AND SYNTHESIS

Credits 3:1:0

Unit I: S-Domain Analysis
S-domain network -driving point and transfer impedances and their properties -transform network analysis -poles and zeros of network functions -time response from pole-zero plots.
Unit II: Frequency Domain Analysis
Amplitude and Phase Characteristics from pole zero plot- Responses due to exponential and sinusoidal sources- Magnitude and phase plots for RL & RC networks- Complex Loci for RL & RC and RLC networks- Plots based on s-plane phasors.

Unit III: Network Topology
Network graph, Tree, incidence matrix – fundamental cut-sets and fundamental loops -tie set and cut-set schedules -v-shift and I-shift - Formulation of equilibrium equation on loop basis and node basis, Formulation of equilibrium equation in matrix form- Duality, Construction of a dual of a network.

Unit IV: Two-Port Networks & Filters
Characterization of two-port networks in terms of z, -y, h-and T, g and inverse T - parameters -Relations between network parameters- Network Equivalents -Analysis of T, π , ladder, bridged- T and lattice networks -Transfer function of terminated two-port networks.
Filters and attenuators -Design of constant -k, m-derived and composite filters
Design of symmetrical and asymmetrical attenuators (T and π)

Unit V: Elements of Network Synthesis
Realisability of one-port network -Hurwitz polynomials and properties -p. r. functions and properties -synthesis of RL, RC and LC one-port networks.

Text Book
1. Kuo. F.F., "Network Analysis and Synthesis", Wiley International Edition, New Delhi, 2nd Edition, 1966.

References
1. Paranjothi,S.R., "Electric Circuit Analysis", New age International Publishers Limited, New Delhi
2. 2nd Edition, 2000.
3. Sudhakar, A., and Shyammohan, "Circuits and Networks Analysis and Synthesis", Tata Mc Graw- Hill Publishing Company Limited, New Delhi, 1994.
4. M.L.Soni and J.C.Gupta, "A Course in Electrical Circuit Analysis", Dhanapat Rai & Sons Limited, New Delhi, 3rd Edition 1981.
5. Umesh Sinha, "Network Analysis and Synthesis", Sataya Prakasan Publishers Limited, New Delhi, Fifth edition , 1992.

6. Sivanandam.S.N., “Electric Circuit Analysis”, Vikas Publishing House Private Limited, New Delhi, 2001

EE296 ELECTRICAL ENGINEERING

Credit: 3:1:0

Unit I: Electric Circuits

Electrical quantities: Voltage, Current, Power and Energy, Elements: Resistance, Inductance and Capacitance- Simple Resistive Circuits- Ohm’s Law - Kirchoff’s Laws- Generation of alternating EMF – Equations of alternating voltage and current- parameters of alternating quantity, Power factor- Mesh Analysis, Node Analysis.

Unit II: Circuit Theorems and Resonance

Superposition theorem - Thevenin's theorem. -Norton's theorem - Maximum power transfer theorem - Millman's theorem- Series resonance and parallel resonance - bandwidth and Q factor, Coupled Circuits.

Unit III: Electrical Machines

Electromechanical energy conversion principles-Basic Concepts in Rotating Machines, DC Motors- Construction, Operating Principle, Types and Applications – Three Phase induction motors (squirrel cage and slip ring)- Construction, Operating Principle and Applications- Stepper Motors- Servo Motors (DC and AC)- Universal Motor- Reluctance Motor- Hysteresis Motors- Construction, Operating Principle and Applications – Transformers (Single Phase and Three Phase) - Construction, Operating Principle and Applications.

Unit IV: Light & Lighting

Eye & Vision, Light & Lighting, Light & Vision, Light & Color , Basic Concepts and Units, Quantity and Quality of Lighting- .Light sources: daylight, incandescent, electric discharge, fluorescent, arc lamps, lasers, neon signs, LED-LCD displays, Luminaries, wiring, switching & control circuits.

Unit V: Wiring Circuits, Instruments and Power Conditioning Equipments

Domestic wiring – accessories – types – staircase wiring – fluorescent tube circuits – simple layout – earthing – Voltmeters – Ammeters – Wattmeter – CRO – RPS – UPS.

References

1. Arumugam M and Premakumaran N, Electric Circuit Theory, Khanna Publishers, New Delhi , 2006.
2. Theraja B.L and Theraja B.L, Electrical Technology- Volume II (AC & DC Machines)’ , S. Chand & Company Ltd., New Delhi, 2003.
3. Joseph B. Murdoch, Illumination Engineering From Edison's Lamp to the Laser, Visions Communications , Washington DC, USA,1994
4. Jack L. Lindsey, Applied Illumination Engineering, Prentice Hall, 1997
5. Sawhney A.K, A Course in Electrical and Electronics Measurements and Instrumentation, Dhanpat Rai & Co., (Pvt) Ltd., 2000.

EE328 POWER SEMICONDUCTOR DEVICES

Credit :4:0:0

Unit I: **Introduction**

Status of Development of power semiconductor Devices - Types of static switches - Controlled and uncontrolled - Ideal and real switches - Static and dynamic performance - Use of heat sinks - Switching losses. Power Diodes: Types - Electrical rating - Switching and steady state characteristics - switching aid circuits - Series and parallel operation - Schotky diodes - Fast recovery diodes.

Unit II: **Thyristors**

Physics of device operation - Electrical rating - Switching and steady state characteristics - Gate circuit requirements - Protection - Series and parallel operation - Driver circuit - Types of Thyristors: Asymmetrical Thyristor - Reverse conducting Thyristor - light fired Thyristor - switching losses.

Unit III: **Special Types of Thyristors**

TRIACs, GTOs and MCTs: Electrical rating - Switching and steady state characteistics - protection - Gate circuit requirements-Turn ON and Turn OFF methods – Series, Parallel operation of GTO Thyristors.

Unit IV: **Power Transistors & Power Mosfets**

Types - Ratings - Static and switching characteristics - Driver circuit - Switching aid circuit - Power Darlington. Power MOSFETS: Types - Comparison with BJTs - Structure - Principle of operation - Switching losses - Driver circuit - Switching aid circuit.

Unit V: **Igbts & Emerging Devices**

Comparison with power BJT and MOSFET - Structure, Principle of working - Switching characteristics - Gate drive requirements. Emerging Devices: SITs-characteristics - Power Integrated circuit - Characteristics - Field Controlled Thyristors - New semiconductor materials for devices - Intelligent power modules.

References

1. Williams, B.W, “ Power Electronic Devices, Applications and Passive Components”, ELBS Oxford University Press, London, 1992
2. Joseph Vithayathil, “Power Electronics :Principles and Applications”, McGraw – Hill Publishing Company Limited, New York, 1995.
3. Ned Mohan, et.al., “Power Electronics converters, Applications and Design”, Third edition, JohnWiley and Sons, New York, 2002.
4. Muhammad H. Rashid, “Power Electronics - Circuits, Devices and Applications”, Academic Press, 2nd Edition, 2006
5. Muhammad H. Rashid, “Power Electronics Hand Book”, Academic Press, 1st Edition, 2001.

EE329 POWER ELECTRONICS – I

Credit :3:1:0

Unit I : **Single Phase Controlled Rectifiers**

Half controlled and Fully controlled thyristor bridge converters -R, RL and RLE loads - Continuous and discontinuous current operations- Evaluation of performance parameters-Harmonics, ripple and input power factor.

Unit II: **Three Phase Controlled Rectifiers**
Half controlled and Fully controlled thyristor bridge converters -R, RL and RLE loads - Continuous and discontinuous current operations- Evaluation of performance parameters - Harmonics, ripple and input power factor.

Unit III: **Performance**
Effects of source inductance- Power factor improvement techniques - twelve pulse converters - Dual converters - Design of converter circuits.

Unit IV: **Inverters**
Single phase and three phase bridge inverters with R, RL and RLE loads - Voltage control - Harmonic reduction - Rectifier mode of operation - Current source inverters - Inverter Circuit Design.

Unit V: **Resonant Pulse Converters**
Series and parallel resonant inverters - Zero current and Zero voltage switching resonant converters - Two quadrant zero voltage switching resonant converters - Resonant dc link inverters

References:

1. Muhammad H. Rashid, "Power Electronics - Circuits, Devices and Applications", Academic Press, 2nd Edition, 2006.
2. Ned Mohan, et.al, "Power Electronics converters, Applications and Design", John Wiley and sons, New Jersey, 3rd Edition 2002.
3. Joseph Vithayathil, "Power Electronics :Principles and Applications", McGraw Hill Inc., New York, 1995.
4. Vedam Subrahmanyam, "Power Electronics", New Age International (P) Limited, New Delhi, Revised 2nd Edition, 2006.
5. Muhammad H. Rashid, "Power Electronics Hand Book", Academic Press, 1st Edition, 2001.

EE330 POWER ELECTRONICS – II

Credit :3:1:0

Unit I: **Dc Choppers**
Step down DC Chopper with R, RL and RLE loads - Control strategies - Continuous and discontinuous current operations.

Unit II: **Dc Choppers**
Two quadrant and Four-quadrant DC Chopper - Multiphase DC Chopper - Switching Mode Regulators: Buck, Boost, Buck-Boost and Cuk regulators - Chopper circuit design.

Unit III: **Ac Voltage Controllers**
Principles of on-off control and phase control - Single-phase half and full wave controller with R, RL and RLE loads - Three phase half wave and full wave controllers.

Unit IV: **Ac Voltage Controllers**
Single-phase transformer tap changers - AC voltage controllers with PWM control (AC chopper) - Design of ac voltage controller circuits - Effects of source inductance.

Unit V: **Cyclo Converters**

Principle of operation - Envelope and phase controlled Cyclo converters - Single phase and three phase versions - Circulating current and circulating current free mode of operation - Effect of source inductance - Advantages and disadvantages of Cyclo converters.

References

1. Muhammad H. Rashid, "Power Electronics - Circuits, Devices and Applications", Academic Press, 2nd Edition, 2006.
2. Ned Mohan, et.al., "Power Electronics converters, Applications and Design", John Wiley and sons, New York, 3rd Edition, 2002.
3. Joseph Vithayathil, "Power Electronics - Principles and Applications", McGraw Hill Inc., New York, 1995.
4. Vedam Subrahmanyam, "Power Electronics", New Age International (P) Limited., New Delhi, Revised 2nd Edition, 2006.
5. Muhammad H. Rashid, "Power Electronics Hand Book", Academic Press, 1st Edition, 2001.

EE331 LINEAR SYSTEMS

Credit :3:1:0

Unit I: **State Space Analysis**

Limitations of conventional control theory - Modern control theory: Concepts of state, state variables and state model - State model for linear time invariant systems: State space representation using physical - Phase and canonical variables - Solution of state equation - State transition matrix.

Unit II: **Decomposition Methods**

Transfer function from state model - Transfer matrix - Decomposition of transfer functions: Direct, cascade and parallel decomposition techniques.

Unit III: **State Space Representation for Discrete System**

State space representation of linear time invariant discrete time systems - Solution of discrete time state equation. - Discretization of continuous time state equations. Eigen Values And Eigen Vectors: Characteristic equation, Eigen values, Eigen vectors - Invariance of Eigen values - Diagonalization - Jordan canonical form .

Unit IV: **Concepts of Controllability and Observability**

Kalman's and Gilbert's - Controllable and observable phase variable forms - Effect of pole-zero cancellation on controllability & observability. State Estimators: Pole placement by state feedback - State estimators -Open loop and asymptotic state estimators

Unit V: **Liapunov Stability Analysis**

Stability in the sense of Liapunov - Definiteness of Scalar Functions - Quadratic forms - Second method of Liapunov - Liapunov stability analysis of linear time invariant system.

References

1. Katsuhiko Ogata, "Modern Control Engineering", Prentice Hall of India Private Limited., New Delhi, 3rd Edition, 1998.
2. Nise S. Norman, "Control Systems Engineering", John Wiley & Sons Inc, New Delhi, 3rd Edition, 2000.

3. Nagrath I.J, & Gopal M, “Control System Engineering”, New Age International Publishers Limited, New Delhi, 5th Edition, 2007

EE332 SOLID STATE DC DRIVES

Credit :3:1:0

Unit I: **Review of Conventional Dc Drives**

Methods of speed control of DC motors – Methods of braking of series and separately excited DC motor – Ward-Leonard Speed control – Models and transfer function of series and separately excited DC motor.

Unit II: **Converter Control of Dc Motors**

Analysis of series and separately excited DC motor with single phase and three phase converters operating in different modes and configurations – Evaluation of Performance Parameters – Power factor improvement – Dual converters fed DC Drives – Reversible DC Drives – Braking in phase-controlled drives – Problems in Converter fed DC Drives.

Unit III: **Chopper Control of Dc Motors**

Analysis of series and separately excited DC motors fed from Single Quadrant Choppers – Evaluation of Performance Parameters – Two Quadrant and Four Quadrant Chopper controlled Drives.

Unit IV: **Design of Converter Fed Dc Drives**

Closed Loop Speed Control – Motor Transfer Function – P, PI & PID Controllers – Current Control – Load Torque Disturbance – Phase-Locked Loop (PLL) Control – Harmonics and associated problems – Digital controller and Firing circuits - Simulation.

Unit V: **Intelligent Controllers for Dc Drive**

Fuzzy – Neuro – Neuro-Fuzzy controllers – Processor based Control.

References

1. Sen, P.C., “Thyristor D. C. Drives”, Krieger Publishing Company, 1991.
2. Krishnan, R., “Electric Motor Drives – Modeling, Analysis and Control”, Prentice Hall of India Private Limited., New Delhi, 2003.
3. Vedam Subrahmanyam, “Electric Drives – Concepts and Applications”, Tata McGraw- Hill, Publishing Company Limited., New Delhi, 2001.
4. Leonhard Werner, “Control of Electrical Drives”, Springer –Verlag, 3rd Edition, 2003.
5. Dubey G.K, “Fundamentals of Electrical Drives”, Narosa Publishing House, New Delhi, 2001.
6. Muhammad H. Rashid, “Power Electronics Hand Book”, Academic Press, 1st Edition, 2001.

EE333 SOLID STATE AC DRIVES

Credit :3:1:0

Unit I: **Induction Motor: Stator Voltage Control**

Adjustable speed drives – Torque-Slip characteristics - Operation with different types of loads – Performance – Equivalent circuit of IM, Closed loop speed control & Speed reversal – NEMA classification & Design of SQIM – Load characteristics – Transient Stability – Choice of drives - Comparison of different AC power controllers – Production of Stator Flux (RMF).

Unit II: **Induction Motor: Stator Frequency Control**
Operation of Induction Motor with non- sinusoidal supply waveforms – Air gap MMF harmonics – Harmonic behavior of IM – Constant volt and variable frequency operation of 3-phase Induction Motors - Constant flux operation - Current fed operations – Constant torque, constant power, high speed motoring – Stator current control - Dynamic and regenerative braking of CSI and VSI fed drives - Principle of vector control.

Unit III: **Induction Motor: Rotor Resistance Control & Slip Power Recovery Schemes**
Torque-Slip characteristics with mechanical rotor resistance control – Static rotor resistance control - Torque Equations - Closed loop operation -Constant torque operations – TRC strategy - Combined stator voltage control and rotor resistance control. Slip Power Recovery Scheme: Torque equation - Torque-Slip characteristics - Power Factor considerations - Sub-synchronous and Super-synchronous operation - Closed loop control – Static Kramer and Scherbius Drive – Four-quadrant sub-synchronous cascade with DC dynamic braking.

Unit IV: **Synchronous Motor Drives**
Introduction – Control of Synchronous Motors on Fixed Frequency and Variable Frequency Supply – Voltage Source Inverter (VSI) fed Drive – Cycloconverter fed Drive – Load Commutated Thyristor Inverter fed Drive – Current Source Inverter (CSI) fed Drive.

UnitV: **Permanent Magnet Ac Motor Drives (Pmac) & Applications Of Ac Drives**
Introduction – Sinusoidal PMAC Motor Drives – Brushless DC (Trapezoidal PMAC) Motor Drives -
Applications of AC Drives: Sugar Mills – Centrifugal Pumps – Turbo compressor.

References

1. Dubey, G.K., "Fundamentals of Electrical Drives", Narosa Publishing House, New Delhi, 2nd Edition, 2001.
2. Sheperd, W. and Hully, L.N., Liang, "Power Electronics and Motor Control", Cambridge University Press, Cambridge, 2nd Edition, 1998.
3. Subrahmanyam, V., "Thyristor Control of Electric Drives", Tata McGraw- Hill Publishing Company. Limited., New Delhi, New Edition, 2003.
4. Dubey, G.K., "Power Semiconductor Controlled Drives", Prentice Hall International, New Jersey, 1989.
5. Subrahmanyam, V., "Electric Drives", Tata McGraw- Hill Publishing Company Limited., New Delhi, 1994.
6. Singh M.D., Khanchandani, K.B., "Power Electronics", Tata Mc Graw -Hill Publishing Company Limited., New Delhi, New Edition, 2004.

EE334 ADVANCED DIGITAL SIGNAL PROCESSING

Credit :4:0:0

Unit I: **Review of Discrete Time Systems**
Discrete time Signals-Sequences –Stability and Causality –Frequency domain Representation of Discrete time Systems and Signals –Two-dimensional Sequences and Systems –Z-Transform –Z- Transform Theorems and Properties –Two-dimensional Z-Transform. Structures for discrete time system – Direct, cascade and parallel forms – Lattice structure.

Unit II: **Discrete Fourier Transform**
Representation of Periodic Sequences-the Discrete Fourier Series –Properties of the discrete Fourier series –Sampling, Z-transform –discrete Fourier transform –properties of discrete Fourier Transform –Linear Convolution –Decimation –in- Time and Decimation-in- Frequency –FFT Algorithms.

Unit III: **Digital Filter Design Techniques**
Introduction – Design of IIR Digital Filters from Analog Filters –Analog –Digital Transformation –Properties of FIR Digital Filters –Design of FIR Filters Using Windows –A Comparison of IIR and FIR Digital Filters.

Unit IV: **Finite Register Length Effects**
Introduction - Effects of coefficient on Quantization –Quantization in Sampling - Analog Signals - Finite Register Length effects in realizations of Digital Filters - discrete Fourier Transform Computations.

Unit V: **Introduction to Digital Signal Processors**
Commercial DSP devices – TMS C240 processor and ADSP 2181 processor – Architecture – Addressing modes – Program control – Instruction and programming – Simple programs.

References

1. Emmanuel C. Ifeachor, Barrie W. Jervis, “Digital Signal Processing: A Practical Approach”, Pearson Education India Series, New Delhi, 2nd Edition,2004
2. Sanjit K Mitra, “ Digital Signals Processing: A Computer Based Approach”, Tata McGraw- Hill
   Publishing Company Limited, 2nd Edition, 2004.
3. Alan Oppenheim. V and Ronald W.Schafer, “Digital Signal Processing”, Prentice Hall of India
   Private. Limited., New Delhi, 1989.
4. John G. Proakis and Manolakis. D.G, “Digital Signal Processing: Principles Algorithms and
   Applications,” Prentice Hall of India, New Delhi, 2004.
5. Oppenheim. V and Ronald W.Schafer, “Discrete Time Signal Processing”, Prentice Hall of India Private Limited., New Delhi, 2001.

6. Avatar Singh and Srinivasan. S , " Digital Signal Processing: Implementation using DSP Microprocessors with Examples from TMS 320C54XX, Thompson Brooks/Cole, 2004.

EE335 SIMULATION OF POWER ELECTRONIC SYSTEMS

Credit :3:1:0

Unit I: **Introduction**
Need for simulation - Challenges in simulation - Classification of simulation programs - Overview of PSpice, MATLAB and SIMULINK. Mathematical Modelling of Power Electronic Systems: Static and dynamic models of power electronic switches - Static and dynamic equations and state space representation of Power Electronic systems.

Unit II: **Pspice**
File formats - Description of circuit elements - Circuit description - Output variables - Dot commands - SPICE models of Diode, Thyristors, Triac, BJT, Power MOSFET, IGBT and Power S-Functions - Converting S-Functions to blocks.

Unit III: **Matlab and Simulink**
MATLAB – Intro Variables – Matrix representation and operation, Trigonometric functions, Logical relations, Exponential Complex Numbers – m file – Function – For loop – While – If else. Graphics – 2D Plots. SIMULINK: Intro – Basic Block – Sources and Sinks model analysis using SIMULINK - S-functions - converting S-functions to blocks.

Unit IV: **Introduction to Psim**
General Information – Power Circuit Components – Control Circuit & Other Components – Analysis specification – Circuit Schematic Design – Waveform Processing – Error and Warning messages.

Unit V: **Simulation Using Pspice, Psim, Matlab and Simulink**
Diode rectifiers - controlled rectifiers - AC voltage controllers - DC choppers - PWM inverters - voltage source and current source inverters - Resonant pulse inverters - Zero current switching and zero voltage switching inverters.

References
1. Rashid, M.H., "SPICE for Power Electronics and Electric Power", CRC Press, 2nd Edition, 2006
2. Ned Mohan, "Power Electronics, Computer Simulation Analysis and Education using PSPICE", Minnesota Power Electronics Research and Education, USA, 1992
3. Chee-Mun-Ong, "Dynamic simulation of Electric Machinery using MATLAB/SIMULINK", Prentice Hall Private Limited, New Jersey, 1998.
4. "The PSPICE User's Guide", Microsim Corporation, California,1996.
5. "The SIMULINK User's Guide", Math works Inc, 1994
6. " PSIM User's Guide", Powersim Inc., 2006.

EE336 POWER ELECTRONICS APPLICATIONS TO POWER SYSTEMS

Credit :3:1:0

Unit I: **Introduction**
High power devices for power system controllers - Characteristics - Converters configurations for large power control-Single and three phase converters: Properties - Current and voltage harmonics - Effects of source and load impedance - Choice of best circuit for power systems.

Unit II: **Converter Control**
Gate control - Basic means of control - Control characteristics - Stability of control - Reactive power control - Power flow analysis: Component models - Converter model - analysis of converter - Transient and dynamic stability analysis – protection.

Unit III: **Wind Energy Conversion System**
Basic components - Generator control - Harmonics - Power factor improvement. PV Conversion Systems: Different schemes - DC and AC power conditioners - Synchronized operation with grid supply.

Unit IV: **Hvdc Systems**
Application of converters in HVDC systems - Static VAR control - Sources of reactive power - Harmonics and filters

Unit V: **Facts**
Concept of Flexible AC Transmission System (FACT) - Static VAR compensators - Thyristor Controlled Reactor - Thyristor Switched Capacitor - Static Condenser - Controllable Series Compensation.

References

1. Padiyar. K.R., ”HVDC Power Transmission System- Technology and System Interaction”, New Age International Private Limited, New Delhi, Reprint 2002.
2. Erich Uhlmann, “Power Transmission by Direct Current”, Springer International Edition, 1st Indian Reprint 2004.
3. Rai, G.D., “Solar Energy Utilization”, Khanna Publishers Limited, New Delhi, 1997.
4. Kimbark, E.X., “Direct Current Transmission”, Wiley Interscience, New York, 1971.
5. Rao, S.,”EHVAC and HVDC Transmission”, Khanna Publishers Limited, New Delhi, 1991.

EE337 NEURO-FUZZY CONTROLLERS FOR ELECTRIC DRIVES

Credit :4:0:0

Unit I: **Introduction to Neural Network**
Introduction - Biological neurons and their artificial models - Learning, adaptation and neural network's learning rules - Types of neural networks- Single layer, multiple layer- Feed forward, feedback networks; Back propagation -Learning and training -Hopfield network.

Unit II: **Neuro Controller**
Neural network. for non-linear systems -Schemes of Neuro control- System identification forward model and inverse model- Indirect learning neural network control applications.

Unit III: **Introduction to Fuzzy Logic**
Fuzzy sets- Fuzzy operation -Fuzzy arithmetic -Fuzzy relations- Fuzzy relational equations -Fuzzy measure -Fuzzy functions -Approximate reasoning -Fuzzy propositions - Fuzzy quantifiers - if-then rules.

Unit IV: **Fuzzy Controller**
Structure of fuzzy logic controller -Fuzzification models- Data base -Rule base –inference engine defuzzification module - Non-linear fuzzy control-PID like FLC- sliding mode FLC -Sugeno FLC -adaptive fuzzy control - Fuzzy control applications.

Unit V: **Applications to Electric Drives**
Neuro controllers for AC Drives - Fuzzy Controllers for AC Drives – Hybrid Neuro-Fuzzy Controllers for BLDC motors – Adaptive Neuro – Fuzzy Controllers for Switched Reluctance Motor Drives.

References

1. Jacek M Zurada, "Introduction to Artificial Neural Systems", Jaico Publishing House, New Delhi, 2001.
2. Timothy Ross, "Fuzzy Logic with Engineering Applications", McGraw- Hill International Editions, Singapore, 1998.
3. Laurene Fausett, "Fundamentals of Neural Networks", Pearson Education of India, New Delhi, 2004.
4. Driankov, Hellendroon, "Introduction to Fuzzy Control", Narosa Publishers Limited, New Delhi.
5. Sivanandam S.N., Sumathi. S and Deepa S.N., "Introduction to Neural Networks using MATLAB 6.0", Tata Mc Graw-Hill Publishing Company Limited, New Delhi, 2006.
6. Sivanandam S.N., Sumathi. S and Deepa S.N., "Introduction to Fuzzy Logic using MATLAB 6.0", Springer Verlag Publisher, Germany, 2007.

EE338 GENERALISED THEORY OF ELECTRICAL MACHINES

Credit :3:1:0

Unit I: Generalised Theory
Conversions - Basic two pole machines - Transformer with movable secondary - Transformer voltage and speed voltage - Kron's primitive machine - Analysis of electrical machines.

Unit II: Linear Transformations
Invariance of Power - Transformations from displaced brush axis, three phases to two phase, Rotating axes to stationary axes-Transformed impedance matrix - Torque calculations.

Unit III: Dc Machines

Generalized Representation - Generator and motor operation - Operation with displaced brushes - Steady state and transient analysis - Sudden short circuit - Sudden application of inertia load - Electric braking of DC motors.

Unit IV: Ac Machines
Synchronous Machines: Generalized Representation - Steady state analysis - Transient analysis - Electromechanical transients. Induction Machines: Generalized representation-performance equation - steady state analysis - Transient analysis - Double cage machine - Harmonics - Electric braking.

Unit V: Special Machines
Generalized Representation and steady state analysis of Reluctance Motor – Brushless DC Motor – Variable Reluctance Motor – Single phase series motor.

References

1. Bimbhra P.S., "Generalized Circuit Theory of Electrical Machines", Khanna Publishers Limited, 5th Edition, 4^{th} Reprint, New Delhi, 2000.
2. Adkins B., "The General Theory of Electrical Machines", John Wiley & Sons, New Jersey,1980.
3. Seely S., "Electro-Mechanical Energy Conversion", McGraw –Hill Publishing Company Limited, New York, 1966.

EE339 COMPUTER AIDED DESIGN OF ELECTRICAL MACHINES

Credit :3:1:0

Unit I: Introduction
Conventional design procedures -Limitations -Need for field analysis based design.

Unit II: Mathematical Formulation of Field Problems
Development of torque/force -Electromagnetic Field Equations -Magnetic Vector/Scalar potential -Electrical Vector/Scalar potential- Stored energy in field problems – Inductances -Laplace and Poisson's Equations -Energy functional- Principle of energy conversion.

Unit III: Finite Element Method
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
Elements of a CAD System -Preprocessing -Modelling -Meshing -Material properties -Boundary Conditions -Setting up solution -Postprocessing.

Unit V: Design Applications
Design of Solenoid Actuator -Induction Motor -Switched Reluctance Motor – Synchronous Machines.

References

1. Silvester and Ferrari, “Finite Elements for Electrical Engineers” Cambridge University press, Third Edition,1996.
2. Hoole S.R.H, “Computer- Aided, Analysis and Design of Electromagnetic Devices”, Elsevier, New York, Amsterdam, London, 1989.
3. Lowther D.A. and Silvester P.P, “Computer Aided Design in Magnetics”, Springer Verlag, New York, 1986.
4. Salon. S.J, “Finite Element Analysis of Electrical Machines”, Kluwer Academic Publishers, London,1995.
5. Trowbridge C.W, “An Introduction to Computer Aided Electromagnetic Analysis” Vector Field Limited, 1990.
6. User Manuals of “MAGNET”, “MAXWELL & ANSYS” - Software Packages.

EE340 ADVANCED ELECTRIC DRIVES AND CONTROLS

Credit :3:1:0

Unit I: Introduction

Need for advanced controls - Principle factor affecting the choice of drive – Parameter identification techniques for electric motors – Electromagnetic compatibility of electric drives – Different options for an adjustable speed electric drive – Simulation of electrical drives – Advanced control strategies for electrical drives – DSP based control of electric drives.

Unit II: Dsp Controllers and Instruction Set

TMS 320 family overview – 320 C24X Series of DSP controllers – Architecture overview – C24X CPU internal bus structure – Memory – Central processing unit – Memory and I/O spaces – Overview of Memory and I/O spaces – Program control – Address modes – System configuration and interrupts – Clocks and low power modes – Digital input/output (I/O). Instruction set: Assembly language instructions – Instruction set summary – Instruction description – Accumulator, arithmetic and logic instructions – Auxiliary register and data page pointer instructions – TREG, PREG, and Multiply instructions – Branch instructions – Control instructions – I/O and memory instructions.

Unit III: Pwm Inveter Control

Inverter – Operation principle – Inverter switching – Unipolar – Bipolar – Inverter dead-time – inverter modulation – Different types – Sine Triangle – Analysis of Sine Triangle Modulation – Trapezoidal Modulation – Third harmonic Modulation – Analysis of Third Harmonic Modulation – Output filter requirement for different PWM techniques.

Unit IV: Space Vector Modulation

Concept of a Space Vector – dq0 Components for Three-phase sine wave source/1evel – dq0 Components for Voltage Source Inverter (VSI) operated in Square Wave Mode – Synchronously rotating reference frame – Space Vector Modulation (SVM) – Principle – SVM compared to regular sampled PWM Phase Lag reference for SVM – Naturally sampled SVM – Analytical solution for SVM – Harmonic losses for SVM – Placement of Zero Space Vector – Discontinuous Modulation – Phase Lag reference for discontinuous PWM.

Unit V: Neural Network and Fuzzy Controllers

Current and speed control of Induction Motor – Current control algorithm – Sensorless motion control strategy – Induction Motor Controller using VHDL design. Fuzzy Logic Control of a Synchronous Generator – System representation – VHDL Modelling – FPGA implementation.

References

1. Bimal K. Bose, "Power Electronics and Variable Frequency Drives – Technology and Applications", IEEE Press, 1997.
2. Grafame Holmes. D and Thomas A. Lipo, "Pulse Width Modulation for Power Converters – Principles and Practice", IEEE Press, 2003.
3. Peter Vas, "Vector Control of AC Machines", Oxford University Press, 1990.
4. Hamid A. Toliyat and Steven G.Campbell, "DSP based Electromechanical Motion Control", CRC Press 2004.
5. Ned Mohan, "Advanced Electric Drives: Analysis, Control and Modelling using SIMULINK", John Wiley & Sons Ltd., 2001.

EE341 SPECIAL MACHINES AND CONTROLLERS

Credit :4:0:0

Unit I: Stepper Motors

Constructional features, Principle of operation, Modes of excitation torque production in Variable Reluctance (VR) stepping motor, Dynamic characteristics, Drive systems and circuit for open loop control, Closed loop control of stepping motor.

Unit II: Switched Reluctance Motors

Constructional features, Principle of operation. Torque equation, Characteristics, Control Techniques, Drive Concept.

Unit III: Permanent Magnet Brushless Dc Motors

Commutation in DC motors, Difference between mechanical and electronic commutators, Hall sensors, Optical sensors, Multiphase Brushless motor, Square wave permanent magnet brushless motor drives, Torque and emf equation, Torque-speed characteristics, Controllers-Microprocessors based controller.

Unit IV: Permanent Magnet Synchronous Motors

Principle of operation, EMF, power input and torque expressions, Phasor diagram, Power controllers, Torque speed characteristics, Self control, Vector control, Current control schemes.

Unit V: Servomotors & Linear Motors

Servomotor – Types – Constructional features – Principle of Operation – Characteristics - Control – Microprocessor based applications. Linear Motors: Linear Induction Motor (LIM) Classification – Construction – Principle of operation – Concept of Current sheet – Goodness factor – DC Linear Motor (DCLM) types – Circuit equation – DCLM control applications.

References

1. Miller, T.J.E. "Brushless Permanent Magnet and Reluctance Motor Drives", Clarendon Press, Oxford, 1989.

2. Kenjo, T, “Stepping Motors and their Microprocessor control”, Clarendon Press, Oxford, 1989.
3. Naser A and Boldea I, “Linear Electric Motors: Theory, Design and Practical Application”, Prentice Hall Inc., New Jersey,1987
4. Floyd E Saner,”Servo Motor Applications”, Pittman USA, 1993.
5. Kenjo, T and Naganori, S “Permanent Magnet and brushless DC motors”, Clarendon Press, Oxford, 1989.

EE342 POWER ELECTRONICS IN WIND AND SOLAR POWER CONVERSION

Credit :4:0:0

Unit I: **Introduction**
Trends in energy consumption - World energy scenario - Energy sources and their availability - Conventional and renewable sources - need to develop new energy technologies.

Unit II: **Photovoltaic Energy Conversion**
Photovoltaic Energy Conversion: Solar radiation and measurement - solar cells and their characteristics - influence of insulation and temperature - PV arrays - Electrical storage with batteries - solar energy availability in India - Switching devices for solar energy conversion - Maximum power point tracking. DC Power conditioning converters - maximum power point tracking algorithms - AC power conditioners - Line commutated inverters - synchronized operation with grid supply - Harmonic problem – Applications

Unit III: **Wind Energy Conversion (Wec)**
Basic Principle of wind energy conversion - nature of wind - wind survey in India - Power in the wind - components of a wind energy - conversion system - Performance of induction generators for WECS - classification of WECS.

Unit IV: **Self-Excited & Grid Connected Wecs**
Self excited induction generator for isolated power generators - Theory of self-excitation - Capacitance requirements - Power conditioning schemes - Controllable DC Power from Self excited induction generators (SEIGs) - system performance. Grid Connected WECS: Grid connectors concepts - wind farm and its accessories - Grid related problems - Generator control - Performance improvements - Different schemes - AC voltage controllers - Harmonics and PF improvement .

Unit V: **Stand Alone Power Supply Systems**
Wind/solar PV integrated systems - Optimization of system components - storage - Reliability evolution- .

References

1. Rai, G.D., “Non-conventional Energy Sources”, Khanna Publishers Limited, New Delhi, 2002.
2. Rai, G.D., “Solar Energy Utilization”, Khanna Publishers Limited, New Delhi, 1997.
3. Mukund R Patel, “Wind and Solar Power Systems”, CRC Press, 2004.
4. Gray.L.Johnson, “Wind energy systems”, Prentice Hall Inc., Singapore, 1985.

5. Thomas Markvart and Luis Castaser, “Practical Handbook of Photo Voltaics”, Elsevier Publication, UK, 2003.

EE343 EMBEDDED CONTROLLER APPLICATIONS IN POWER ELECTRONICS

Credit :3:1:0

Unit I: Review of Microprocessors
Architecture and Programming of 8085 and 8086, A/D and D/A converters, Interfacing of 8253, 8255, 8155 and other interfacing ICs.

Unit II: Microprocessor Based Firing Scheme for Converters
Firing schemes for single phase and three phase rectifiers - 3-phase AC choppers, Firing at variable voltage and frequency environment, Firing scheme for DC choppers, voltage and current commutation, Inverters, PWM Techniques.

Unit III: Applications in Drives
Importance of measurement and sensing in closed loop control, Measurement of voltage, current, speed, power and power factor using microprocessors, Implementation of various types of controllers using microprocessors.

Unit IV: Applications of Power Electronics
Static excitation of synchronous generators, Solid State tap-changers for transformers, UPS systems, Induction furnace control.

Unit V: Arm Processor
Fundamentals: Register – Current Program Status Register – Pipeline – Exceptions, Interrupts, Vector Table – Core Extensions – Architecture Revisions – ARM Processor Families – ARM Instruction Set: Data Processing Instructions – Branch Instructions – Load-Store Instructions – Software Interrupt Instruction – Program Status Register Instructions – Loading Constants – ARMv5E Extensions – Conditional Execution.

References

1. Gaonkar R.S., “Microprocessor Architecture, Programming and Application with 8080/8085A”, WileyEastern Limited, New Delhi, 1991.
2. Hall, D. V, “Microprocessors and Interfacing”, McGraw-Hill Publishing Company, New Delhi, 1999.
3. Andrew N sloss Dominic Symes, “ARM System Developers Guide Designing and Optimizing System Software”, Margan Kaufmann Publishers, 2005.
4. Ned Mohan, Tore M. Undeland, William P. Robbins, “Power Electronics: Converters, Applications and Design”, John Wiley & Sons Inc, New Jersey, 3rd Edition, 2002.

EE344 HVDC TRANSMISSION

Credit :4:0:0

Unit I: Dc Power Transmission Technology
Historical development – HVAC and HVDC links – Comparison – Economic Technical Performance – Reliability – Limitations.

Unit II: Analysis of Hvdc Converters
Single and three phase converters – Analysis with gate control but no overlaps – With overlaps less than 60 degree – With overlap greater than 60 degree – Complete characteristics of rectifier and Operation of Inverter.

Unit III: Converter and Hvdc System Control
Basic means of Control – Gate Control – Power reversal – Constant Current Vs Constant Voltage – Control characteristics – Stability of Control – Frequency control – Multi terminal lines.

Unit IV: Misoperation of Converters & Protection
Converter disturbance - By pass action in bridge- Short circuit on a rectifier- Commutation failure Protection: Basics of protection- DC reactors- Voltage and current oscillations- Clearing line faults and re-energizing- Circuit breakers- Over voltage protection.

Unit V: Harmonics and Filters
Characteristics and uncharacteristic harmonics – Troubles due to harmonics – Means of reducing harmonics – Harmonic filters – Telephone interface.

References

1. Padiyar. K.R,"HVDC Power Transmission System- Technology and System Interaction", New Age International Private Limited, New Delhi, Reprint 2002.
2. Erich Uhimann, " Power Transmission by Direct Current", Springer International Edition, 1st Indian Reprint 2004.
3. Arrilaga J., "High Voltage Direct Current Transmission", Peter Peregrinus Limited, London, UK, 1983.
4. Narain G. Hingorani, "Understanding FACTS", IEEE Press, New York 2000.

EE345 ADVANCED TOPICS IN POWER ELECTRONICS

Credit :4:0:0

Unit I: **Resonant Converters**
Zero voltage and Zero current switching- Classification of Resonant converters- Basic Resonant circuit concepts-Load resonant converters-Resonant switch converters- Zero voltage switching, clamped voltage topologies- Resonant DC link inverters and Zero voltage switching- High frequency link integral half cycle converters- Application in SMPS and lighting.

Unit II: **Improved Utility Interface**
Generation of current harmonics- Current harmonics and power factor- Harmonics standards and recommended practices- Need for improved utility interface- Improved single phase utility interface-Improved three phase utility interface- Electromagnetic interference.

Unit III: **Facts and Custom Power**
Introduction-principles of reactive power control in load and transmission line compensation-Series and shunt reactive power compensation- Concepts of flexible AC

transmission system(FACTS)- Static Var Compensator(SVC)- Thyristor Controlled Reactor-Thyristor Switched Capacitor. Solid state power control- Static condensers- Controllable series compensation- Thyristor controlled phase angle regulator and unified power flow control

Unit IV: **Facts – Analysis & Protection**
Modelling and methods of analysis of SVC and FACTS controllers- System control and protection- Harmonics and filters- Simulation and study of SVC and FACTS under dynamic conditions.

Unit V: **Emerging Devices and Circuits**
Power Junction Field Effect Transistors- Field Controlled Thyristors- JFET based devices VS other power devices- MOS controlled Thyristors-Power Integrated Circuits-New semiconductor materials for power devices.

References

1. Muhammad H. Rashid, "Power Electronics - Circuits, Devices and Applications", Academic Press, 2nd Edition, 2006.
2. Mohan, M.et.al., "Power Electronics Converters, Applications and Design", John Wiley and Sons, New Jersey, 3rd Edition 2002.
3. Joseph Vithayathil, "Power Electronics - Principles and Applications", McGraw Hill Inc., New York, 1995.
4. Tagare D. M., " Reactive Power Management", Tata Mc Graw- Hill Publishing Company Limited, New Delhi, 2004.
5. Narain G. Hingorani, "Understanding FACTS", IEEE Press, New York, 2000.

EE346 OPTIMIZATION TECHINIQUES

Credit: 4:0:0

Unit I: **Introduction to Optimization**
Statement of Optimization problems – Classical optimization techniques – Single variable and multi variable optimization – Method of direct substitution constraint variation – Lagrange multipliers multivariable optimization with equality constraints – Kuhn Tucker conditions.

Unit II: **Linear Programming**
Linear programming definition – Pivotal reduction of general system of equation – Simplex algorithms – Two phases of the simplex method – Revised simplex method – Duality in linear programming.

Unit III: **Nonlinear Programming (One Dimensional)**
Unimodal function – Elimination methods – Unrestricted and exhaustive search, Dichotomous search, Fibonacci method – Interpolation methods – Direct root method.

Unit IV: **Nonlinear Programming (Unconstrained Optimization)**
Direct search methods – Univariate method, Pattern search methods – Rosenbrock's method – The simplex method – Descent method – Conjucate gradient method – Quasi Newton methods.

Nonlinear Programming (Constrained Optimization): Direct methods – The Complex method – Cutting plane method – Methods of feasible directions and determination of step length – Termination criteria, determination of step length.

Unit V: **Special Techniques**
Multistage decision process – Computational procedure – Final value problem to initial value problem – Continuous dynamic programming – Discrete dynamic programming. Heuristic Techniques for optimization – Neural Networks – Genetic algorithm – Adaptive genetic algorithm – Typical applications.

References

1. Nash S G and Ariela Sofer, " Linear and Nonlinear Programming", McGraw- Hill Inc., New York, 1996.
2. David E Goldberg, " Genetic Algorithms in Search, Optimization and Machine Learning", Addision Wesley Publishing Company, 1999.
3. Kalyanmoy Deb, "Multi-Objective Optimization Using Evolutionary Algorithms", John Wiley and Sons, New Delhi, 2001.
4. Ras S.S, " Optimization Theory and Application", Wiley Eastern Limited, NewDelhi, 2003.

EE347 VIRTUAL INSTRUMENTATION SYSTEMS

Credit :3:1:0

Unit I: **Introduction**
General Functional description of a digital instrument – Block diagram of a Virtual Instrument – Physical quantities and Analog interface – Hardware and Software – User interface – Advantages of Virtual Instruments over conventional instruments – Architecture of a Virtual instrument and its relation to the operating system.

Unit II: **Software Overview**
LabVIEW – Graphical user interface – Controls and indicators – 'G' programming – Data types – Data flow programming – Editing – Debugging and Running a Virtual instrument – Graphical programming pallets – Front panel objects – Controls, Indicators, Object properties and their configuration – Typical examples.

Unit III: Programming Structure
FOR loops, WHILE loop, CASE structure, formula node, Sequence structures – Array and Clusters – Array operations – Bundle – Bundle/Unbundle by name, graphs and charts – String and file I/O – High level and Low level file I/Os – Attribute modes Local and Global variables.

Unit IV: **Hardware Aspects**
Installing hardware, installing drivers – Configuring the hardware – Addressing the hardware in LabVIEW – Digital and Analog I/O function – Data Acquisition – Buffered I/O – Real time Data Acquisition.

Unit V: **Labview Applications**
Motion Control: General Applications – Feedback devices, Motor Drives – Machine vision – LabVIEW IMAQ vision – Machine vision Techniques – Configuration of IMAQ

DAQ Card – Instrument Connectivity – GPIB, Serial Communication – General, GPIB Hardware & Software specifications – PX1 / PC1: Controller and Chassis Configuration and Installation.

References

1. Garry M Johnson, " LABVIEW Graphical Programming", Tata Mc Graw-Hill Publishing Company Limited, 2nd Edition,1996.
2. Sanjay Gupta and Joseph John, "Virtual Instrumentation Using LABVIEW", Tata McGraw-Hill Publishing Company Limited, New Delhi, 1st Edition, 2005.
3. LABVIEW: Basics I & II Manual, National Instruments, 2006.
4. Barry Paron, " Sensors, Transducers and LABVIEW", Prentice Hall of India, New Delhi, 2000.

EE348 ROBOTICS AND FACTORY AUTOMATION

Credit :4:0:0

Unit I: Fundamentals Concepts of Robotics

History, Present status and future trends in Robotics and automation – Laws of Robotics – Robot definitions – Robotics systems and robot anatomy – Specification of Robots – resolution, repeatability and accuracy of a manipulator – Robotics applications.

Unit II: Robot Drives and Power Transmission Systems

Robot drive mechanisms, hydraulic – electric – servomotor – stepper motor – pneumatic drives, Mechanical transmission method – Gear transmission, belt drives, cables, Roller chains, Link – Rod systems – Rotary –to-Rotary motion conversion, Rotary-to-Linear conversion, Rack and Pinion drives, Lead screws, Ball Bearing screws, End effectors – Types.

Unit III: Sensors

Sensor characteristics, Position sensors – Potentiometers – Encoders – Resolvers – LVDT, Velocity sensors – Tacho generators – Encoders – Proximity sensors, Limit switches – Tactile sensors – Touch sensors – Force and torque sensors. Vision Systems for Robotics: Robot vision systems, image capture – cameras – vidicon and solid state, Image representation – Gray scale and colour images, image sampling and quantization – Image processing and analysis – Image data reduction – Segmentation – Feature extraction – Object Recognition – Image capturing and communication – JPEG, MPEGs and H.26x standards, packet video, error concealment – Image texture analysis.

Unit IV: Transformations and Kinematics

Homogeneous coordinates – Coordinate reference frames – Homogeneous transformations for the manipulator – The forward and inverse problem of manipulator kinematics – Motion generation – Manipulator dynamics – Jacobian in terms of D-H matrices – Controller architecture.

Unit V: Plc & Factory Automation

Building blocks of automation, Controllers – PLC –Role of PLC in FA – Architecture of PLC – Advantages – Types of PLC – Types of Programming – Simple process control programs using Relay Ladder Logic and Boolean logic methods – PLC arithmetic functions. Factory Automation: Flexible Manufacturing Systems concept – Automatic feeding lines, ASRS, transfer lines, automatic inspection – Computer Integrated Manufacture – CNC, intelligent automation, Industrial networking, bus standards, HMI Systems, DCS and SCADA, Wireless controls.

References

1. Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern Economy Edition, Prentice Hall of India Private Limited., New Delhi, 1989.
2. Fu K.S., Gomalez R.C., Lee C.S.G., "Robotics: Control, Sensing, Vision and Intelligence", Mc Graw- Hill Publishing Company Limited, New York , 1987.
3. Mikell P Groover et. Al., "Industrial Robots – Technology, Programming and Applications", McGraw Hill Publishing Company Limited, New York, 1986.
4. Saeed B Niku, " Introduction to Robotics Analysis, Systems, Application", Prentice Hall of India Private Limited ,New Delhi, 2003.
5. Deh S R., "Robotics Technology and Flexible Automation", Tata Mc Graw -Hill Publishing Company Limited, New Delhi, 1994.

EE349 MICROCONTROLLERS AND APPLICATIONS

Credit :4:0:0

Unit I: Intel 8051

Architecture of 8051- Memory organization- Register Banks- Bit addressable area- SFR area- Addressing modes- Instruction set- Programming examples. Interrupt structure- Timer modules- Serial features- Port structure- Power saving modes- MCS51 family features:8031/8051/8751.

Unit II: Motorola 68hc11

Controller features – Different modes of operation and memory map – Functions of I/O Ports in single chip and expanded multiplex model – Timer System. Input Capture, Output compare and pulsed accumulator features of 68HC11 – Serial peripheral and serial communications interface – Analog to digital conversion features – Watchdog feature.

Unit III: Pic Microcontrollers

Program memory – CPU Registers – Register file structure – Block diagram of PIC 16C74 – I/O Ports.

Unit IV: Features Of Pic

Timers 0,1 and 2 features – Interrupt Logic – Serial Peripheral Interface – I^2C Bus – ADC – UART – PIC family parts.

Unit V: Typical Applications

Stepper motor control – DC motor control – AC Power control – Introduction to Microcontroller developments tools.

References

1. "8-Bit Embedded Controllers", Intel Corporation, 1990.
2. John B Peatman, "Design with Micro Controllers", McGraw- Hill International Edition, Singapore, 1988.

3. John B Peatman, "Design with PIC Micro Controllers", Pearson Education India Series, New Delhi, 2005.

EE350 COMPUTER NUMERICAL CONTROL

Credit :4:0:0

Unit I: **Numerical Control**
Introduction Need of NC machine tool, CNC – Principle of Operation, Advantages and Features of CNC, block diagram of CNC, Types of CNC machine, DNC – Types of DNC, Advantage and Disadvantage, Classifications of machine tool control systems.

Unit II: **Types of Cnc Machines**
Major types of CNC machine tools and their constructional features – Lathe, machining centres, grinding machines, EDMs, turret punch press, laser and water jet cutting machines, Design considerations – Axis representations, Various operating modes of a CNC machine. NC Part Programming Process: Axis notation, EIA and ISO codes, Explanations of basic codes. Tooling concepts, machining methods, part geometry and writing of tool motion statements. Canned cycles. Development of simple manual part programs for turning operations. Post processors – CNC part programming with CAD/CAM systems.

Unit III: **Input Output Units**
Keyboard, Tape reader, Hand held terminals, PC interfacing, Display devices and Ethernet communication. Drive Units: Axis drive arrangements, ball screw, timing belts and couplings, AC & DC servomotors, Stepper motors, Hydraulic Servo, AC permanent magnet synchronous motor for spindle drives Characteristics and drive schemes for these motors.

Unit IV: **Feedback Elements**
Absolute and incremental encoders, Resolvers, linear optical encoders, Proximity switches, limit switches – Transducer placement measuring schemes using these feed back devices. Control Units: Functions of CNC, system hardware, Contouring control – Digital differential analyzer, Linear and circular interpolation, software development process, Open architecture systems.

Unit V: **Programmable Logic Controllers**
Hardware, programming techniques, Ladder logic programming of PLCs using basic functions – Timers and counters – Advanced programming with control and arithmetic instructions. Role of PLC in CNC machines. Microprocessor in CNC machines, Sensors for Adaptive Control of CNC machine tools. New developments in CNC technology.

References
1. Yoram Koran, "Computer Control of Manufacturing Systems", McGraw- Hill Publishing Company Limited, NewYork, 1983.
2. HMT Limited, "Mechatronics", Tata McGraw- Hill Publishing Company Limited, New Delhi, 1998.
3. Peter Smid, "CNC Programming Handbook", Industrial Press Inc., New York, 2000.
4. Thyer GE, " Computer Numerical Control of Machine Tools ", BH.Newners, 2nd Sub Edition, 1993.

EE351 EMBEDDED SYSTEMS

Credit :4:0:0

Unit I: **Introduction**

Introduction to embedded systems – hardware and software components – Types – Examples – Characteristics – Challenges in Embedded computing system design – Embedded system design processes.

Unit II: **Architecture of Embedded System**

Hardware components – SOC – Processors – CPU – Types of memory – Memory management – I/O devices and interfacing – Software components – Interpreter – Compiler and Assembler – Cross Assembler – RTOS – Languages for embedded applications – Hardware and software architecture. Examples: Cell phone, Smartcard, Digital Thermometer.

Unit III: **Os for Embedded Systems**

Introduction to real time theory – Operating System Services – Real time Operating System Concepts – Basic design using a RTOS - Underground tank monitoring system. Introduction to Micro C/OS-II operating system and its uses.

Unit IV: **Performances Issues of an Embedded System**

CPU performance – CPU Power Consumption – Analysis and Optimization of CPU Power Consumption program execution time – Analysis and optimization of energy and power – Analysis of program size – Hardware accelerators.

Unit V: **Design Examples**

Personal Digital Assistants – Set Top Boxes – Ink Jet Printers – Telephone PBX.

References

1. Wayne Wolf, "Computer as Components – Principles of Embedded Computing System Design", Harcourt India Private Limited., 2001.
2. David E Simon, "An Embedded Software Primer", Pearson Education, Singapore, 2004.
3. Sriram V Iyer, Pankaj Gupta, "Embedded Real-time Systems Programming", Tata Mc Graw- Hill Publishing Company Limited, New Delhi, 2004.
4. Prasad K.V.K.K., "Embedded Real-time Systems: Concepts, Design and Programming", Dreamtech Press, 2004.
5. Raj Kamal, "Embedded System: Architecture, Programming and Design" Mc Graw-Hill International Inc., New York, 2005.

EE352 SCADA AND DCS

Credit :4:0:0

Unit I: **Introduction**

Introduction to Factory & Process Automation, PLC – Networking standards. Vertical Integration of Industrial Automation – field bus and Ethernet. HMI Systems: Necessity and Role in Industrial Automation, Text display – operator panels – Touch panels – Panel PCs – Integrated displayers (PLC & HMI).

Unit II: **Supervisory Control and Data Acquisition**
Supervisory Control and Data Acquisition (SCADA) – Overview – Developer and runtime packages – architecture – Tools – Tag – Internal & External graphics, Alarm logging – Tag logging – structured tags – Trends – history – Report generation, VB & C Scripts for SCADA application.

Unit III: **Communication Protocols of Scada**
Proprietary an open Protocols – OLE/OPC – DDE – Server/Client configuration – Messaging – Recipe – User administration – Interfacing of SCADA with PLC, drive and other field devices.

Unit IV: **Distributed Control Systems**
Distributed Control Systems (DCS) – Difference between SCADA system and DCS – architecture – Local control unit – Programming language – Communication facilities – Operator interface – Engineering interfaces.

Unit V: **Applications of Scada & Dcs**
Applications of SCADA & DCS – Case studies of Process plants using SCADA & DCS – Advanced features / options in SCADA & DCS – Role of PLC in DCS and SCADA – Comparison – field devices (Transducers, drives etc) in DCS/SCADA.

References

1. John W. Webb & Ronald A. Reis, "Programmable Logic Controllers", Prentice Hall of India, New Delhi, 1995.
2. WINCC Software Manual, Siemens, 2003.
3. RS VIEW 32 Software Manual, Allen Bradley, 2005.
4. CIMPLICITY SCADA Packages Manual, Fanuc India Limited, 2004.
5. Michael P. Lukas, "Distributed Control Systems", Van Nostrand Reinfold Company, 1995.

EE353 POWER QUALITY MANAGEMENT

Credit :3:1:0

Unit I: Introduction
Definition of Power Quality –Power Quality issues: Short/Long duration voltage variations, Transients, Waveform distortion, Voltage imbalance/fluctuation, Power frequency variations – Sources and Effects of Power Quality problems –Power Quality and Electro Magnetic Compatibility (EMC) Standards.

Unit II: Short & Long Interruptions
Introduction – Origin of short interruptions: Voltage magnitude events due to reclosing, Voltage during the interruption – Monitoring of short interruptions – End user issues – Utility system fault clearing issues – Single phase tripping – Voltage during fault and post fault period, Current during fault period – Prediction of short Interruptions-Long Interruptions: Origin of interruptions – Causes of long interruptions – Voltage regulating devices, Applications: Utility side, End-User side.

Unit III: Voltage Sag & Transients

Definition – Characterization – Causes of Voltage Sag – Three Phase Unbalance – Phase angle jumps – Load influence on voltage sags – Equipment behavior – Stochastic assessment of voltage sags – Overview of mitigation methods. Transients: Definition – Power system transient model – Principles of over voltage protection – Types, causes of transients and devices for over voltage protection – Utility capacitor switching transients – Utility lightning protection – Transients from load switching.

Unit IV: Waveform Distortion, Wiring & Grounding
Definition and terms – Harmonics, Harmonics indices, Inter harmonics, Notching – Voltage Vs Current distortion – Harmonics Vs Transients – Sources and effects of harmonic distortion – System response characteristics – Principles of controlling harmonics – Standards and limitation – Mitigation and control techniques. Wiring and Grounding: Definitions and terms – National Electrical Code (NEC) grounding requirements – Utility power system grounding – Telecommunication system grounding – End-User power system grounding – Wiring and grounding problems – Solutions to wiring and grounding problems.

Unit V: Power Quality Solutions
Introduction – Power quality monitoring: Evolution, Deregulation effect – Brief introduction to power quality measurement equipment and power conditioning equipments – Planning, Conducting and Analyzing power quality survey.

References

1. Roger C. Durgan, Mark F. McGranaghan and H.Wayne Beaty, "Electrical Power Systems Quality", McGraw-Hill Publishing Company Limited, New York, 2nd Edition, 2002.
2. Barry W.Kennedy, "Power Quality Primer", McGraw-Hill Publishing Company Limited, New York, 2000.
3. Sankaran.C, "Power Quality", CRC Press, Washington D.C., 2002.
4. Math H.J.Bollen, "Understanding Power Quality Problems: Voltage Sags and Interruptions", IEEE Press, New York, 2000.
5. Arrilaga.J, Watson.N.R and Chen.S, "Power System Quality Assessment", John Wiley &Sons Limited., England, 2000.

EE354 FLEXIBLE AC TRANSMISSION SYSTEMS

Credit :4:0:0

Unit I : Introduction
FACTS-a toolkit, Basic concepts of Static VAR compensator, Resonance damper, Thyristor controlled series capacitor, Static condenser, Phase angle regulator, and other controllers**.**

Unit II : Series Compensation Schemes
Sub-Synchronous resonance, Torsional interaction, torsional torque, Compensation of conventional ASC, NGH damping schemes, Modelling and control of Thyristor controlled series compensators.

Unit III: Unified Power Flow Control (Upfc)
Introduction, Implementation of power flow control using conventional Thyristors, Unified power flow concept, Implementation of unified power flow controller.

Unit IV : Design Of Facts Controllers
Introduction to VSC, Approximate multi-model decomposition, Variable structure FACTS controllers for Power system transient stability, Non-linear variable-structure control, variable structure series capacitor control, variable structure resistor control.

Unit V: Modern Facts Devices
Basic concepts, Centre Node Unified Power Flow Controller (C-UPFC), Fault Current Controller (FCC), Interlined Power Flow Controller (IPFC), location of FACTS.

References

1. Narain G. Hingorani, "Understanding FACTS", IEEE Press, New York 2000.
2. Yong Hua Sung and Allan T. John (ed), "Flexible AC Transmission System (FACTS)", The Institution of Electrical Engineering, London 1999.
3. Narain G. Hingorani, "Flexible AC Transmission", IEEE Spectrum, April 1993, pp 40-45.
4. Narain G. Hingorani, "High Power Electronics and Flexible AC Transmission Systems", IEEE Power Engineering Review, 1998.
5. Narain G.Hingorani, "Power Electronics in Electric Utilities: Role of Power Electronics in future Power Systems", Proceedings of IEEE, Vol.76, no.4, April 1988.
6. Einar V.Larsen, Juan J. Sanchez-Gasca, Joe H.Chow, "Concepts for design of FACTS Controllers to damp power swings", IEEE Trans On Power Systems,Vol.10, No.2, May 1995.

EE355 POWER ELECTRONICS LABORATORY

Credit :0:0:2

12 Experiments will be notified by the HOD from time to time.

EE356 ELECTRIC DRIVES AND CONTROL LABORATORY

Credit :0:0:2

12 Experiments will be notified by the HOD from time to time.

EE357 POWER SYSTEMS AND POWER ELECTRONICS SIMULATION LABORATORY

Credit :0:0:2

12 Experiments will be notified by the HOD from time to time.

ADDITIONAL SUBJECTS

Code	Subject Name	Credit
09EE101	Basic Electrical Engineering	3:0:0
09EE201	Electronic Circuits	3:1:0
09EE202	Digital Electronics	3:1:0
09EE203	Communication Engineering	4:0:0
09EE204	Special Electrical Machines	3:0:0
09EE205	Energy Systems	4:0:0
09EE206	Neural Networks and Fuzzy Systems	3:1:0
09EE207	Illumination Engineering	3:0:0
09EE208	Automotive Electronics	3:0:0
09EE209	Digital System Design	3:0:0
09EE210	Grid Computing	4:0:0
09 EE211	Nano Computing	4:0:0
09EE212	Electrical and Electronics Workshop Practice	0:0:2
09EE213	Circuits and Devices Lab	0:0:2
09EE214	DC Machines and Transformers Laboratory	0:0:2
09EE215	AC Machines and Controls Laboratory	0:0:2
09EE216	Electronic Circuits Laboratory	0:0:2
09 EE217	Linear and Digital IC Laboratory	0:0:2
09EE218	Power Electronics Laboratory	0:0:2
09EE219	Measurements and Computer Aided Electrical Machine Design Lab	0:0:2
09EE220	Computer Aided Power Systems Analysis Laboratory	0:0:2
09EE301	Industrial Electronics And Instrumentation	4:0:0
09EE302	Microprocessor Applications in Power Electronics	3:1:0
09EE303	Advanced Microprocessors and Microcontrollers	4:0:0
09EE304	PLC and Automation	4:0:0

09EE101 BASIC ELECTRICAL ENGINEERING

Credits 3:0:0

COURSE OBJECTIVE

- To impart the basic knowledge about the Electric and Magnetic circuits.
- To inculcate the understanding about the AC fundamentals.
- To understand the working of various Electrical Machines.
- To know about various measuring instruments and house wiring.

UNIT I: DC CIRCUITS

Standard symbols – Units & Abbreviations – Circuit Elements – Current and Voltage Sources – Ohm's and Kirchhoff's law – Resistive circuits – Series and Parallel reduction – Voltage and Current Division – Source transformation – Star Delta Transformation

UNIT II: MAGNETIC CIRCUITS

Magnetic flux- flux density – reluctance – permeance-magnetic effect of electric circuit-Law of Electromagnetic induction – induced emf – self and mutual inductance – coupling co-efficient – inductance in series and parallel, Magnetic Materials.

UNIT III: AC FUNDAMENTALS

Sources of Electrical Energy – Thermal, Hydro and Nuclear power generating station – Transmission of Electric Power – Introduction to Alternating Quantities – Average and RMS

6.7

values – Circuit Elements – Series and Parallel Combinations – Phasor representation – Introduction to three phase system.

UNIT IV: ELECTRICAL MACHINES

Working principle, operation and application of DC Generator, DC Motor, Transformer, Three Phase Induction motor ,Single phase Induction motor, Alternator. (Quantitative approach)

UNIT V: MEASURING INSTRUMENTS AND HOUSE WIRING

Classification of Instruments – Essential features of Indicating Instrument – Deflecting, Controlling and Damping Mechanism - Moving Coil instrument – Moving Iron Instrument – Induction type Instruments – examples.

Wiring materials and accessories – Types of wiring – Fluorescent lamp wiring – stair case wiring – basic principles of earthing – layout for a residential building.

COURSE OUTCOME

After the completion of the course, the student should be able

- To predict the behavior of any electrical and magnetic circuits.
- To identify the type of electrical machine used for that particular application.
- To wire any circuit depending upon the requirement.

TEXT BOOK

Muraleedharan K. A, Muthusubramanian R & Salivahanan S, "Basic Electrical, Electronics & Computer Engineering", Tata McGraw Hill Limited, New Delhi, 2006.

REFERENCE BOOK

1. Chakrabarti .A, Sudipta nath and Chandan Kumar, "Basic Electrical Engineering", Tata Mc Graw Hill Limited, New Delhi, 1st edition, 2009.
2. Edward Hughes, "Electrical Technology", ELBS, 6th edition, 2002.
3. Mittle. V.N., "Basic Electrical and Electronics Engineering", Tata McGraw Hill Edition, New Delhi, 1st edition, 2007.
4. Openshaw Taylor .E, "Utilization of Electrical Energy in SI Units", Orient Longman limited, New Delhi, 2007.
5. Delton T. Horn, Abraham Pallas, "Basic Electricity and Electronics", McGraw-Hill Limited, Europe, 1993

09EE201 ELECTRONIC CIRCUITS

Credits 3:1:0
Pre requisite: EE 247 Electron Devices

COURSE OBJECTIVE

- The course is aimed to impart in-depth knowledge of Electronic circuits and its Characteristics
- Introduce about the different types of amplifiers.
- Gives the knowledge about the different wave shaping circuits.

UNIT I: POWER SUPPLIES

Rectifiers – Half wave and Full wave rectifiers, Average and RMS value, Ripple factor, Regulation, Rectification efficiency, Transformer Utility Factor. Filters – Inductor, Capacitor, L type and π type, Ripple Factor and Regulation. Need for voltage regulators – Series and Shunt regulators, Comparison, Current limiting and protection circuits – Introduction to Switched Mode Power Supplies.

UNIT II: WAVE SHAPING

Response of High pass and Low pass RC circuit for sinusoidal, step, pulse, square, ramp and exponential inputs. Linear wave shaping – Integrator, Differentiator. Non-linear wave shaping– Clipping and clamping circuits, clamping circuit theorem and applications, Attenuator and compensated attenuator. Introduction to Pulse Transformers and applications.

UNIT III: VOLTAGE AMPLIFIERS

BJT and JFET amplifiers – RC coupled amplifiers, Cascaded BJT amplifiers, Analysis at low, medium and high frequencies BIFET amplifiers, DC amplifiers – Problems in DC Amplifiers, Differential and Common mode gain, CMRR. Cascade and Darlington Amplifiers. Chopper Amplifiers.

UNIT IV: POWER AMPLIFIERS AND FEEDBACK AMPLIFIERS

Power Amplifiers– Classification, Class A/B/C, Single ended and Push-Pull configuration, Power dissipation and output power, Conversion efficiency, Complementary Symmetry Power Amplifiers, Class AB operation. Basic concepts of feedback amplifiers – Effect of negative feedback on input and output resistances, gain, gain stability, distortion and bandwidth. Voltage and Current feedback circuits.

UNIT V: OSCILLATORS AND MULTIVIBRATORS

Oscillators – Barkhausen criteria, RC and LC oscillators using BJT – RC Phase Shift, Wien bridge oscillators, Hartley and Colpitt's oscillators. Frequency stability of oscillators. Crystal Oscillators. Non-sinusoidal oscillators – Multivibrators – Bi-stable, Monostable, Astable Multivibrators and Schmitt Trigger using BJT.

COURSE OUTCOME

On completion of course the students will be able to:

- Design and analyze the various amplifiers characteristics.
- Design the Oscillator circuits for various applications.
- Design the wave shaping circuits required for specific use.

TEXTBOOKS

1. Salivahanan.S. Suresh Kumar.N. and Vallavaraj.A, “Electronic Devices and Circuits”, TataMc Graw Hill Publishing Company Ltd., New Delhi, 4th Edition, 2008.
2. Jacob, Millman and Herbert Taub, “Pulse, Digital and Switching Waveforms”, Tata Mc Graw Hill Publishing Company Ltd., NewDelhi, 2nd Edition, 2007.

REFERENCE BOOKS

1 Mehta.V.K, “Principles of Electronics”, S.Chand & Co. Ltd., New Delhi, 23rd Revised Edition,2005.

2.Boylestad R.L. and Nashelsky L., “Electronic Devices and Circuit Theory”, Pearson Education India Series, New Delhi, 8th Edition 2003.
3. Millman J. and Halkias C., “Electronic Devices & Circuits”, Tata Mc Graw Hill Publishing Company Limited, New Delhi, 2002.

09EE202 DIGITAL ELECTRONICS

Credits 3:1:0

Pre requisite: EE 247 Electron Devices

COURSE OBJECTIVE

- To introduce the concepts of Boolean algebra,
- To make them familiar with the implementation of combinational logic functions.
- To make them understand about the working of counters and flip flops

UNIT I: NUMBER SYSTEMS AND BOOLEAN ALGEBRA

Review of Binary, Octal & Hexadecimal number Systems-representation of signed Numbers-floating point number representation-BCD-ASCII-EBCDIC-Excess 3 codes, gray Code-error detecting & correcting codes. Boolean algebra: Postulates & theorems of Boolean algebra – canonical forms –simplification of Logic Functions using Karnaugh map, Quine Mcclausky method.

UNIT II: COMBINATIONAL LOGIC DESIGN

Logic gates –implementation of combinational logic functions – encoders & decoders – multiplexers & demultiplexers –code converters – comparator - half adder, full adder –parallel adder – binary adder – parity generator/checker – implementation of logical functions using multiplexers.

UNIT III: COUNTERS AND REGISTERS

RS, JK, JK Master– Slave, D&T Flip Flops – level triggering and edge triggering –excitation tables –Asynchronous & Synchronous counters – modulus counters–shift register –Johnson counter- Ring counter – timing waveforms-counter applications.

UNIT IV: SEQUENTIAL LOGIC DESIGN

Basic models of sequential machines – concept of state table – state diagram – state reduction through partitioning & implementation of synchronous sequential circuits – Introduction to asynchronous sequential logic design.

UNIT V: PROGRAMMABLE LOGIC DEVICES
Semicustom design – Introduction to PLD's – ROM – PAL – PLA – FPGA – Architecture of PLD's: PAL 22V10, PLS 100/101 – Implementation of digital functions.
LOGIC FAMILIES: RTL, DTL, TTL families, Schottky – clamped TTL, Emitter Coupled Logic (ECL), Integrated Injection Logic (IIL), MOS inverters, CMOS inverters, Comparison of performance of various logic families.

COURSE OUTCOME
On completion of the course, the students will be able to
- Apply Boolean algebra & K –map to digital circuits
- Design combinational and Sequential circuits
- Design the logic families to specific applications.

TEXT BOOKS
1. Morris Mano M., "Digital Electronics", Prentice Hall PTR, New Jersey, 3rd Edition, 2001.
2. Thomas L. Floyd, "Digital Fundamentals", Prentice Hall Higher Education Series, 10th Edition 2008.

REFERENCE BOOKS
1. Tocci.R.J., "Digital Systems – Principles & Applications", Prentice Hall India, New Delhi, 10th Edition , 2008.
2. Fletcher.W.I, "An Engineering Approach to Digital Design", Prentice Hall India, New Delhi, 2007.
3. Morris Mano M., "Digital Logic & Computer Design", Prentice Hall India, New Delhi, 2007.

09EE203 COMMUNICATION ENGINEERING

Credits 4:0:0
Prerequisite: **09EE202 Electronic Circuits**
COURSE OBJECTIVE
- To learn the basic principles, concepts and types of communication systems.
- To understand the various design issues in a communication systems.
- To gain knowledge about optical communication.
- To become familiar with the performance capabilities of present communication systems.

UNIT I: RADIO COMMUNICATION SYSTEMS
Frequency spectrum –concept of modulation - Principle of AM and FM – AM and FM transmitters and receivers – Introduction to Microwave communication systems – Principle of Satellite communication.

UNIT II: PULSE COMMUNICATION SYSTEMS

Pulse Amplitude Modulation, Pulse Position Modulation, Pulse Duration Modulation, Pulse Code Modulation –delta modulation – differential PCM – merit and demerits – comparison of pulse modulation schemes.

UNIT III: DATA TRANSMISSION
Base band signal receiver – error probability – optimum and matched filter techniques coherent reception – digital modulation systems – ASK, FSK, PSK – comparison of data transmission systems.

UNIT IV: TRANSMISSION MEDIUM
Characteristics of cables – optical fibers – effects of EM radiation – bandwidth and noise restrictions – statistical measurements of random noise – concept of multiplexing – FDM and TDM.

UNIT V: TELEVISION
Scanning methods – B/W and Colour television systems – Camera and Picture tubes – synchronization – transmitters and receivers.

COURSE OUTCOME
After the completion of the subject, the student will be able to

- Analyze and design basic communication systems, particularly with application to noise-free analog and digital communications,
- Apply concepts and techniques from circuit analysis to communication systems.
- Develop the ability to compare and contrast the strengths and weaknesses of various communication

TEXT BOOKS

1. William Schweber, "Electronic Communication Systems - A Complete Course", Prentice Hall International, New Jersey, 4th Edition, 2002.
2. Anokh Singh,"Principles of Communication Engineering", S. Chand & Co, New Delhi, 5th Edition, 2006.

REFERENCE BOOKS

1. Taub and Schilling, "Principles of Communication", Tata Mc - Graw Hill Publishing Company Limited, New Delhi, 3rd Edition, 2008.
2. Kennedy G, "Electronic Communication Systems", Tata McGraw-Hill Publishing Company Limited, New Delhi, 4th Edition, 1999.
3. Simon Haykins, "Communication Systems", John Wiley & Sons, New Jersey, 4th Edition, 2001.
4. Bruce Carlson. A, "Communication Systems", Tata Mc-Graw Hill Publishing Company Limited, New Delhi, 4th Edition, 2002.

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09EE204 SPECIAL ELECTRICAL MACHINES

Credits 3:1:0

Pre requisite: EE 250 DC Machines and Transformers

EE 251 Induction and Synchronous Machines

COURSE OBJECTIVE

- Differentiate the constructional features and principle of operation, characteristics of various special machines.
- Devise suitable control techniques for the special machine considered.
- Control of special machines with microprocessor and microcontrollers.

UNIT I: STEPPER MOTOR

Constructional features – principle of operation – variable reluctance motor – Single and Multi stack configurations – Permanent Magnet Stepper motor – Hybrid stepper motor. Different modes of Excitation - theory of torque Production – linear and non-linear analysis – characteristics – drive circuits.

UNIT II: SWITCHED RELUCTANCE MOTOR

Constructional features – principle of operation – torque Production – power controllers – Nonlinear analysis – Microprocessor based control - characteristics – computer control.

UNIT III: PERMANENT MAGNET MOTORS

Principle of operation – types – magnetic circuit analysis – EMF and Torque equations – Power Controllers – Motor characteristics and control of PMDC, PMSM , BLDC motor.

UNIT IV: AC COMMUTATOR MOTORS

Schrage motor - Principle of operation, Phasor diagram, Performance - Principle of operation – Equivalent circuit – Phasor diagram – Performance of Repulsion motor and Universal motor

UNIT V: LINEAR MOTORS

Linear Induction Motor (LIM) Classification – Construction – Principle of operation – Concept of Current sheet – Goodness factor – DC Linear Motor (DCLM) types – Circuit equation – DCLM control applications.

COURSE OUTCOME

At the completion of the course, the student should be able to

- Select a energy efficient linear or rotary motor based on the characteristics of the load & application
- Incorporate the correct control technique to the machine for efficient operation
- Improve the performance of the motor by enhancing the motor suitably.

TEXT BOOK

Venkataratnam K., "Special Electric Machines", Taylor and Francis, London, 2008.

REFERENCE BOOKS

1. Miller, T.J.E. "Brushless Permanent Magnet and Reluctance Motor Drives", Clarendon Press, Oxford, 1989.

2. Kenjo, T, "Stepping Motors and their Microprocessor control", Clarendon Press, Oxford, 1989.
3. Naser A and Boldea I, "Linear Electric Motors: Theory, Design and Practical Application", Prentice Hall Inc., New Jersey,1987
4. Kenjo, T and Naganori, S "Permanent Magnet and brushless DC motors", Clarendon Press, Oxford, 1989.

09EE205 ENERGY STYSTEMS

Credits 4:0:0

COURSE OBJECTIVE

- To impart knowledge about the various non conventional energy sources
- To understanding about the theory of illumination
- To know the various ways of generating high voltage
- To know about the traction

UNIT I: SOLAR AND WIND ENERGY SOURCE

Solar Thermal Systems: Principle of solar thermal power generation Solar Photovoltaic Systems: Solar cells and their characteristics - Influence of insolation and temperature - PV arrays – Series and parallel connections - Synchronized Operation with grid supply - Stand alone PV systems - Charge controllers. Wind Energy: Nature and Power in the wind - Basic principle of wind energy conversion – Blade element Theory - Components of a wind energy conversion system - Classification of WECS – Wind Turbines – Types - Horizontal axis and vertical axis wind turbines - Generator control - Load control.

UNIT II: MISCELLANEOUS ENERGY SOURCE

Energy From Oceans**:** Ocean thermal energy conversion systems - Energy from tides Ocean Waves - MHD Energy Conversions: Magneto Hydro Dynamic (MHD) power generation - Types - Fuel cells - Types - Energy from fusion Hybrid Systems**:** Range and type of Hybrid systems - Case studies of Diesel-PV and Wind-PV systems.

UNIT III : ILLUMINATION, ELECTRIC HEATING & WELDING

Lighting calculations – determination of MHCP and schemes – polar curves of different types of sources – Rousseau's construction – photometers – lighting schemes – design of lighting schemes – factory & flood lighting – electric lamps – gaseous discharge construction and application – control equipment, efficiency and losses – resistance heating, induction heating – furnaces – high frequency dielectric heating, resistance welding arc welding.

UNIT IV: ELECTRIC TRACTION

Requirements of traction system – Systems of traction – speed time curves – tractive effort calculations – power of traction motor – specific energy consumption – series, parallel control of DC motor, open circuited, shunt and bridge traction – electric braking.

UNIT V : GENERATION OF HIGH VOLTAGES AND CURRENTS AND ITS MEASUREMENTS

Generation of high DC voltage using voltage multiplier circuits – Van de Graff generator – generation of high alternating voltages using cascade transformers – High DC voltage measurement techniques – methods of measurement for power frequency AC voltage – sphere gap measurement technique – use of CRO for impulse voltage and current measurements.

COURSE OUTCOME

After the completion of the subject, the student will able to

- Identify and develop the best non conventional energy system for a firm depending upon the needs and availability.
- Develop a better illumination system
- Know the appropriate method of controls of electric traction.

TEXT BOOKS

1. Khan B.H., "Non-Conventional Energy Resources", Tata Mc-Graw Hill Publishing Company Ltd, New Delhi 2006.
2. Open Shaw Taylor E., "Utilization of Electric Energy in SI Units.", Orient Longman Ltd, New Delhi, Eleventh reprint, 2007.

REFERENCE BOOKS

1. Wadhwa C.L., "High Voltage Engineering", New Age International (P) Ltd Publishers., New Delhi, 2nd Edition, 2007
2. Rao S and Paruklekar, "Energy Technology – Non Conventional, Renewable and Conventional", Khanna Publishers, New Delhi 1999.
3. Gupta J.B., "Utilization of Electric Power and Electric Traction", S.K.Kataria and Sons, 2002.
4. Partab H., "Art and Science of Utilization of Electrical Energy", Dhanpat Rai and Co, New Delhi, 2004.

09EE206 NEURAL NETWORKS AND FUZZY SYSTEMS

Credits 3:1:0

COURSE OBJECTIVE

- To expose the students to the concepts of feed forward neural networks.
- To provide adequate knowledge about feedback neural networks.
- To teach about the concept of fuzziness involved in various systems. To provide adequate knowledge about fuzzy set theory.
- To provide comprehensive knowledge of fuzzy logic control and adaptive fuzzy logic.

UNIT I: INTRODUCTION TO NEURAL NETWORK

The biological neural network – The human brain organization – computer & human brain. Fundamentals of artificial neural networks – artificial neuron – activation function – single and multilayer networks – perceptron representation – linear separability – learning – training algorithm.

UNIT II: BACK PROPOGATION NETWORKS

Back propagation – training algorithm – applications – counter propagation networks – network structure – applications – statistical methods – Boltzmann training.

UNIT III: HOPFIELD NETWORK

Hopfield nets – Associative memory – Bi-directional associative memories – BAM structure – continuous BAM-adaptive and competitive BAM – applications.

UNIT IV: INTRODUCTION TO FUZZY SYSTEMS
Fuzzy systems and relations: Crisp set – Vagueness – Uncertainty and imprecision – Fuzziness – Basic definitions – Basic set theoretic operations for fuzzy sets – Types – Operations – Properties – Crisp versus fuzzy relation – Fuzzy relation –Cardinality operations, Properties – Fuzzy Cartesian Product and Composition – Non interactive Fuzzy sets – Tolerance and Equivalence Relations – Fuzzy ordering relations – Fuzzy morphism – Composition of Fuzzy relations.

UNIT V: FUZZY LOGIC CONTROL
Membership function – Knowledge base – Decision-making logic – Adaptive fuzzy system – Fuzzy logic control – Inverted pendulum – Image processing – Home heating system – Blood pressure monitoring during anaesthesia – Introduction to neuro fuzzy controller.

COURSE OUTCOME
After the completion of the subject, the student will be able to

- Apply the concept of neural network for optimization of any system performance.
- Use a appropriate network for fault diagnosis and pattern recognition
- Apply the concepts of fuzzy logic for parameter identification

TEXT BOOKS

1. Timothy Ross, "Fuzzy Logic with Engineering Applications", Mc Graw Hill, Singapore, 1998.
2. Jacek M Zurada, "Introduction to Artificial Neural Systems", Jaico Publishing House, New Delhi, 2001.

REFERENCE BOOKS

1. Sivanandam S.N., Sumathi. S and Deepa S.N., "Introduction to Neural Networks using MATLAB 6.0", Tata Mc Graw-Hill Publishing Company Limited, New Delhi, 2006.
2. Sivanandam S.N., Sumathi. S and Deepa S.N., "Introduction to Fuzzy Logic using MATLAB 6.0", Springer Verlag Publisher, Germany, 2007.
3. Laurene Fausett, "Fundamentals of Neural networks", Pearson Education India, New Delhi, 2004.

09EE207 ILLUMINATION ENGINEERING

Credits 3:0:0
Pre requisite: EE101/09EE101 Basic Electrical Engineering
COURSE OBJECTIVE

- To understand the illumination in electrical system.
- To discuss various measurements and accessories with illumination.
- To study about interior and exterior lighting.

UNIT I: LANGUAGE OF LIGHT & LIGHTING
Eye & vision, Light & Lighting, Light & Vision, Light & Color , Basic Concepts and Units, Photometry and Measurement, Quantity and Quality of Lighting.

UNIT II: ACCESSORIES
Light sources: Daylight, Incandescent, Electric Discharge, Fluorescent, Arc lamps, Lasers, Neon signs, LED-LCD displays, Luminaries, Wiring, Switching & Control circuits.

UNIT III: CALCULATION AND MEASUREMENT
Polar curves, Effect of voltage variation on efficiency and life of lamps, Lighting calculations, Solid angle, Inverse square and cosine laws, Illumination from point, line and surface sources. Photometry and Spectro -photometry, photocells.

UNIT IV: INTERIOR LIGHTING
Lighting design procedure for Industrial, Residential, Office, Departmental stores, Indoor stadium, Theatres and Hospitals.

UNIT V: EXTERIOR LIGHTING
Environment and glare, Lighting Design procedure for Flood, Street, Aviation and Transport lighting, Lighting for Displays and Signaling.

COURSE OUTCOME
- Can develop a High Performance Electronics Ballast for Energy Efficient Illumination.
- It also helps to design and develop various overload trip circuit renewable energy sources.
- Select and design an illumination system for a given environment.

TEXT BOOKS
1. Joseph B. Murdoch, "Illumination Engineering From Edison's Lamp to the Laser", Visions Communications , Washington DC, USA, 2nd Edition, 1994.
2. Jack L. Lindsey, "Applied Illumination Engineering", Prentice Hall of India, New Delhi, 3rd Sub Edition, 2008.

REFERENCE BOOKS
1. Marc Schiler, "Simplified Design of Building Lighting", John Wiley and Sons, 1997
2. IES Lighting Handbook, 8th Edition, 1993

09EE208 AUTOMOTIVE ELECTRONICS

Credits 3:0:0
Pre requisites: EE 101 / 09EE101 Basic Electrical Engineering
EC 104 / 09EC218 Basic Electronics
COURSE OBJECTIVE
- To study the concepts of sensors, actuators, drives.
- To study Electronics Fuel Injection System.
- To study the Lighiting system and accessories.
- To study the digital control of starting and braking methods in the automobile system.

UNIT I: SENSORS AND ACTUATORS
Introduction, Basic sensor arrangement, types of sensors such as - oxygen sensors, Crank angle position sensors - Fuel metering / vehicle speed sensor and detonation sensor - Altitude sensor, flow sensor. Throttle position sensors, Solenoids, Stepper motors, Relays.

UNIT II: STARTING SYSTEM
Condition at Starting, Behavior of starter during starting. Series motor and its Characteristics. Principle & construction of starter motor. Working of different starter drive units, care & maintenance of starter motor. Starter switches.

UNIT III: ELECTRONIC FUEL INJECTION AND IGNITION SYSTEMS
Introduction, Feedback carburetor systems (FBC) Throttle body injection and multi port or point fuel injection, Fuel injection systems, injection system controls. Advantages of electronic ignition systems. Types of solid state ignition systems and their principle of operation, Contact less electronic ignition system, Electronic spark timing control.

UNIT IV: LIGHTING SYSTEM & ACCESSORIES
Insulated & earth return systems. Positive & negative earth systems. Details of Head light & Side light. Head light dazzling & preventive methods. Electrical Fuel Pump, Speedometer, Fuel, Oil & Temperature gauges, Horn, Wiper system, Trafficator.

UNIT V: DIGITAL CONTROL SYSTEMS
Current trends in modern Automobiles- Open loop and closed loop control systems - Engine cranking and warm up control - Acceleration enrichment - Deceleration leaning and idle speed control. Distributor less ignition - Integrated engine control system, Advanced suspension, electronically controlled electric power steering, electronically controlled electric brakes.

COURSE OUTCOME
During the end of this course, the student would be able,

- To design the digital control of drives using sensors and Digital Control Systems.
- To design the starting and braking system for the automobiles.
- To do research in field of automotive electrical applications.

TEXT BOOK
William B.Ribbens, "Understanding Automotive Electronics", Butterworth, Heinemann Woburn, New York, 6th Edition, 2003.

REFERENCE BOOKS

1. James D. Halderman and Chase D. Mitchell, "Diagnosis and Troubleshooting of Automotive Electric, Electronic, and Computer Systems", Prentice Hall, New Jersey, 4th Edition,2006.
2. James D. Halderman and Chase D. Mitchell, "Automotive Electricity and Electronics", Prentice Hall of India, New Delhi , 2004.

09EE209 DIGITAL SYSTEM DESIGN

Credits 3:0:0
COURSE OBJECTIVE

- To have a wide knowledge on the programmable logic devices and its programming abilities.
- To be aware of Xilinx and Altera Programming techniques.

- Also to have a clear idea to write the codings for the above mentioned softwares.

UNIT I: PROGRAMMABLE LOGIC DEVICES& FPGA
Basic concepts - Programming techniques - Programmable Logic Element (PLE) -Programmable Logic Array (PLA) - Programmable Array Logic (PAL) - Structure of Standard PLD's - Design of combination and sequential circuits using PLD's.Type of FPGA – Xilinx XC3000 Series – Logic Cell Array (LCA) – Configurable Logic Blocks (CLB) Input/Output Blocks (I/OB) – Programmable Interconnects - CPLD-AlteraMax 7000 Series – Introduction to Actel Act-1 Logic Module – Xilinx XC4000 Series.

UNIT II: SEQUENTIAL LOGIC CIRCUITS
Mealy machine - Moore machine - State diagrams - State table minimization – Incompletely specified sequential machines - State assignments - Design of synchronous and asynchronous sequential logic circuits working in the fundamental mode and pulse mode.

UNIT III: SYMMETRIC FUNCTIONS
Elementary symmetric functions - Partially symmetric and totally symmetric functions – Mc Cluskey de-composition method - Synthesis of symmetric function by contact networks.

UNIT IV: INTRODUCTION TO VHDL
Entity - Architecture - Data Types Variables – Signals – Constants – Arrays – Operators – Functions – Procedures – Packages – Libraries – Attributes – Operator Overloading –Generics – Modeling Delays - Modeling Synchronous Logic And State Machine Modeling.

UNIT V: INTRODUCTION TO VERILOG
Design methodology – Modules – Ports – Basic concepts – Operators – Nos. specification Data types – Arrays – Parameters – Gate delays – Operator types – Conditional statements Multiway branches - Loops - Switch – Modeling elements.

COURSE OUTCOME
On completion of the course the graduates will be able to:

- Have an understanding on the FPGA and its programming coding such as VERILOG or VHDL
- Know about the sequential logic circuits and the other symmetric functions.
- Knowledge on the programmable logic devices and its programming abilities.

TEXT BOOK
Charles H. Roth, Jr., "Digital System Design using VHDL", PWS Publishing Co., Boston, Massachusetts USA, 2001.

REFERENCE BOOKS
1. Godse A.P., Godse D.A., "Digital Systems", Technical Publications, Pune, 2nd Edition, 2003.
2. Samir Palnitkar, "Verilog HDL", Pearson Publication India, New Delhi ,2nd Edition, 2003.
3. Bhaskar J., "A VHDL Synthesis Primer", BS Publications, Hyderabad , 3rd Edition, 2004.

09EE210 GRID COMPUTING

Credits 4:0:0

COURSE OBJECTIVE

- To introduce about the grid computing techniques
- To explain and describe the structure of Grid Computing in Business.
- To make a complete case study of enterprise grid, engine and grid cyper-infrastructure.

UNIT I: INTRODUCTION

A vision of the grid and its promises-Scientific Roots- Business Perspective-WS-Resource Frame Format and its meaning-Virtual Organizations and its security-Open Grid Service Architecture(OGSA) and its overview-Grid Versus Distributed Computing-Grid Versus Web Services-Grid Versus Peer to Peer(P2P)

UNIT II: GRID COMPUTING IN BUSINESS

Grid Taxonomy- Departmental Grids – Enterprise Grids- Open Grids and the Grid Joining the Grid- Strategies for Participation- Building an Enterprise Grid- example-Software Release Engineering on the Grid-Grid Enabling a Solution-Grid Infrastructure Provider-Service Provider on the Grid-example-Grid for Equipment Health Monitoring

UNIT III: TECHNICAL ISSUES

High Level System Design-Analogies-The Web –Peer to Peer – Technology Areas-Data Management And Databases-Storage Management- Resource Management – Super Computers-Clusters And Farms-On – Demand CPU Resources-Workflow Management-Security-Internal Versus External Security

UNIT IV: MANAGEMENT ISSUES

Building And Selling Grid Business Case-Change And Transition Period Management-Role Of Consultants risk Mitigation: Risk Identification-Risk Quantification-Risk Response Development-Risk Response Control-Fighting White Space Risk-White Space In The Grid Sector-Agile Development: Pair Programming-Test-Driven Programming-The Globus Campaign System.

UNIT V: CASE STUDIES:

The MCNC enterprise grid-SUN N1 grid engine-LSF suite-the NEES grid cyper-infrastructure-the globus toolkit 4 service container.

COURSE OUTCOME

On completion of the course the graduates will be able to:

- Acquire knowledge about open grid service architecture.
- Understand about the grid taxonomy , grid infrastructure provider
- Know about the security in grid computing

TEXT BOOK

1. Plazczak P., Wellner R., “Grid Computing: The Savvy Managers Guide”, Elsevier, New Delhi, 2006 .

REFERENCE BOOK

1. Joshy Joseph and Craig Fellenstein, “Grid Computing”, Pearson Education, New Delhi, 2007.

09EE211 NANO COMPUTING

Credits 4:0:0

COURSE OBJECTIVE

- To make the students know about the introduction to nanoelectronics.
- To be aware of the different architecture.
- To be aware of the different Nanosystems.

UNIT I: INTRODUCTION TO NANO ELECTRONICS

The development of microelectronics – The region of Nanoelectronics – The complexity problem – The challenge initiated by Nanoelectronics. Basics of Nanoelectronics: Electromagnetic Fields and Photons – Quantization of Action, Charge, and Flux – Electrons behaving as waves – Electrons in potential wells – Diffusion process

UNIT II : BIOCHEMICAL AND QUANTUM-MECHANICAL COMPUTERS

DNA Computer – Information processing with Chemical reactions – Nanomachines – Parallel Processing. Quantum Computers – Bit and Qubit – Coherence and Entanglement – Quantum Parallelism.

UNIT III: PARALLEL ARCHITECTURES FOR NANOSYSTEMS

Mono and Multiprocessor Systems – Some considerations to parallel processing – Influence of Delay Time – Power Dissipation – Architecture for processing in Nanosystems: Classic systolic Arrays – Processor with large memory –Processor with large memory – Processor array with SIMD and PIP architecture – Reconfigurable computers – The Teramac Concept as a Prototype.

UNIT IV: SOFT COMPUTING AND NANAOELECTRONICS

Methods of Soft Computing –Fuzzy Systems – Evolutionary Algorithms – connectionistic systems – computationally intelligent systems – Characteristics of Neural networks in Nano-electronics – Local Processing – Distributed and Fault – tolerant Storage – Self-organization.

UNIT V: NANOSYSTEMS AS INFORMATION PROCESSING MACHINES: Nanosystems as functional machines-information processing as information modifications-system design and its interfaces-requirements of nanosystems. Uncertainties: Removal of Uncertainties by nano machines- Uncertainties in nano systems – Uncertainties in the development of nano electronics.

COURSE OUTCOME

At the end of the course the student will have

- Good knowledge in the basis of Nanotechnology
- Good knowledge on soft computing
- Aware of the development of Nanoelectronics

TEXT BOOK

1. Karl goser et.at, "Nanoelectronics and Nanosystems: from Transistors to molecular and Quantum devices", Springer Link, New Delhi,2005.

09EE212 ELECTRICAL AND ELECTRONICS WORKSHOP PRACTICE

Credits 0:0:2

1. *Study of Lighting Schemes*
2. Study of accessories used in wiring and types of wiring.
3. Exercises in house wiring and power wiring
4. Study of Earthing and Measurement of Earth resistance using Megger.
5. Experiment on the various types of Electrical Machines.
6. Study of domestic appliances.
7. Study of Power Supplies.
8. Study of CRO
9. PCB Fabrication.
10. Measurement of Circuit Elements .
11. Characteristics of PN junction diode and Zener diode.
12. Transducers

09EE213 CIRCUITS AND DEVICES LAB

Credits 0:0:2

1. Verification of Ohms and Kirchhoff 's law.
2. Verification of Superposition Theorem using PSPICE.
3. Verification of Thevenin and Norton Theorem using PSPICE.
4. Transient Response of a simple RL, RC and RLC circuits using PSPICE.
5. Resonance of series RLC and parallel RLC circuits using PSPICE.
6. Filters using PSPICE.
7. Characteristics of PN diode & Zener diode
8. Characteristics of JFET
9. Characteristics of UJT & SCR
10. Input Output Characteristics of Transistor under CE configuration
11. Study of Half wave & Full wave Rectifier with and without filter
12. Non-Linear wave shaping techniques-Clipper and Clamper

09EE214 DC MACHINES AND TRANSFORMERS LABORATORY

Credits 0:0:2

1. Load characteristics of a separately excited DC Generator.
2. Load characteristics of DC Shunt Generator
3. Load characteristics of DC Compound Generator
4. Load test on DC Shunt Motor
5. Load test on DC Series Motor
6. Speed control of DC Shunt Motor
7. Electric Braking of DC Shunt Motor
8. Swinburne's Test
9. Load test on Single Phase Transformer
10. Open circuit and Short circuit test on Single Phase Transformer
11. Sumpner's Test on a Single Phase Transformer.

12. Three Phase Transformer Connections

09EE215 AC MACHINES AND CONTROLS LABORATORY

Credits 0:0:2

1. Load test on Three Phase Induction Motor
2. No load and blocked rotor tests on Three Phase Induction Motor
3. Speed control of Three Phase Induction Motor
4. Load test on Single Phase Induction Motor
5. Regulation of Alternator by EMF/ MMF methods
6. Operation of alternator on Infinite bus bar
7. V and Inverted V curve for Synchronous Motor
8. Measurement of transient and sub-transient reactance in direct and quadrature axis of an Alternator.
9. Transfer function of Separately Excited DC Generator.
10. Transfer function of a) Field controlled DC Motor b) Armature controlled DC Motor.
11. Time & Frequency Response of the System using MATLAB
12. Measurement of Physical Variable with the help of LABVIEW

09EE216 ELECTRONIC CIRCUITS LABORATORY

Credits 0:0:2

1. BJT Amplifier (CE)
2. JFET Amplifier (CS)
3. Differential Amplifier using BJT
4. Study of Half-Wave & Full-Wave Rectifiers (with and without Filter)
5. Integrator and Differentiator using R and C
6. Voltage Regulator (Series Type)
7. Emitter Follower
8. RC Phase-Shift Oscillator
9. Colpitts Oscillator
10. Astable Multivibrator
11. Bistable Multivibrator
12. Schmitt Trigger Circuit

09EE217 LINEAR AND DIGITAL IC LABORATORY

Credits 0:0:2

1. Performance characteristics of Op-amp IC
2. Instrumentation amplifier using Op-amp ICs.
3. Maximally flat active filter using Op-amp IC.
4. Precision full wave and half wave rectifier, using Op-amp IC.
5. Wien’s bridge oscillator using Op-amp IC.
6. Astable multivibrator and Schmitt trigger, using Op-amp IC
7. Realization of different flip-flops, using logic gates.
8. Realization of simple switching functions, using NAND or NOR gates.
9. Half adder, Full adder, Half subtractor and Full subtractor using logic gates.

10. Shift register and Ring counter
11. Multiplexer and Demultiplexer
12. Digital to Analog converter

09EE218 POWER ELECTRONICS LABORATORY

Credits 0:0:2

1. Characteristics of MOSFET, IGBT, SCR and TRIAC
2. Single Phase and Three Phase Diode Bridge Rectifier with R & R – L Load
3. Single Phase Half and Fully Controlled Thyristor Converter with R & R – L Load
4. D.C. Chopper with R & R – L Load
5. Three Phase PWM Inverter with R & R – L Load
6. Single Phase A.C. Voltage Controller with R & R – L Load
7. Three Phase A.C. Voltage Controller with R & R – L Load
8. Single Phase Cycloconverter with R & R – L Load
9. Single Phase Series Inverter with R & R – L Load
10. Simulation of Power Electronic Circuits using MATLAB Simulink
11. Simulation of Power Electronic Circuits using PSPICE
12. Simulation of Power Electronic Circuits using PSIM

09EE219 MEASUREMENTS AND COMPUTER AIDED ELECTRICAL MACHINE DESIGN LAB

Credits 0:0:2

1. Measurement of Resistance using Wheatstone and Kelvin's bridge
2. Measurement of Inductance using Hays and Anderson bridge
3. Measurement of Capacitance using Schering and Maxwell bridge
4. Calibration of voltmeter, Ammeter and Wattmeter
5. Study of Resistive , Inductive and Capacitive Transducers.
6. Study of Thermo Electric Transducers
7. Design of D.C Machine using AutoCAD
8. Design of Single and Three Phase Transformer using AutoCAD
9. Design of Three phase Induction Motor using AutoCAD
10. Design of Single Phase Induction Motor using AutoCAD
11. Design of Synchronous Machine using AutoCAD
12. Effect of air gap variation on induction machines performance

09EE220 COMPUTER AIDED POWER SYSTEMS ANALYSIS LABORATORY

Credits 0:0:2

1. Formation of Y_{bus} Matrix using Direct Inspection Method
2. Formation of Y_{bus} Matrix using Singular Transformation Method
3. Load Flow Analysis by Gauss-Seidel Method
4. Load Flow Analysis by Newton- Raphson Method
5. Automatic Load Frequency Control
6. Simulation of AVR(Automatic Voltage Regulator) using MATLAB-SIMULINK
7. Z_{bus} Formation using building algorithm
8. Analysis of Symmetrical Faults
9. Perform Economic Load Dispatch using MATLAB programming

10. Transient Stability Analysis of Single Machine Infinite Bus Bar (SMIB)
11. Harmonic Analysis of simple electrical circuit using MATLAB-SIMULINK
12. Speed Control of DC motor using MATLAB-SIMULINK

09EE301 INDUSTRIAL ELECTRONICS AND INSTRUMENTATION

Credit :4:0:0

COURSE OBJECTIVE

- To understand the concepts of Conventional and Digital Transducers
- To study the concepts of Industrial heating, Photoelectric devices and Smart Transducers
- To study the Microprocessor based instrumentation

UNIT I : REVIEW OF CONVENTIONAL TRANSDUCERS

Review of variable resistance transducers – variable inductance transducers – variable capacitance transducers-piezoelectric transducers.

UNIT II : DIGITAL TRANSDUCERS

Direct digital transducers – absolute and incremental displacement transducers – Moiré Fringe transducers – transducers with frequency output for the measurement of force and pressure – IC sensors for measurements of temperature and pressure.

UNIT III : INDUSTRIAL HEATING & PHOTOELECTRIC DEVICES

Industrial Heating using high frequency dielectric heating infrared and ultra violet heating – laser heating. Photoelectric devices and their application for industrial measurement and control – Introduction to PLC based industrial control.

UNIT IV : MICROPROCESSOR BASED INSTRUMENTATION

Detection of zero crossing of an alternating waveform – Microprocessor based triggering of a Thyristor – Microprocessor based AC voltmeter – Microprocessor based AC Ammeter – Microprocessor based Speed monitoring unit to provide protection against over speed – Microprocessor based phase difference and power factor monitoring unit – Microprocessor based over and under voltage and over current protection.

UNIT V : SMART TRANSDUCERS

Concept of smart/intelligent transducer – comparison with conventional transducers – self diagnosis and calibration features – two win transmitters – Measurement of flow, pH with smart transducers.

COURSE OUTCOME

During the end of the course the student would be able to

- Select the type of transducer for the Industrial application.
- Help the students to do case studies and mini projects in industries.
- Design the Microprocessor based Controllers.

REFERENCES

1. Biswas S.N, "Industrial Electronics", Dhanpat Rai & Company (P) Ltd., 2nd Edition, 2004.
2. Doebelin E.O, "Measurement Systems, Application and Design", Mc - Graw Hill Publishing Company Ltd., New Delhi, 5th Edition, 2002.
3. Chapman, P., "Smart Sensors" ISA publication, 1995.
4. Muhammad H. Rashid, " Power Electronics: Circuits, Devices and Applications", 2nd Edition, Prentice – Hall of India, New Delhi, 2003.
5. David Buchla and Wayne Mclachlan, "Applied Electronics Instrumentation and Measurement", Prentice Hall International, New Jersey, 1997.
6. Bhuyan Manabendra, "Intelligent Instrumentation: Principals and Applications", CRC Press, New Delhi, 2009.

09EE302 MICROPROCESSOR APPLICATIONS IN POWER ELECTRONICS

Credit :3:1:0

COURSE OBJECTIVE

For the students to

- Increase the understanding of Microprocessors and the interfacing of various peripherals
- Understand the flexibility of Embedded system in Power Electronic controls,
- Understand the fundamentals of ARM Processor, its internal architecture and features

UNIT I: REVIEW OF MICROPROCESSORS

Architecture and Programming of 8085 and 8086, A/D and D/A converters, Interfacing of 8253, 8255, 8155 and other interfacing ICs.

UNIT II: MICROPROCESSOR BASED FIRING SCHEME FOR CONVERTERS

Firing schemes for single phase and three phase rectifiers - 3-phase AC choppers, Firing at variable voltage and frequency environment, Firing scheme for DC choppers, voltage and current commutation, Inverters, PWM Techniques.

UNIT III: MICROPROCESSORS IN CLOSED LOOP CONTROL SCHEMES

Importance of measurement and sensing in closed loop control, Measurement of voltage, current, speed, power and power factor using microprocessors, Implementation of various types of controllers using microprocessors.

UNIT IV: SPECIAL APPLICATIONS OF POWER ELECTRONICS

Static excitation of synchronous generators, Solid state tap-changers for transformers, UPS systems, Induction furnace control.

UNIT V: ARM PROCESSOR

Fundamentals: Register – Current Program Status Register – Pipeline – Exceptions, Interrupts, Vector Table – Core Extensions – Architecture Revisions – ARM Processor Families – ARM Instruction Set: Data Processing Instructions – Branch Instructions – Load-Store Instructions – Software Interrupt Instruction – Program Status Register Instructions – Loading Constants – ARMv5E Extensions – Conditional Execution.

COURSE OUTCOME

Students will be able to

- Understand the role that power electronics play in the improvement of energy usage efficiency.
- Gain in-depth technical competence in selection of appropriate Microcontrollers and interfaces for solving a particular technical problem
- Design embedded controlled Power electronic converters and drives.

REFERENCES

1. Gaonkar R.S., "Microprocessor Architecture, Programming and Application With 8085", Prentice Hall, New Jersey, Paperback Edition, 2002.
2. Hall, D. V, "Microprocessors and Interfacing", Mcgraw-Hill Publishing Company, 2nd Edition, New Delhi, 2005.
3. Andrew N, Sloss, Dominic Symes, "ARM System Developers Guide Designing And Optimizing System Software", Margan Kaufmann Publishers, San Francisco, Illustrated Edition, 2004.
4. *Ned Mohan, Tore M. Undeland, William P. Robbins, "Power Electronics: Converters, Applications and Design", John Wiley & Sons Inc, New Jersey, 3rd Edition, 2002.*

09EE303 ADVANCED MICROPROCESSORS AND MICROCONTROLLERS

Credits 4:0:0

COURSE OBJECTIVE

For the student to

- Understand the basic architecture, memory and the features of Microprocessors and Microcontrollers
- Understand the concepts of modular programming.
- Understand the detailed architecture and features of Pentium processors,
- Understand the detailed architectures and features of popular RISC and ARM processors.

UNIT I: ADVANCED MICROPROCESSOR ARCHITECTURE

Internal Microprocessor Architecture-Real mode memory addressing – Protected Mode Memory addresses –Memory paging - Data addressing modes – Program memory addressing modes – Stack memory addressing modes – Data movement instructions – Program control instructions - Arithmetic and Logic Instructions.

UNIT II : MODULAR PROGRAMMING AND ITS CONCEPTS

Modular programming –Using keyboard and Video display –Data Conversions- Disk files-Interrupt hooks - using assembly languages with C/ C++.

UNIT III: PENTIUM PROCESSORS

Introduction to Pentium Microprocessor – Special Pentium registers- Pentium memory management – New Pentium Instructions – Pentium Processor –Special Pentium pro features – Pentium IV Processor.

UNIT IV: 16-BIT MICRO CONTROLLER

8096/8097 Architecture-CPU registers –RALU-Internal Program and Data memory Timers-High speed Input and Output –Serial Interface-I/O ports –Interrupts –A/D converter-Watch dog timer –Power down feature –Instruction set- External memory Interfacing –External I/O interfacing.

UNIT V: RISC PROCESSORS AND ARM

The RISC revolution – Characteristics of RISC Architecture – The Berkeley RISC – Register Windows – Windows and parameter passing – Window overflow – RISC architecture and pipelining – Pipeline bubbles – Accessing external memory in RISC systems – Reducing the branch penalties – Branch prediction – The ARM processors – ARM registers – ARM instructions – The ARM built-in shift mechanism – ARM branch instructions – sequence control – Data movement and memory reference instructions.

COURSE OUTCOME

Students will able to

- Explore the peripheral features, processing speeds and limitations of popular microcontrollers.
- Handle the design and develop of small scale embedded projects
- Perform programming in both assembly and high-level languages.

REFERENCES

1. Barry B.Brey, "The Intel Microprocessors 8086/8088, 80, 86, 80286, 80386 80486, Pentium, Pentium Pro Processor, Pentium II, Pentium III, Pentium 4, Architecture, Programming and interfacing", Prentice Hall of India Private Limited, New Delhi, 6th Edition, 2003.
2. John Peatman, "Design with Micro Controllers", McGraw- Hill International Edition, Singapore, illustrated Edition, 1988.
3. Alan Clements, "The principles of computer Hardware", Oxford University Press, New Delhi, 4th Edition, 2006.
4. Raj kamal, "The concepts and feature of micro controllers 68HC11, 8051 and 8096"; S Chand Publishers, New Delhi, 2004.

09EE304 PLC AND AUTOMATION

Credit :4:0:0

COURSE OBJECTIVE

- To learn the basics of PLC.
- To study the programming of PLC and HMI systems.
- To study about the DCS.
- To understand the concept of Automation.

UNIT I: PROGRAMMABLE LOGIC CONTROLLERS

Basics of PLC - Architecture of PLC - Advantages - Types of PLC - Introduction to PLC Networking- Networking standards. - Protocols - Field bus - Process bus and Ethernet IEEE Stand

UNIT II: PROGRAMMING OF PLC & HMI SYSTEMS PROGRAMMING OF PLC: Types of Programming - Simple process control programs using Relay Ladder Logic and Boolean logic methods - PLC arithmetic functions - Introduction to advanced programming methods.

HMI systems: Necessity and Role in Industrial Automation, Text display - operator panels - Touch panels - Panel PCs - Integrated displays (PLC & HMI)

UNIT III: DISTRIBUTED CONTROL SYSTEMS (DCS)
Difference between SCADA system and DCS – architecture – local control unit – programming language – communication facilities – operator interface – engineering interfaces.

UNIT IV: APPLICATIONS OF PLC & DCS
Case studies of Machine automation, Process automation, Introduction to SCADA Comparison between SCADA and DCS

UNIT V: AUTOMATION
Factory Automation: Flexible Manufacturing Systems concept – Automatic feeding lines, ASRS, transfer lines, automatic inspection – Computer Integrated Manufacture – CNC, intelligent automation, Industrial networking, bus standards, HMI Systems, DCS and SCADA, Wireless controls.

COURSE OUTCOME

During the end of the course the student would be able

- To understand the concepts of PLC
- To design controllers for industrial automation systems

REFERENCES

1. John.W.Webb & Ronald A. Reis, "Programmable logic controllers: Principles and Applications", Prentice Hall of India, 2003.
2. Michael P. Lukas, "Distributed Control systems", "Van Nostrand Reinfold Company, 1995.
3. Gary Dunning, "Introduction to Programmable Logic Controllers", Thomson Press, 3rd Edition, USA, 2005.
4. Bolton. W, "Programmable Logic Controllers", Elsevier India Private Limited, 4th Edition, New Delhi, 2008.
5. Mikell P. Groover, "Automation Production systems and Computer Integrated Manufacturing", Prentice Hall of India, New Delhi, 2007

ELECTRICAL AND ELECTRONICS ENGINEERING

ADDITIONAL SUBJECTS

Sl.No	Subject Code	Name of the Subject	Credits
1	10EE201	Electric Circuits and Networks	3:1:0
2	10EE202	Digital Signal Processing	3:1:0
3	10EE203	Renewable Energy Sources	3:0:0
4	10EE204	Micro Electro Mechanical Systems	4:0:0

10EE201 ELECTRIC CIRCUITS AND NETWORKS

Credit: 3:1:0
Course Objective:

This Course will provide the students to
1. Develop an understanding of the fundamental elements of electric circuits.
2. Develop the ability to apply the basic theorems to analyze a DC and AC electric circuit.
3. Use mathematical methods such as Laplace and Fourier transforms and some linear algebra techniques and differential equations to solve circuits problems
4. Synthesize a network with stable condition.

Course Outcome:
At the end of this course, the student should be able to
1. Analyze simple circuits applying Ohm's and Kirchhoff's laws
2. Analyze first-order, second order response of RL, RC and RLC circuits.
3. Demonstrate the network parameters of a transmission cable.
4. Design any non linear network, filters and attenuators for an application

Unit I: Circuit Analysis
System of Units-Electrical Quantities-Circuit elements-Independent and Dependent sources-Ohm's Law-Kirchhoff's Laws-Analysis of circuits using Kirchhoff's law, Source transformation, Wye-Delta transformation - Network graph - tree and cut sets - Cut set and tie set schedule- dual network - Matrix representation and solution of AC and DC networks, Node and Loop basis analysis of AC and DC.

Unit II: Network Theorems
Superposition, Reciprocity, Substitution, Thevenin, Norton, and Maximum Power Transfer Theorems - Problems

Unit III: Transient Response of Electric Circuits
Transient Concepts – Singularity functions-unit step, unit impulse-transient response of simple RL, RC and RLC series and parallel circuits for step input and sinusoidal excitation-Laplace transform application to the solution of RL, RC & RLC circuits: initial and final value theorem and applications – Concept of complex frequency – Driving point and transfer impedances – Poles and zeros of network function.

Unit IV: Coupled Circuits and Three Phase Circuits
Coupled circuits – coefficient of coupling – self and mutual inductances – analysis of coupled circuits – single and double tuned coupled circuits – Three phase circuits – balanced circuits - star and delta connected loads - phase sequence - unbalanced circuits - solution of unbalanced star and delta connected loads – power measurement by two wattmeter method.

Unit V: Two Port Networks and Filters
Driving point and transfer impedance/admittance - voltage and current ratios of two port networks - admittance, impedance, hybrid, transmission and image parameters for two port networks – impedance matching – equivalent π and T networks – passive filters as a two port network – characteristics of ideal filter – low pass and high pass filters.

Text Books:

1. Navhi and Edminister J A, " Theory and Problems of Electric circuits" Tata McGraw- Hill Publishing Company Limited, New Delhi, 2007.
2. Sudhakar , Shyammohan S Palli, "Circuits and Networks – Analysis and Synthesis", Tata McGraw- Hill Publishing Company Limited, New Delhi, 2007.

Reference Books

1. Charles K Alexander and Mathew N O Sadiku, "Fundamentals of Electric Circuits", Tata Mc Graw -Hill Publishing Company Limited, New Delhi, 2007.
2. Jack E Kemmerly, Steven M Durbin and William H Hayt Jr, "Engineering Circuit Analysis", Tata Mc Graw- Hill Publishing Company Limited, New Delhi, 2006.
3. Sivanandam.S.N., "Electric Circuit Analysis", Vikas Publishing House Private Limited, New Delhi, 2001.

10EE202 DIGITAL SIGNAL PROCESSING

Credits 3:1:0

Course Objective:

This Course will provide the students

1. To have an overview of signals and systems.
2. To study DFT & FFT Transforms.
3. To study the design of IIR filters.
4. To study the design of FIR filters.
5. To study the applications of DSP techniques in processors.

Course Outcomes:

At the end of the course the students will have an understanding on the

1. Different types of digital signals and systems.
2. Different Transforms and its application to signals and systems.
3. Design of IIR & FIR filters.
4. Different DSP processors.

Unit I: Discrete Time Signals and Systems
Need and benefits of Digital Signal Processing – Signal Classification and basic operations on them – Properties of DT system: Linear, Time Invariance, Causal, Stable, Passive and Lossless – LTI system: Convolution Sum- Interconnection Schemes- I/O relationship determination of

impulse response and step response -Anti Aliasing and Anti Imaging Filtering-Typical DSP system: ADC/DAC – sampling, quantization, and encoding.

Unit II: Discrete Transforms

Discrete Fourier Transform (DFT): Properties – DIT FFT and DIF FFT algorithms- linear filtering via circular convolution-inverse FFT- Wavelet Transform: MRA by the wavelet method.

Unit III: Infinite Impulse Response Digital Filters

Review of design of Analogue Butterworth and Chebyshev Filters, Frequency transformation in analogue domain – Design of IIR digital filters using impulse invariance technique – Design of digital filters using bilinear transform – pre warping – Frequency transformation in digital domain – Realization using direct, cascade and parallel forms.

Unit IV: Finite Impulse Response Digital Filters

Symmetric and Anti symmetric FIR filters – Linear phase FIR filters – Design using Frequency sampling technique – Window design using Hamming, Hanning and Blackmann Windows – Concept of optimum equiripple approximation – Realization of FIR filters – Transversal, Linear phase and Polyphase realization structures.

Unit V: General Purpose Signal Processors

Computer Architectures for Signal Processing – Van Neumann and Harvard architectures pipelining- hardware multiplier-accumulator-special instructions-replication-on-chip memory-extended parallelism: SIMD, VLIW, and super scalar processing –selecting digital signal processors.

Text Books:

1. Emmanuel C. Ifeachor, Barrie W.Jervis, “Digital Signal Processing , A Practical approach”, Pearson Education India Series, New Delhi, 2004.
2. Lonnie C.Ludeman, “Fundamental of Digital Signal Processing”, John Wiley & Sons, New Jersey, 2003.

Reference Books:

1. Oppenheim, A.V.and Schaffer, R.W., “Discrete Time Signal Processing”, Prentice Hall of India, New Delhi,2001.
2. Sanjit K.Mitra, “Digital Signal Processing, A Computer Based Approach”, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2004.
3. John. G. Proakis , Dimitris .G. Manolakis, “Digital Signal Processing: Principles, Algorithms & Applications”, Prentice Hall of India, New Delhi, 2007.

10EE203 RENEWABLE ENERGY SOURCES

Credits: 3:0: 0

Course Objectives:

1. To explain concept of various forms of renewable energy
2. To outline division aspects and utilization of renewable energy sources for both domestics and industrial applications
3. To analyse the environmental and cost economics of using renewable energy sources compared to fossil fuels.

Course Outcome:
At the end of the semester the student will
1. Have knowledge about various renewable energy sources
2. Be able to choose the appropriate renewable energy as an alternate for conventional power in any application.
3. Be able to analyze the cost effect of renewable energy sources.

Unit I: Solar Energy
Solar radiation its measurements and prediction - solar thermal flat plate collectors, concentrating collectors – applications - heating, cooling, desalination, power generation, drying, cooking etc - principle of photovoltaic conversion of solar energy, types of solar cells and fabrication. Photovoltaic applications: battery charger, domestic lighting, street lighting, and water pumping, power generation schemes.

Unit II: Wind Energy
Atmospheric circulations – classification - factors influencing wind - wind shear – turbulence - wind speed monitoring - Betz limit - Aerodynamics of wind turbine rotor- site selection - wind resource assessment - wind energy conversion devices - classification, characteristics, and applications. Hybrid systems - safety and environmental aspects.

Unit III: Bio-Energy
Biomass resources and their classification - chemical constituents and physicochemical characteristics of biomass - Biomass conversion processes - Thermo chemical conversion: direct combustion, gasification, Pyrolysis and liquefaction - biochemical conversion: anaerobic digestion, alcohol production from biomass - chemical conversion process: hydrolysis and hydrogenation. Biogas - generation - types of Biogas Plants- applications

Unit IV: Hydrogen and Fuel Cells
Thermodynamics and electrochemical principles - basic design, types, and applications - production methods - Biophotolysis: Hydrogen generation from algae biological pathways - Storage gaseous, cryogenic and metal hydride and transportation. Fuel cell – principle of working- various types - construction and applications.

Unit V: Other Types of Energy
Ocean energy resources - principles of ocean thermal energy conversion systems - ocean thermal power plants - principles of ocean wave energy conversion and tidal energy conversion – hydropower – site selection, construction, environmental issues - geothermal energy - types of geothermal energy sites, site selection, and geothermal power plants.

Text Book:

1. Rai G. D., “Non conventional Energy Sources”, Khanna Publishers, New Delhi, 2007.

Reference Books:

1. Sukhatme, S.P., “Solar Energy”, Tata McGraw - Hill Publishing Company Limited, 2006.
2. John Twidell, Tony Wier, “Renewable Energy Sources”, Taylor & Francis Publishers, New York, 2005.

3. Thomas .b. Johansson, Henry Kelly, Amulya K.N .Reddy, Robert .H. Williams, "Renewable Energy Sources for Fuels and Electricity", Island Press, Washington DC, 2009.
4. Anthony San Pietro, Biochemical and Photosynthetic aspects of Energy Production, Academic Press, 1980.
5. Khandelwal K.C, Mahdi S.S., Biogas Technology - A Practical Handbook, Tata Mc Graw Hill, 1986.

10EE204 MICRO ELECTRO MECHANICAL SYSTEMS

Credits: 4:0:0

Course Objective:

1. To introduce the concept of Micro Electro Mechanical Systems
2. To outline different methods of micromachining , microstructures, micro sensors, and micro actuators
3. To cover various applications of MEMS

Course Outcomes

At the end of the semester the students will be able to

1. Have knowledge about various Micro Electro Mechanical Systems
2. Understand Material Processing and Device Fabrication using which can do Microsystems Design for various applications.
3. Understand the Applications of MEMS in various fields.

Unit I: Introduction To MEMS:

Historical background of Micro Electro Mechanical Systems, role of MEMS in improved efficiency, Smart materials and structures, materials-processing, synthesis, Multifunctional polymers.

Unit II: Material Processing and Device Fabrication:

Lithography, Ion Implantation, Etching, Wafer bonding, Integrated processes, Bulk silicon micro machining, surface micro machining, CVD oxide process.

Unit III: Micro Sensors and Micro actuators:

Micromechanical components – springs, bearings, gears and connectors, High temperature sensors, Capacitive pressure sensor, bulk micro-machined accelerometer, Surface micro machined micro spectrometer.

UNIT IV : Microsystems Design and Packaging

Design considerations, Mechanical Design, Process design, Realization of MEMS components using intellisuite. Micro system packaging, Packing Technologies, Assembly of Microsystems, Reliability in MEMS.

Unit V: Applications of MEMS:

Blood Pressure Monitoring Transducers, Disposable Blood Pressure Monitoring Transducers. MEMS devices – Infusion pumps, Kidney dialysis, Respirators, Active noise and vibration control, Intelligent structures, micro –robots, Smart structures for aircraft, automotive requirements, automobile, Satellite, Buildings and Manufacturing systems.

Text book:

1. Tai-Ran Hsu, "MEMS & Microsystems, Design and Manufacture", McGraw Hill, New York, 2006.

Reference Books:

1. Maluf, Nadim, An introduction to Micro Electro mechanical Systems Engineering, AR Tech house, Boston 2000.
2. Julian W.Gardner,Vijay K.Varadan,Osama O.Awadel Karim,Microsensors MEMS and Smart Devices, John Wiley & Sons Ltd., New York, 2001.
3. S.Fatikow,U.Rembold, Microsystems Technology and Micro robotics, Springer-Verlag Berlin Heidelberg ,1997.
4. Mohamed Gad-el-Hak, The MEMS Hand book, CRC Press 2002.
5. Lawrence.J.Kamm, "Understanding Electro-Mechanical Engineering", PHI, 2000.

DEPARTMENT OF ELECTRICAL
&
ELECTRONICS ENGINEERING

NEW SUBJECTS

Subject Code	Name of the Subject	Total Credits
10EE301	Optimization Techniques	3:1:0
10EE302	Power Converters and Analysis	3:1:0
10EE303	Solid State Drives and Control	3:1:0
10EE304	Electro Magnetic Interference and Compatibility	4:0:0
10EE305	Electric and Hybrid Vehicles	3:1:0

10EE301 OPTIMIZATION TECHINIQUES

Credit: 3:1:0

Course Objectives:

- To insist the importance of optimization problems and their applications
- To instruct the steps for formulating optimization problems
- To impart the knowledge of traditional and modern optimization techniques

Course Outcomes:

- Students will be able to state the different types of optimization problems, their formulation and solution techniques.
- Students will be able to understand the mechanisms of various traditional and modern optimization techniques
- Students will be able to apply the optimization techniques for practical applications

Unit I: **Introduction to Optimization**

Statement of optimization problem –Formulation of optimization problems-Examples- Classical optimization techniques – Single variable and multi variable optimization – Method of direct substitution- constraint variation – Lagrange multipliers- Multivariable optimization with equality constraints- Kuhn Tucker conditions.

Unit II: **Linear Programming**

Linear programming definition – Pivotal reduction of general system of equations – Simplex algorithms – Two phases of the simplex method – Revised simplex method – Duality in linear programming

Unit III: **Nonlinear Programming (Unconstrained Optimization)**

One dimensional problems-Dichotomous search, Fibonacci method– Multidimensional problems- Univariate method- Simplex method –Steepest descent method – Conjugate gradient method- Quasi Newton methods

Unit IV: **Nonlinear Programming (Constrained Optimization)**

Direct methods – The Complex method – Cutting plane method – Methods of feasible directions and determination of step length – Termination criteria, determination of step length.

Unit V: **Modern Optimization Techniques**

Limitation of conventional methods- Modern heuristic techniques for optimization – Genetic algorithm –concept- operators – procedure, Adaptive genetic algorithm – Evolutionary programming, Simulated annealing- Neural Network Optimization- Fuzzy logic optimization- Typical applications to power engineering problems.

References

1. Rao S.S, "Engineering Optimization: Theory and Practice", New Age International Pvt. Ltd., New Delhi, 2009.
2. Sivanandam S.N., Deepa S.N., "Principles of Soft Computing", Wiley India Pvt. Ltd., New Delhi, 2008.
3. Kalyanmoy Deb, "Optimization for Engineering Design: Algorithms and Examples" Prentice-Hall of India Pvt. Ltd., New Delhi, 2003.

10EE302 POWER CONVERTERS AND ANALYSIS

Credits: 3:1:0

Course Objective:

1. To give in depth knowledge of the various power electronics circuits,
2. Analyze the behavior of the Power Electronic circuits along with their design.

Course Outcome:

After completing the course, the student should be able to:

1. Analyze the circuits and select them for the suitable applications.
2. Understand the problems associated with the Power Electronic circuits.

Unit I: AC to DC Converters

Single phase and three phase bridge rectifiers, half controlled and fully controlled converters with RL, RLE loads, Freewheeling diode, Dual Converter. Evaluation of performance parameter, Input harmonics and output ripple, smoothing inductance, power factor, effect of source impedance, overlap, Design of converter circuits – Snubber circuit design – Control circuit strategies.

Unit II: DC to DC Converters

DC Choppers: Step down dc chopper with R, RL and RLE loads – Control strategies – Continuous and discontinuous current operations – Two quadrant and four quadrant DC chopper – Multiphase DC chopper – Switching mode regulators: Buck, Boost, Buck-Boost and CUK regulators – Chopper circuit design – Control circuit strategies.

Unit III: AC Phase Converter

Principle of phase control, single-phase bidirectional controllers with R, L and R-L loads, 3-phase bidirectional Controllers, different Configurations, Analysis with pure R and L loads. Principle of operation – single phase and three phase cyclo converters – Control circuit strategies.

Unit IV: DC to AC Converters

Single phase and Three phase bridge inverters – Evaluation of performance parameters – Voltage control and Waveform improvement Techniques – Current source inverters – Inverter circuit design.

Unit V: Resonant and Soft-Switching Converters
Introduction – Classification – Resonant Switch – Quasi-Resonant Converters – Multi resonant Converters.

References:

1. Rashid M.H., "Power Electronics Circuits, Devices and Applications", Prentice Hall India, New Delhi, 2003.
2. Sen P.C., "Modern Power Electronics", Tata McGraw Hill, New Delhi, 2004.
3. Ned Mohan, Tore M. Undeland, William P Robbins, "Power Electronics: Converters, Applications, and Design", John Wiley and Sons Inc., New York, 2003.
4. Joseph Vithayathil, "Power Electronics", New Age International (P) Limited, New Delhi, 1995.
5. MD Singh and K B Khanchandani, "Power Electronics", Tata McGraw Hill, 2nd Edition, New Delhi, 2006.

10EE303 SOLID STATE DRIVES AND CONTROL

Credits: 3:1:0

Course Objective:
1. To understand the basic concept of DC and AC Drives.
2. To understand the various control techniques involved with both DC and AC Drives.
3. To brief about the working principle of Special Electrical Drives.

Course Outcome:
After taking this course, the student will be able to:
1. Design and Analyze different control techniques of DC Drive
2. Design and Analyze different control techniques of AC Drive
3. Select suitable Special Electrical Drive and apply appropriate control method for the application.

Unit I: Converter Fed DC Drives
Single-phase and Three-phase drives – Separately excited and series motor drives – Semiconverter and full converter fed drives – General analysis – Evaluation of performance parameters – Dual converter fed drives.

Unit II: Chopper Fed DC Drives
Single – quadrant chopper controlled drives – Evaluation of performance parameters for separately excited and series motor drives – Two quadrant and four quadrant chopper controlled drives.

Unit III: Induction Motor Drives

Stator control: Stator voltage control of 3-Phase induction motors: control by AC voltage controllers – Variable frequency square wave VSI drives – PWM Drives – CSI drives – closed loop control. R**otor Control:** Static rotor resistance control – Slip power recovery: Static Kramer drive – Static Scherbius drive.

Unit IV: Vector Control, Sensor less and Direct Torque Control of Induction Motors
Principle of vector – Rotor flux – Oriented control, Stator Flux-oriented control, Magnetizing flux-oriented control of Induction Machines. Basic types of torque controlled drive scheme: vector drives – direct torque controlled drives.

Unit V: Special Drives
Synchronous Motor Drives: Scalar Control – True synchronous and self control modes – Permanent magnet motor control – Switched reluctance motor and stepper drives.

References:

1. Gopal K Dubey, "Fundamentals of Electric Drives", Narosa Publishing House, New Delhi, 2005.
2. Pillai S.K., "Analysis of Thyristor Power Conditioned Motors", University Press, 1992.
3. Bimal K Bose, "Power Electronics and Variable Frequency Drives – Technology and Application", IEEE Press, New York, 1997.
4. Peter Vas, "Vector Control of AC Machines", Oxford University Press, 1990.
5. Krishnan R, "Electric Motor Drives: Modeling, Analysis and Control, Prentice Hall of India, Pvt. Ltd., New Delhi, 2002.

10EE304 ELECTRO MAGNETIC INTERFERENCE AND COMPATIBILITY

Credits: 4:0:0

Course Objective:
1. To understand different Electro Magnetic Interference problems and various mitigation techniques.
2. To understand EMI Sources, EMI problems and their solution methods in PCB level / Subsystem and system level design.
3. To understand EMC Design and Standards.

Course Outcome:
After completing the course, the student should be able to:
1. Design a compatible system with less interference.
2. Provide solution methods in PCB level / Subsystem and system level design.

Unit I: EMI Environment
Sources of EMI conducted and radiated EMI, Transient EMI, EMI-EMC Definitions and units of parameters.

Unit II: EMI Coupling Principles & EMI Specification / Standards / Limits
Conducted, Radiated and Transient Coupling, Common Impedance Ground Coupling, Radiated Common Mode and Ground Loop Coupling, Radiated Differential Mode Coupling, Near Field

Cable to Cable Coupling, Power Mains and Power Supply Coupling -Units of specifications, Civilian standards Military standards.

Unit III: EMI Measurements
EMI Test Instruments /Systems, EMI Test, EMI Shielded Chamber, Open Area Test Site, TEM Cell Antennas, Conductors Sensors/Injectors/Couplers, Military Test Method and Procedures, Calibration Procedures.

Unit IV: EMI Control Techniques
Shielding, Filtering, Grounding, Bonding, Isolation Transformer, Transient Suppressors, Cable Routing, Signal Control, Component Selection and Mounting.

Unit V: EMC Design of PCBs
PCB Traces Cross Talk, Impedance Control, Power Distribution Decoupling, Zoning, otherboard Designs and Propagation Delay Performance Models.

References:

1. Clayton R. Paul, "Introduction to Electromagnetic Compatibility", John Wiley & Sons, New York, 2006.
2. William D. Kimmel and Daryl D. Gerke, " EMI Suppression Handbook" , Seven Mountains Scientific Inc., 1998.
3. Bernhard Keiser, "Principles of Electromagnetic Compatibility", Artech house, 1998.
4. Henry W.Ott, "Noise Reduction Techniques in Electronic Systems", John Wiley and Sons, NewYork. 1988.
5. Kodali V.P., "Engineering EMC Principles, Measurements and Technologies", IEEE Press, 1996.

10EE305 ELECTRIC AND HYBRID VEHICLES

Credits: 3:1:0

Course Objective:
1. To understand the concept of Electric Vehicle Technology.
2. To understand various architectures of Hybrid Electric Vehicle (HEV) technology.

Course Outcomes:
1. The students will be able to understand the need of Hybrid Vehicles and Electric vehicles.
2. The students will be able to design different types of Architectures in Electric & Hybrid Vehicles.

Unit I: Electric Vehicles
Layout of an Electric Vehicle, performance of electric vehicles – traction motor characteristics, tractive effort, transmission requirements, vehicle performance, energy consumption, advantage and limitations, specifications, system components, electronic control system.

Unit II: Hybrid Vehicles
Concepts of hybrid electric drive train, architecture of series and parallel hybrid electric drive train, merits and demerits, series and parallel hybrid electric drive train design.

Unit III: Electric Propulsion System and Motor Control system

DC Motors, AC Motors, Permanent Magnet Motors, Brushless DC and Reluctance Motors, Characteristics, Regenerative Braking, Control System Principles, speed and torque control – DC motors and AC Motors

Unit IV: Energy Storages & Generators

Electromechanical batteries – types of batteries – lead acid batteries, nickel based batteries, lithium based batteries, electrochemical reactions, thermodynamic voltage, specific energy, specific power, energy efficiency, ultra capacitors – DC Generators, AC Generators, Voltage and Frequency regulations.

Unit V: Fuel Cells & Solar Cars

Fuel Cell, Construction, Working, Equations, possible fuel sources, fuel reformer, design, solar cars, photovoltaic cells, tracking, efficiency and cost comparison.

References:

1. Mehrdad Ehsani, Yimin Gao, Sebatien Gay and Ali Emadi, " Modern Electric, Hybrid Electric and Fuel cell vehicles: Fundamentals, Theory and Design", CRC press, 2004.
2. James Larminie and John Loury, " Electric Vehicle Technology – Explained", John Wiley & Sons Ltd, 2003.
3. Sandeep Dhameja, "Electric Vehicle Battery Systems", Butterworth – Heinemann, 2002.
4. Ronald K Jurgen, "Electric and Hybrid – Electric Vehicles", SAE, 2002.
5. Ron Hodkinson and John Fenton, "Light Weight Electric/Hybrid Vehicle Design", Butterworth – Heinemann, 2001.

ADDITIONAL SUBJECTS

Sl.No	Subject Code	Subject Name	Credits
1	11EE101	Basic Electrical Engineering	3:0:0
2	11EE201	Electric Circuits	3:1:0
3	11EE202	Network Theory	3:1:0
4	11EE203	Electronic Devices	3:1:0
5	11EE204	Circuits and Devices Lab	0:0:2
6	11EE205	Electrical and Electronics Workshop	0:0:2
7	11EE206	Electromagnetic Fields	3:1:0
8	11EE207	DC Machines and Transformers	3:1:0
9	11EE208	DC Machines and Transformers Laboratory	0:0:2
10	11EE209	Induction and Synchronous Machines	3:1:0
11	11EE210	AC Machines and Control System Laboratory	0:0:2
12	11EE211	Electrical Machine Design	3:1:0
13	11EE212	Power Electronics	3:1:0
14	11EE213	Power Electronics and Drives Laboratory	0:0:2
15	11EE214	Electric Drives and Control	3:0:0
16	11EE215	Generation, Transmission and Distribution	3:1:0
17	11EE216	Power System Analysis	3:1:0
18	11EE217	Computer Aided Power System Analysis Laboratory	0:0:2
19	11EE218	Power System Protection and Switchgears	4:0:0
20	11EE219	Control Systems	3:1:0
21	11EE220	Linear Integrated Circuits	3:1:0
22	11EE221	Microprocessors and Microcontrollers	3:1:0
23	11EE222	Microprocessor and Microcontroller Laboratory	0:0:2
24	11EE223	C++ and Data Structures	4:0:0
25	11EE224	C++ and Data Structures Laboratory	0:0:2
26	11EE225	Measurement and Instrumentation	4:0:0
27	11EE226	Measurements and Computer Aided Electrical Machine Design Laboratory	0:0:2
28	11EE227	Material Science	3:0:0
29	11EE228	Mobile Communication	4:0:0
30	11EE229	Biomedical Instrumentation	4:0:0
31	11EE230	VLSI Design	4:0:0
32	11EE231	Embedded system	4:0:0
33	11EE232	Virtual Instrumentation	4:0:0
34	11EE233	Operating Systems	3:0:0
35	11EE234	Computer Communication	3:0:0
36	11EE235	Computer Architecture	3:0:0
37	11EE236	High Voltage Engineering	3:0:0
38	11EE237	Power System Stability	4:0:0

39	11EE238	Power System Control	4:0:0
40	11EE239	Illumination Engineering	4:0:0
41	11EE240	Automotive Electronics	4:0:0
42	11EE241	Network Analysis and Synthesis	3:1:0
43	11EE242	Energy Systems	4:0:0
44	11EE243	Micro Electromechanical Systems	4:0:0
45	11EE244	Advanced Control System	3:1:0
46	11EE245	PLC and Automation	4:0:0
47	11EE246	Distributed Control System	3:1:0
48	11EE247	Virtual Instrumentation	3:0:0
49	11EE248	Illumination Engineering	3:0:0
50	11EE249	Automotive Electronics	3:0:0
51	11EE250	Basics of Electric and Hybrid Vehicle	3:0:0
52	11EE251	Building Automation	3:0:0
53	11EE252	Fundamentals of Electrical Safety	3:0:0
54	11EE301	Power Semiconductor Devices	4:0:0
55	11EE302	Linear Systems	3:1:0
56	11EE303	Advanced Digital Processing	4:0:0
57	11EE304	Simulation of Power Electronics Systems	3:1:0
58	11EE305	Power Electronics Applications to Power Systems	3:1:0
59	11EE306	Neuro – Fuzzy Controllers for Electric Drives	4:0:0
60	11EE307	Generalized Theory of Electrical Machines	3:1:0
61	11EE308	Special Machines and Controllers	4:0:0
62	11EE309	Power Electronics in Wind and Solar Power Conversion	4:0:0
63	11EE310	HVDC Transmission	4:0:0
64	11EE311	Advanced Topics in Power Electronics	4:0:0
65	11EE312	Robotics and Factory Automation	4:0:0
66	11EE313	Microcontrollers and Applications	4:0:0
67	11EE314	Computer Numerical Control	4:0:0
68	11EE315	Embedded Systems	4:0:0
69	11EE316	SCADA and DCS	4:0:0
70	11EE317	Power Quality Management	3:1:0
71	11EE318	Flexible AC Transmission Systems (FACTS)	4:0:0
72	11EE319	Industrial Electronics and Instrumentation	4:0:0
73	11EE320	Restructured Power Systems	4:0:0
74	11EE321	Power Electronics Laboratory	0:0:2
75	11EE322	Electric Drives and Control Laboratory	0:0:2
76	11EE323	Power Engineering Simulation Laboratory	0:0:2
77	11EE324	Photovoltaic Systems	4:0:0
78	11EE325	Power Electronic Circuits	3:1:0
79	11EE326	Solar Thermal Energy Conversion	4:0:0
80	11EE327	Advanced Control Techniques for Induction Generators	3:1:0
81	11EE328	Energy Engineering	4:0:0

82	11EE329	Wind Energy	4:0:0
83	11EE330	Hydrogen and Fuel Cells	4:0:0
84	11EE331	Energy Management and Audit	3:1:0
85	11EE332	Bio-Mass Energy	4:0:0
86	11EE333	Energy Modelling, Economics and Project Management	3:1:0
87	11EE334	Solar Energy Lab	0:0:2
88	11EE335	Wind Energy Lab	0:0:2
89	11EE336	Solar Passive Architecture	4:0:0
90	11EE337	Green Building	4:0:0
91	11EE338	Data Mining for Renewable Energy Technology	3:1:0
92	11EE339	Soft Computing Techniques	3:1:0

11EE101 BASIC ELECTRICAL ENGINEERING

Credits 3:0:0

Course Objective:

i. To impart the basic knowledge about the Electric and Magnetic circuits.
ii. To inculcate the understanding about the AC fundamentals.
iii. To understand the working of various Electrical Machines.
iv. To know about various measuring instruments and house wiring.

Unit I: DC Circuits

Standard symbols – Units & Abbreviations – Circuit Elements – Current and Voltage Sources – Ohm's and Kirchhoff's law – Resistive circuits – Series and Parallel reduction – Voltage and Current Division – Source transformation – Star Delta Transformation.

Unit II: Magnetic Circuits

Magnetic flux- flux density – reluctance – permeance-magnetic effect of electric circuit-Law of Electromagnetic induction – induced emf – self and mutual inductance – coupling co-efficient – inductance in series and parallel, Magnetic Materials.

Unit III: AC Fundamentals

Sources of Electrical Energy – Thermal, Hydro and Nuclear power generating station – Transmission of Electric Power – Introduction to Alternating Quantities – Average and RMS values – Circuit Elements – Phasor representation – Introduction to three phase system.

Unit IV: Electrical Machines

Working principle, operation and application of DC Generator, DC Motor, Transformer, Three Phase Induction motor, single phase Induction motor, Alternator. (Quantitative approach)

Unit V: Measuring Instruments and House Wiring

Classification of Instruments – Essential features of Indicating Instrument – Deflecting, Controlling and Damping Mechanism - Moving Coil instrument – Moving Iron Instrument – Induction type Instruments – examples. Wiring materials and accessories – Types of wiring –

Fluorescent lamp wiring – stair case wiring – basic principles of earthing – layout for a residential building.

Course Outcome:

At the end of the course, student would be able to:

i. Predict the behavior of any electrical and magnetic circuits.
ii. Identify the type of electrical machine used for that particular application.
iii. Wire any circuit depending upon the requirement.

Text Book

1. Muraleedharan K.A, Muthusubramanian R & Salivahanan S, "Basic Electrical, Electronics & Computer Engineering", Tata McGraw Hill Limited, New Delhi, 2006.

Reference Books

1. Chakrabarti .A, Sudipta nath and Chandan Kumar, "Basic Electrical Engineering", Tata Mc Graw Hill Limited, New Delhi, 1st Edition, 2009.
2. Edward Hughes, "Electrical Technology", ELBS, 6th Edition, 2002.
3. Mittle. V.N., "Basic Electrical and Electronics Engineering", Tata McGraw Hill Edition, New Delhi, 1st edition, 2007.
4. Openshaw Taylor .E, "Utilization of Electrical Energy in SI Units", Orient Longman limited, New Delhi, 2007.

11EE201 ELECTRIC CIRCUITS

Credits 3:1:0

Course Objective:

i. To understand the concepts and investigate the behavior of electric circuits by analytical techniques.
ii. To learn the basic concepts of single phase DC and AC electrical circuits.
iii. To imbibe the methods of circuit analysis using network theorems.
iv. To introduce the concepts of AC resonance circuits.

Unit I: Introduction

System of Units-Electrical Quantities-Circuit elements-Independent and Dependent sources-Ohm's Law-Kirchoff's Laws-Analysis of circuits using Kirchoff's law-Circuits with dependent sources –Network reduction, Star-Delta transformation – Introduction to PSPICE.

Unit II: AC Circuits

Introduction to time varying and alternating quantities-Average and RMS (effective) values-Form Factor- Phasor Relationships for circuit elements-Steady state using Phasor algebra – Analysis using Kirchoff's laws – Power triangle – Power factor.

Unit III: Mesh and Nodal Analysis

Loop analysis – mesh equations for circuits with independent current sources-mesh equations for circuits with dependent sources –Nodal Analysis: Node equations for circuits with independent voltage sources-node equation for circuits with dependent sources.

Unit IV: Network Theorems

Superposition theorem, Source transformation, Thevenin's theorem, Norton's theorem, Maximum Power transfer theorem, Reciprocity theorem, Tellegen's theorem.

Unit V: Resonance

Resonance in Series and Parallel RLC circuits – Bandwidth – Quality Factor –Selectivity.

Course Outcome:

At the end of the course, student would be able to:

i. Apply the elementary concept of electric sources, elements and their properties in the circuits.
ii. Calculate the current and voltage in any practical circuits.
iii. Analyze DC and AC circuits using mathematical tools.

Text Books

1. Navhi and Edminister J A, "Theory and Problems of Electric circuits" Tata McGraw- Hill Publishing Company Limited, New Delhi, 4th Edition, 2007.
2. Sudhakar and Shyammohan S Palli, "Circuits and Networks – Analysis and Synthesis", Tata McGraw- Hill Publishing Company Limited, New Delhi, 3rd Edition, 2007.

Reference Books

1. Charles K Alexander and Mathew N O Sadiku, "Fundamentals of Electric Circuits", Tata Mc Graw -Hill Publishing Company Limited, New Delhi, 3rd Edition, 2007.
2. Jack E Kemmerly, Steven M Durbin and William H Hayt Jr, "Engineering Circuit Analysis", Tata Mc Graw- Hill Publishing Company Limited, New Delhi, 7th Edition, 2006.
3. Sivanandam.S.N., "Electric Circuit Analysis", Vikas Publishing House Private Limited, New Delhi, 2001.

11EE202 NETWORK THEORY

Credits 3:1:0

Course Objective:

i. To understand the basic concepts of three phase AC electrical circuits.
ii. To examine the transient and steady state response of the circuits subjected to step and sinusoidal excitations.
iii. To know and analyze the concepts of coupled circuits.
iv. To understand the concepts of two port networks and passive filters.

Unit I: Three Phase Circuits

Phase sequence-line and phase quantities-phasor diagram – Balanced and unbalanced star, Delta loads-Analysis of balanced load-Analysis of unbalanced load – Neutral shift method - Power measurements in three phase circuits – single and two wattmeter methods – Balanced and unbalanced star, delta loads – power factor calculation – Reactive power measurements.

Unit II: Magnetically Coupled Circuits

Mutual inductance – Co-efficient of coupling – Dot convention-analysis of coupled circuits, Ideal transformer, Ideal auto transformer – Analysis of single tuned and double tuned circuits

Unit III: Network Transients
Transient Concepts – Singularity functions-Unit step, Unit impulse-transient response of simple RL, RC and RLC series and parallel circuits for step input and sinusoidal excitation-Laplace transform application to the solution of RL, RC & RLC circuits: initial and final value theorem and applications – Concept of complex frequency – Driving point and transfer impedances – Poles and zeros of network function.

Unit IV: Two Port Network, Filters and Attenuators
Two port network parameters-interconnection of two port networks: series, parallel and cascade – T and π equivalent networks - Low pass filter, Band pass filter, Band stop filter – Constant K and m-derived filter – attenuators - T and π type, lattice attenuator

Unit V: Network Synthesis
Reliability concept – Hurwitz property – positive realness – properties of positive real functions-Synthesis of RL, RC and LC driving point impedance functions using simple canonical networks – Foster and Cauer forms.

Course Outcome:
At the end of the course, student would be able to:

i. Investigate the behavior of electric networks by analytical techniques.
ii. Synthesize the networks by different analytical methods.
iii. Analyze the two port networks, coupled circuits and three phase circuits.

Text Books

1. Navhi and Edminister J A, "Theory and Problems of Electric circuits" Tata Mc Graw-Hill Publishing Company Limited, New Delhi, 4th Edition, 2007.
2. Sudhakar and Shyammohan S palli, "Circuits and Networks – Analysis and Synthesis", Tata Mc Graw -Hill Publishing Company Limited, New Delhi, 3rd Edition, 2007.

Reference Books

1. Charles K Alexander and Mathew N O Sadiku, "Fundamentals of Electric Circuits", Tata Mc Graw - Hill Publishing Company Limited, New Delhi, 3rd Edition, 2007.
2. Jack E Kemmerly, Steven M Durbin and William H Hayt Jr, " Engineering Circuit Analysis", Tata Mc Graw - Hill Publishing Company Limited, New Delhi, 7th Edition, 2006.
3. Sivanandam.S.N, "Electric Circuit Analysis", Vikas Publishing House Private Limited, New Delhi, 2001.

11EE203 ELECTRONIC DEVICES

Credits 3:1:0

Course Objective:

i. To study the operation and characteristics of different semiconductor devices.
ii. To know different methods of fabrication of semiconductor devices in an IC.
iii. To familiarize the student with the principle of operation, capabilities and

limitation of various electron devices and their applications.

Unit I: P-N Junction diode

V-I characteristics - Static and Dynamic resistance, Temperature dependence of characteristics, diffusion and transition capacitances, Diode as a circuit element, small signal and large signal models. Elementary applications - Clippers and clampers, Diode Switching times, PN junction diode ratings. Breakdown phenomena in diodes - Zener diodes -Metal semiconductor junction -Schottky barrier diodes.

Unit II: Bipolar Junction Transistor (BJT)

Physical behaviour of a BJT – Ebers - Moll model, large signal current gains, Modes of transistor operation - Common Base, Common Emitter and Common Collector configurations, Input and output characteristics, Early effect, regions of operation, AC and DC load lines - Need for stability of Q-Point, Bias stability – fixed bias, collector to base bias, self bias. Transistor switching times - Transistor as a switch and an amplifier, High frequency effects, BJT ratings. Introduction to photo transistors.

Unit III: Junction Field Effect Transistor (JFET)

JFET operation - V-I characteristics, transfer characteristics, regions of operation. DC analysis - JFET biasing. Small signal JFET model, JFET as a switch, Voltage variable resistor and an amplifier.

Unit IV: Metal Oxide Semiconductor Field Effect Transistor (MOSFET)

Constructional details - Operation of Enhancement and Depletion type MOSFETs , V-I characteristics, Transfer characteristics, analytic expression for drain current, Comparison of PMOS and NMOS devices - MOSFET biasing, MOSFET as a switch, resistor and amplifier, Introduction to CMOS devices.

Unit V: Integrated Circuit (IC) Fabrication

Monolithic IC technology - Planar processes, Epitaxial growth, Oxidation, Photolithography, Diffusion, Ion implantation, Metallization. BJT fabrication - need for buried layer, Junction and Dielectric isolation, Fabrication of PNP multiple emitter transistors, Monolithic diodes, Fabrication of FETs, NMOS enhancement and depletion MOSFETs, Self isolation, CMOS technology. Monolithic IC Resistors: sheet resistance - Diffused, Ion implanted, Epitaxial, pinch, MOS and thin film resistors, Monolithic IC capacitors - Junction, MOS and thin film capacitors, IC packaging, Micro-electronic circuit layout.

Course Outcome:

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

i. Understand the concepts of semiconductor devices
ii. Understand their application in rectifiers, inverters, choppers etc.
iii. Understand the concepts of IC fabrication.

Text Books

1. Millman J., Grabiel A, "Microelectronics", Tata McGraw-Hill Publishing Company

Limited, New Delhi, 3rd Edition, 2000.
2. Boylestead L. R., Nashelsky L.,"Electronic Devices and Circuit Theory", Pearson Education India Series, New Delhi, 10th Edition, 2009.
3. Gupta.J.B. "Electronic Devices and Circuits", S.K.Kataria & Sons, New Delhi, 3rd Edition, 2010

Reference Books

1. Thomas L. Floyd, "Electronic Devices", Pearson Education India Series, New Delhi, 7th Edition, 2007.
2. David A Bell, "Electronic Devices and Circuits", Prentice Hall of India, New Delhi, 4th Edition, 2000.
3. R.S. Sedha,"A Text Book of Applied Electronics", S.Chand & Company Ltd, New Delhi. 3rd Edition, 2000.
4. Roy Choudhury, and Shail Jain, "Linear Integrated Circuits", New Age International Limited, New Delhi, 2nd Edition, 2003.
5. Gupta.J.B. "Electronic Devices and Circuits", S.K.Kataria & Sons, New Delhi, 3rd Edition, 2010

11EE204 CIRCUITS AND DEVICES LAB

Credits 0:0:2

1. Verification of Ohms and Kirchhoff's law.
2. Verification of Superposition Theorem using PSPICE.
3. Verification of Thevenin and Norton Theorem using PSPICE.
4. Transient Response of a simple RL, RC and RLC circuits using PSPICE.
5. Resonance of series RLC and parallel RLC circuits using PSPICE.
6. Filters using PSPICE.
7. Characteristics of PN diode & Zener diode
8. Characteristics of JFET
9. Characteristics of UJT & SCR
10. Input Output Characteristics of Transistor under CE configuration
11. Study of Half wave & Full wave Rectifier with and without filter
12. Non-Linear wave shaping techniques-Clipper and Clamper

11EE205 ELECTRICAL AND ELECTRONICS WORKSHOP PRACTICE

Credits 0:0:2

1. Study of Lighting Schemes
2. Study of electrical wiring and accessories
3. Exercises in house wiring and power wiring
4. Study of Earthing and Measurement of Earth resistance using Megger.
5. Study of step down transformer
6. Study of domestic appliances.
7. Study of Power Supplies.
8. Study of CRO
9. PCB Fabrication.

10. Measurement of Circuit Elements.
11. Characteristics of PN junction diode and Zener diode.
12. Transducers

11EE206 ELECTROMAGNETIC FIELDS

Credits 3:1:0

Course Objective:

i. To understand the concepts of coordinate systems.
ii. To realize the electromagnetic fields, charges and currents.
iii. To calculate electromagnetic field distribution.
iv. To impart knowledge on vector fields - electrostatic and magneto static fields, electro-dynamics and electromagnetic waves.

Unit I: General Principles

Review of vector algebra-Coordinate systems-Rectangular, Cylindrical and Spherical Coordinate Systems- Coordinate transformation-Differential Line, Surface and Volume Elements-Line, Surface and Volume Integrals- Gradient, Divergence and Curl Operators- Divergence Theorem-Stokes' Theorem.

Unit II: Electrostatic Fields

Field concept – Charge Distributions – Coulomb's Law –Electric Field Intensity- Determination of Electric Field due to Discrete, Line, Surface and Volume Charges- Electric Potential-Relationship between Electric Field Intensity and Electric Potential– Potential due to Electrical Dipole-Potential due to an Infinite Uniformly Charged Line-Electric Flux and Flux Density-Gauss' Law- Relation Between Electric Flux and Electric Field Intensity- Electrostatic Energy-Laplace's and Poisson's Equations – Dielectrics –Capacitance-Boundary Conditions at the Interface of Two Dielectrics.

Unit III: Magneto Static Fields

Current density – Magnetic Flux –Magnetic Flux Density- Magnetic Field Intensity – Relationship between Magnetic Field Intensity and Magnetic Flux density- Biot-Savart Law – Determination of Magnetic Field due to Infinitely Long Straight Conductor, Circular Current Loop and Rectangular Current Loop- Ampere's Law – Determination of Magnetic Field due to a Co-axial Cable using Ampere's Law- Force and Torque in Magnetic Field- Boundary Conditions at the Interface of Two Magnetic Materials-Self and Mutual Inductances-Inductance of a Solenoid and a Toroid.

Unit IV: Electromagnetic fields

Displacement current – Eddy current -Faraday's Law – Lenz's Law – Transformer and Motional emfs, Maxwell's Equations.

Unit V: Electromagnetic Waves

Generation – Propagation of Waves in Dielectrics – Conductors and Transmission lines –Skin effect-Power and the Poynting Vector.

Course Outcome:

At the end of the course, student would be able to:

i. Develop analog and digital electronic system that takes into account propagation and radiation effects.
ii. Analyze and understand advanced electromagnetic field problems that arise in various branches of engineering.
iii. Design various electromagnetic based equipments.

Text Books

1 Joseph. A. Edminister, "Theory and Problems of Electro Magnetics", 2nd Edition, Schaum's Outline Series, Tata Mc Graw- Hill Publishing Company Limited, New Delhi, 2005.
2 William H.Hayt Jr., John A.Buck, "Engineering Electro Magnetics", Tata McGraw- Hill Publishing Company Limited, New Delhi, 3rd Edition, 2007.

Reference Books

1. Matthew N.O. Sadiku, "Elements of Electromagnetics', Oxford University Press, London, 3rd Edition 2005.
2. Gangadhar, K.A., "Field Theory", Khanna Publishers Limited, New Delhi, 15th Edition, Third Reprint 2004.

11EE207 DC MACHINES AND TRANSFORMERS

Credits 3:1:0

Course Objective:

i. To understand the basic concepts about the DC machines and transformers
ii. To conduct various tests for studying the performance of the machines
iii. To learn about the instrument transformers and power transformers

Unit I: DC Generators

Laws of magnetic circuit – Principle of operation, Constructional details, Armature Windings, EMF equation, Methods of Excitation, Separate, Shunt, Series and Compound excitations - No load characteristics – Armature reaction, Commutation, Inter poles, Compensating windings, Load characteristics of various types of DC Generators.

Unit II: DC Motors

Principle of operation – Torque equation, Electrical and Mechanical characteristics of DC Shunt, Series and Compound motors, Starters – Speed control – Armature and Field control – Braking.- Losses and efficiency – Swinburne's test – Separation of losses, Hopkinson's test.

Unit III: Transformers

Principle of operation – Constructional features, Classification of Transformers, EMF equation, Transformation ratio, Transformer on no load and load, Phasor diagrams - Equivalent circuit - Voltage regulation, Regulation curve, Losses, Efficiency, All Day efficiency.

Unit IV Test on Transformer

Phasing out, Polarity and Voltage ratio tests – Open circuit and Short circuit tests, Sumpner's test, Separation of losses – Parallel operation, Auto transformer – Principle of operation – Saving of copper – Phasor diagram – Equivalent circuit.

Unit V: Three Phase Transformer
Constructional features- Connections- Parallel operations of Three phase transformers-Instrument Transformers: Current and Potential transformers.

Course Outcome:
At the end of the course, student would be able to:
i. Choose the machines for the specific application based on their characteristics.
ii. Use the instrument transformers efficiently for measurements.
iii. Estimate the various losses taking place in D.C. machines.

Textbooks
1. Murugesh Kumar, K., "DC Machines and Transformers", Vikas Publishing House Private Limited., New Delhi, 2nd Edition, 2004.
2. Arthur Eugene Fitzgerald, Charles Kingsley Jr, Stephen D. Umans , " Electric Machinery", Mc Graw - Hill Professional Series , New York, 6th Edition, 2002.

Reference Books
1. S. J. Chapman, "Electric Machinery Fundamentals", 4th Edition, McGraw-Hill Publishing Company Limited, New Delhi, 2005.
2. Gupta, B.R., and Vandana, Singhal, "Fundamentals of Electrical Machines", New Age International Publishers Limited, New Delhi, 2005.
3. Irving L.Kosow, "Electric Machinery and Transformers", Prentice Hall of India Private Ltd., New Delhi, Second Edition, Reprint 2007.

11EE208 DC MACHINES AND TRANSFORMERS LABORATORY

Credits 0:0:2
1. Load characteristics of a Separately Excited DC Generator.
2. Load characteristics of DC Shunt Generator
3. Load characteristics of DC Compound Generator
4. Load test on DC Shunt Motor
5. Load test on DC Series and compound motor.
6. Speed control of DC Shunt Motor
7. Electric Braking of DC series Motor
8. Swinburne's Test
9. Load test on Single Phase Transformer
10. Open circuit and Short circuit test on Single Phase Transformer
11. Sumpner's Test on a Single Phase Transformer.
12. Three Phase Transformer Connections

11EE209 INDUCTION AND SYNCHRONOUS MACHINES
Credits 3:1:0

Course Objective:

i. To learn the basic concepts about the different types of induction and synchronous machines
ii. To understand the speed control and the starter operations
iii. To acquire knowledge on two reaction theory

Unit I: Three-Phase Induction Motors
Principle of Operation – Construction and types of Rotor – Torque equation – Torque- Slip characteristics – Maximum torque – Effect of rotor resistance, Equivalent circuit – Phasor diagram – Performance calculation from circle diagram - Induction Generators –Testing, Automatic Starters – DOL, Autotransformer, Star-Delta and Rotor resistance starters – Speed control – Crawling and Cogging – Electrical Braking.

Unit II: Single-Phase Induction Motors
Principle of operation – Double revolving field theory – Equivalent circuit – Performance calculations – Methods of self starting – Types of Single Phase Induction Motor - Magnetic Levitation-Linear Induction Motor.

Unit III: Synchronous Generators
Types - Constructional features – 3-phase windings – Winding factors – EMF equation – Armature reaction – Voltage regulation – Predetermination of regulation by Synchronous Impedance, MMF, and Potier reactance methods, Load characteristics – Power expression – Parallel operation – Synchronizing Current and Synchronizing power – Active and Reactive power sharing – Alternator on infinite Bus bar – General load diagram.

Unit IV: Synchronous Motors
Principle of operation – Methods of starting – Phasor diagrams – V-curves and Inverted V-curves - Power/Power-angle relations – Synchronous Condensers – Hunting and methods of Suppression.

Unit V: Two Reaction Theory
Salient Pole machine analysis – Phasor diagrams – Voltage regulation – Power / Power angle relation – Determination of X_d and X_q.

Course Outcome:

At the end of the course, student would be able to:

i. Familiarizes with working and characteristics of different machines.
ii. Implement speed control methods in industry sectors.
iii. Operate the machines in parallel.

Textbooks

1. Murugesh Kumar, K, "Induction and Synchronous Machines", Vikas Publishing House Limited, New Delhi, 2000.

2. Arthur Eugene Fitzgerald, Charles Kingsley, Stephen D. Umans , “ Electric Machinery”, Mc Graw – Hill Professional Series , New York, 6th Edition, 2002.

Reference Books

1. Kothari D.P. and I.J. Nagrath, “Electric Machines”, Tata McGraw Hill Publishing Company Ltd, New Delhi,2002.
2. Gupta, B.R., Vandana, Singhal, “Fundamentals of Electric Machines”, New Age International Publishers Limited, New Delhi, 2005.
3. Bhimbhra P.S., “Electrical Machinery”, Khanna Publishers, New Delhi, 2003.

11EE210 AC MACHINES AND CONTROL SYSTEMS LABORATORY

Credits 0:0:2

1. Load test on Three Phase Induction Motor
2. No load and blocked rotor tests on Three Phase Induction Motor
3. Speed control of Three Phase Induction Motor
4. Load test on Single Phase Induction Motor
5. Regulation of Alternator by EMF/ MMF methods
6. Operation of alternator on Infinite bus bar
7. V and Inverted V curve for Synchronous Motor
8. Measurement of transient and sub-transient reactance in direct and quadrature axis of an Alternator.
9. Transfer function of Separately Excited DC Generator.
10. Transfer function of DC Motor.
11. Time & Frequency Response of the System using MATLAB
12. Measurement of Physical Variable with the help of LABVIEW

11EE211 ELECTRICAL MACHINE DESIGN

Credits 3:1:0

Course Objective:

i. To gain the knowledge about the calculation of total MMF in the machine.
ii. To find out the dimension of various parts of the machine.
iii. To examine various losses in the machines.
iv. To understand the usage of auxiliary windings.

Unit I: General Aspects

Major considerations – Limitations - Main dimension- Output equation - Choice of specific electric and magnetic loadings - Separation of D and L for rotating machines. MMF for air gap - Effects of slots, ventilating ducts and saliency - MMF for teeth –Total MMF calculation - Leakage reactance, Estimation of number of conductors / turns - Coils - Slots - Conductor dimension - Slot dimension.

Unit II: DC Machines
Choice of number of poles - Length of Air gap - Design of field system, Inter poles, Commutator and Brushes.

Unit III: Transformers
Classification – output equation - Core section - Window dimensions - Yoke dimension -Overall dimension - No load current calculation – Temperature rise of Transformers-Design of tanks and cooling tubes.

Unit IV: Three Phase Induction Machines
Length of air gap - Cage rotor - End ring current - Wound rotor - Dispersion coefficient. No-load current calculation - Stator and rotor resistance - Losses and efficiency.

Unit V: Synchronous Machines
Short circuit ratio – Air gap length –Salient pole machine -Design of field winding- Turbo-alternator – Damper winding.

Course Outcome:
At the end of the course, student would be able to:
i. Design DC machines
ii. Design transformers with reduced loss
iii. Calculate the losses and efficiency in the machines

Text Books
1. Sawhney A.K., Chakrabarti A., "A Course in Electrical Machine Design", Dhanpat Rai & Sons Company Limited, New Delhi, 6th Edition, 2006.
2. Mittle V.N., Mittle A., "Design of Electrical Machines", Standard Publications and Distributors, New Delhi, 2002.

Reference Books
1. Sen, S.K, "Principles of Electric Machine Design with Computer Programmes", Oxford & IBH Publishing Company Private Limited, 2001, Reprint 2004.
2. Agarwal R.K., "Principles of Electrical Machine Design", S.K.Kataria and Sons, New Delhi, 2002.
3. Shanmugasundaram, A., Gangadharan G. and Palani R., "Electrical Machine Design Data Book", New Age International Publishers Private Limited., 1st Edition 1979, Reprint 2005.

11EE212 POWER ELECTRONICS

Credits: 3:1:0
Course Objective:
i. To Learn the Static and Dynamic characteristics of Power Semiconductor Devices
ii. To understand the principles of operation of power electronic converters
iii. To study the various control strategies of various power converters
iv. To study the design parameters for control circuitry requirement of various converters.

Unit I: Power Semiconductor Devices

Introduction – Power Diodes – Power Transistors – Power MOSFETs – IGBTs –Thyristor family : SCRs, Triacs, GTOs and IGCT – Static and Dynamic characteristics – Protection circuits – Series and parallel connections, MCT.

Unit II: AC to DC Converters

Diode rectifiers: Single phase and Three phase diode bridge rectifiers with R, RL and RLE load - Estimation of average load voltage and average load current – Freewheeling diode - Controlled rectifiers: Single phase and three phase half wave Thyristor converters. Estimation of average load voltage and average load current – Single phase Half controlled and Fully Controlled Thyristor Bridge Converters – Estimation of average load voltage and load current for continuous current operation – Input power factor estimation for ripple free load current – Three phase Half and Fully Controlled Thyristor Converters (no analysis) – Dual Converters.

Unit III: AC to AC and DC to DC Converters

AC to AC Converter: Single phase Full Wave controller with R and RL load – Estimation of RMS load voltage, RMS load current and input power factor – Three phase AC voltage controllers (No analysis) – Single phase to Single phase Cyclo-converters – DC TO DC Converter**:** Principle of step up and step down operation – Single quadrant DC chopper with R, RL and RLE load – Time ratio control – Estimation of average load voltage and load current for continuous current operation – Two quadrant and Four quadrant DC choppers.

Unit IV: DC to AC Converters

Types – Voltage source and Current source inverters – Single phase bridge inverters – Three phase bridge inverters – Control of AC output voltage – Harmonic reduction – Single phase Series Inverters.

Unit V: Control Circuits & Applications

Functional requirements of the switching control circuits – Generation of control signals for single phase AC to DC converters – Cosine wave crossing control, Ramp comparator approach. Generation of timing pulses for DC choppers – PWM techniques for DC to AC converters – Introduction to power converter control using Microprocessors, Microcontrollers and DSP – Applications: Motor drive applications: DC Motor Drives using Phase Controlled Thyristor Converters and DC Choppers – AC voltage controller and inverter fed induction motor drives – UPS –HVDC systems – Tap changing of Transformers.

Course Outcome:

At the end of the Course the student would be able to:

i. use electronics and solid-state power devices for the control, conversion, and protection of electrical energy
ii. design switching using power semiconductor devices
iii. apply control techniques to meet desired switching objectives
iv. Specify design criteria (power, efficiency, ripple voltage and current, harmonic distortions, power factor).
v. Select components, interpret terminal characteristics of the components for designing the circuitry for power converters.

Text Books:

1. Rashid, M.H., “Power Electronics – Circuits, Devices and Applications”, Pearson Education India Series Private Limited, New Delhi, 3rd Edition, 2003.
2. Mohan, Ned. et.al, “Power Electronics Converters, Applications and Design”, Wiley India Pvt. Ltd., New Delhi, 3rd Edition 2007.

Reference Books:

1. Philip T. Krein, “Elements of Power Electronics”, Oxford University Press, Inc., New York, 2008.
2. Joseph Vithayathil, “Power Electronics: Principles and Applications”, McGraw – Hill Education India, 2010.
3. Umanand L., “Power Electronics: Essentials & Applications”, Willey India Private Limited, New Delhi, 2009.
4. B. Jayant Baliga, “Fundamentals of Power Semiconductor Devices”, Springer-Verlag Publication, New Delhi, 1st Edition, 2008.

11EE213 POWER ELECTRONICS & DRIVES LABORATORY

Credits: 0:0:2

1. Characteristics of Power Semiconductor Devices – MOSFET, IGBT
2. Single Phase Semi & Full Converter Bridge on R & R – L Load
3. MOSFET based DC Chopper on R & R – L Load
4. Single Phase AC Voltage Controller with R & R – L Load
5. Three Phase AC Voltage Controller with R & R – L Load
6. Single Phase Inverter with R & R – L Load
7. Single Phase Cyclo-converter with R & R – L Load
8. Simulation of Power Converters using PSIM
9. Simulation of Power Converters using MATLAB
10. Single Phase Rectifier fed DC Drive
11. Three Phase Inverter fed Induction Motor Drive
12. Testing of UPS and SMPS

11EE214 ELECTRIC DRIVES AND CONTROL

Credits: 3:0:0
Pre requisites: 11EE212 Power Electronics
11EE207 DC Machines and Transformers
11EE209 Induction and Synchronous Machines

Course Objective:

i. To understand the classification and characteristics of Drives
ii. To analyze the various types and operations of DC Drives
iii. To analyze the various types and operations of Induction Motor Drives
iv. To study the operations of Synchronous Motor Drives, Servo Motor, Stepper Motor and Switched Reluctance Motor.

Unit I: Introduction to Electric Drives

History and development of Electric Drives, Classification of Electric Drives, Basic elements & advantages of variable speed drives- Joint Speed-Torque characteristics of various types of loads and drive motors- Modes of operation, closed loop control of drives - Selection of power rating for drive motors with regard to thermal overloading and load variation-Load Equalization.

Unit II: DC Drives

Speed control of DC motors - Ward - Leonard scheme - drawbacks - Thyristor converter fed dc drives: - Single, two and four quadrant operations - Chopper fed DC drives : - Time ratio control and current limit control - Single, two and four quadrant operations - Effect of ripples on the motor performance.

Unit III: Three Phase Induction Motor Drives

Speed control of 3 phase Induction Motors - Stator control: PWM &V/f control, rotor control: Rotor resistance control - Static control of rotor resistance using DC chopper - Static Krammer and Scherbius drives – Introduction to Vector Controlled Induction Motor Drives.

Unit IV: Drives for Special Machines

Speed control of 3 phase Synchronous Motors - True synchronous and self controlled modes of operations - DC servo drives principle of operation AC servo drives principle of operation - Principle and control of Stepper motor and Switched Reluctance Motor drives.

Unit V: Digital Control and Drive Applications

Digital techniques in speed control - Advantages and limitations - Microprocessor/Microcontroller and PLC based control of drives, networking of drives - Selection of drives and control schemes for Steel rolling mills, Paper mills, Cement mills, Machine tools, Lifts and Cranes. Solar and battery powered drives.

Course Outcome:

At the end of the Course the student would be able to:

i. Understand the dynamics of electrical drive systems.
ii. Select suitable converters and their controls for drive applications.
iii. Use MATLAB/SIMULINK in simulating and designing of controllers for electrical drive systems.

Text Books:

1. Dubey, G.K., “Fundamentals of Electrical Drives”, Narosa Publishing House, 2nd Edition, New Delhi, 2006.
2. Bose, B.K., “Modern Power Electronics and AC Drives", Prentice Hall of India, Private Ltd., 1st Edition, New Delhi, 2009.

Reference Books

1. Ion Boldea and Nasar S. A., “Electric Drives”, CRC Press, 2nd Edition, New York, 2005.
2. Krishnan R, “Electric Motor Drives: Modelling, Analysis and Control, Prentice Hall of India, Private Ltd., 1st Edition, New Delhi, 2009.
3. Vedam Subramanyam, “Electric Drives: Concepts and Applications”, Tata McGraw Hill Education Pvt. Ltd., 2nd Edition, New Delhi, 2010.

4. Mohamed A. El-sharkawi, Mohamed A. El, “Fundamentals of Electric Drives”, Cengage Engineering (Publisher) Washington DC, 1st Edition, 2009.

11EE215 GENERATION, TRANSMISSION AND DISTRIBUTION

Credits: 3:1:0

Course Objective:

i. To under the concepts of various method Electrical Energy Generation.
ii. To learn the usage of passive elements in various Power Transmission Systems.
iii. To understand the factors affecting Insulators and also in Under Ground cables.
iv. To calculate the various parameters in Distribution System.

Unit I: Power Generation
Generation, Transmission & Distribution Scenario of India – Types of generation: Conventional and Non-conventional, Thermal Power Plant, Hydro Power Plant, Gas Power Plant, Nuclear Power Plant, Non-conventional Energy Sources – Load capacity factor - Connected load factor – Load duration curve – Selection of Units.

Unit II: Power Transmission Systems
Various systems of transmission – Advantages of high transmission voltages – Comparison of conductor materials required for various overhead systems – Overhead Lines Parameters **:** Electrical constants - Resistance, Inductance and capacitance of Single and 3 Phase lines – Effects of earth on capacitance – Skin effect – Proximity effect – Transposition – Bundled conductors – Line supports-Performance**:** Short and Medium transmission lines – Phasor diagrams – Nominal T and π methods – Line regulation – Efficiency. Rigorous solution for long line – ABCD constants – Ferranti effect – Tuned power lines – Surge impedance and surge impedance loading.

Unit III: Line Insulators
Types - Potential distribution over a string of suspension insulators – Methods of increasing string efficiency. Corona – Factors affecting corona – Stress and Sag Calculation – Effect of wind and ice – supports at different levels – Stringing chart.

Unit IV: Underground Cables
Types - Capacitance and insulation resistance – Sheath effects – Grading – Stresses – Loss angle – Breakdown voltage – Optimum cable length -Comparison between Overhead lines and Underground cables.

Unit V: Distribution Systems
Feeders, Distributors and Service mains – Radial and ring main systems – Calculation of voltage in distributors with concentrated and distributed loads – A.C. single phase and three phase distribution systems.

Course Outcome:

At the end of the Course the student would be able to:

i. Analyze the performance of various Units involved in the power plants.
ii. Apply power system fundamentals to the design of a system that meet specific needs.
iii. Design a power system solution based on the problem requirements and realistic Constraints.
iv. Develop a major design experience in power a system that prepares them for engineering practice.

Text Books:

1. Mehta, V.K., Rohit Mehta, "Principles of Power Systems", S.Chand & Company Private Limited, New Delhi, Reprint Edition, 2006.
2. Singh S.N, "Electric Power Generation, Transmission and Distribution", PHI Learning Private Limited, New Delhi, 2nd Edition, 2009.

References Books:

1. Soni, M.L., Gupta, P.V., Bhatnagar U.S. Chakrabarthi A., "A Text Book on Power System Engineering", Dhanpat Rai & Sons Company Private Limited, New Delhi, 2008.
2. Uppal, S.L., "Electrical Power", Khanna Publishers Limited, 13th Edition, New Delhi, 2002.
3. Wadhwa, C.L., "Electrical Power Systems", New Age International Publishers Ltd., 6th Edition, New Delhi,2010.
4. Weedy B.M., Cory B.J., "Electric Power Systems", John Wiley & Sons Limited, 4th Edition, Reprint, England, 2009.

11EE216 POWER SYSTEM ANALYSIS

Credits: 3:1:0

Course Objectives:

i. To learn the fundamentals of power system for designing a system that meets specific need.
ii. To analyze the phasor techniques in the analysis of power systems.
iii. To know the necessity of load flow in a regulated system.
iv. To examine the need of various analysis like fault analysis, short circuit analysis stability analysis, steady state and transient analysis.

Unit I: Introduction

Need for System analysis in planning and operation of power system – One line diagram – Per Unit representation – Symmetrical components – Short circuits analysis for fault on machine terminals.

Unit II: Network Formulation & Modeling, Short Circuit Studies

Primitive network and its representation – bus incidence matrix – Formation of Bus admittance matrix and bus impedance matrices – modeling of synchronous machines , transformers, loads, π-equivalent circuit of transformer with off-nominal tap ratio – Short Circuit Studies**:** Types of faults – Algorithms for fault calculations – Sequence Impedance matrices – Symmetrical and Unsymmetrical fault analysis using Z_{bus}.

Unit III: Load Flow Studies

Formulation of load flow problem – bus classification – Solution by Gauss – Seidal , Newton – Raphson and Fast decoupled methods – Comparison –. Computation of slack bus power, transmission loss and line flow.

Unit IV: Economical Operation of Generating Stations
Optimal operation of generators – Economical scheduling of thermal plant with and without transmission losses – Loss formula derivation– Unit commitment – Elementary idea of optimal load scheduling of Hydro –Thermal plants.

Unit V: Stability Studies
Steady state and Transient stability – Swing equation and its solution by Modified Euler and Runge-Kutta methods – Equal area criterion – Factors affecting stability and methods of improving stability – Causes of voltage instability – voltage stability proximity indices for two-bus system

Course Outcome:
At the end of the Course the student would be able to:

i. apply the load flow application to various power system problems like minimization of transmission line losses, minimization of the total fuel cost etc.,
ii. analyze the economic dispatch problem in thermal power plant
iii. design a power system solution based on the problem requirements and realistic constraint

Text Books:

1. Hadi Saadat, "Power System Analysis", Tata Mc Graw-Hill Publishing Company Limited, 2nd Edition, New Delhi, 2009.
2. Gupta, B.R., "Power System Analysis and Design", S.Chand & Company Ltd., Reprint Edition, New Delhi, 2007.

Reference Books

1. Weedy B.M., Cory B.J., "Electric Power Systems", John Wiley & Sons Limited, 4th Edition, Reprint, England, 2009.
2. Wadhwa C. L., "Electrical Power Systems", New Age International Private Limited, 6th Edition, New Delhi, 2010.
3. Nagsarkar T.K., Sukhija M.S., "Power system Analysis" Oxford University Press, 1st Edition, London, 2007.
4. Arthur R. Bergen, Vijay Vittal., "Power System Analysis", Pearson Education Inc., 2nd Edition, New Delhi, 2000.
5. Kothari. D. P., Nagrath. I. J., "Power System Engineering", Tata McGraw-Hill Publishing Company Limited, 2nd Edition, Third Reprint, New Delhi, 2008.

11EE217 COMPUTER AIDED POWER SYSTEMS ANALYSIS LABORATORY

Credits: 0:0:2

1. Formation of Y_{bus} Matrix using Direct Inspection Method
2. Formation of Y_{bus} Matrix using Singular Transformation Method
3. Load Flow Analysis by Gauss-Seidel Method
4. Load Flow Analysis by Newton- Raphson Method
5. Load Flow Analysis by FDLF Method
6. Automatic Load Frequency Control
7. Simulation of AVR(Automatic Voltage Regulator) using MATLAB-SIMULINK
8. Z_{bus} Formation using building algorithm
9. Analysis of Symmetrical Faults
10. Perform Economic Load Dispatch using MATLAB programming
11. Transient Stability Analysis of Single Machine Infinite Bus Bar (SMIB)
12. Harmonic Analysis of simple electrical circuit using MATLAB - SIMULINK

11EE218 POWER SYSTEM PROTECTION AND SWITCHGEARS

Credits: 4:0:0

Course Objective:

i. To understand the principle of protective schemes and various faults in the Power System Scenario.
ii. To examine protection of power system with various protection relays.
iii. To study the various types of the circuit breakers, the arc quenching phenomena and the protection against over voltages.

Unit I: Introduction

Principles and need for protective schemes – Nature and cause of faults – types of fault – per Unit representation - Analysis of Symmetrical fault – Current limiting reactors. Current Transformers and Potential Transformers and their applications in their protection schemes.

Unit II: Protective Relays, Apparatus & Line Protection

Definition - Requirement of relays - Universal torque equation - Non directional and directional over current relays – Earth fault relays - Distance relays - Impedance, Mho and Reactance relays - Differential relays - Negative sequence relays - Pilot (Translay) relay - Carrier and Microwave pilot relays – Under frequency relays - Introduction to static relays - Microprocessor and computer based protective relaying. Apparatus and Line Protection: Alternator, transformer, Bus bar and motor protection using relays – Feeder Protection – radial and ring main system. Microprocessor based protective schemes.

Unit III: Circuit Breakers

Functions of switchgear - Elementary principles of arc extinction - Arc control devices - Recovery voltage and restriking voltage - current chopping and capacitance current breaking - Bulk oil, low oil, air break, air blast, and sulphur hexafluoride and vacuum circuit breakers - HVDC breakers - Rating - Testing of circuit breakers.

Unit IV: Surge and Surge Protection

Switching surges - Lightning phenomenon – Traveling waves on transmission lines - Over voltage due to lightning - Protections against lightning - Lightning arresters – Types - Lightning arrester selection - Surge absorbers.

Unit V: Earthing and Insulation Co-Ordination

Solid, resistance and reactance Earthing - Arc suppression coil - Earthing transformers – Earth wires - Earthing of appliances- Insulation co-ordination: Definition - Determination of line insulation - Insulation levels of sub-station equipment - Co-ordination amongst items of substation equipment - Introduction to Indian Electricity rules.

Course Outcome:

At the end of the Course the student would be able to:

i. Design the relevant protection systems for the main elements of a power system.
ii. Analyze with over current, differential, and ratio protection devices and their application in a coordinated protection scheme.
iii. Do the stability problems and clearing of faults to mitigate these problems.

Text Books:

1. Badri Ram, Vishwakarma D N., "Power System Protection and Switchgear" Tata McGraw Hill Publishing House Limited, New Delhi, 2005.
2. Soni, M.L., Gupta, P.V., Bhatnagar, U.S. and Chakrabarti, A., "A Text Book on Power Systems Engineering", Dhanpat Rai & Sons Company Limited, New Delhi, 2008.

Reference Books

1. Paithankar Y. G., Bhide S. R., "Fundamentals of Power System Protection" Prentice Hall of India Limited, New Delhi , 2nd Edition, 2010.
2. Wadhwa, C.L., "Electrical Power Systems", New Age International Publishers Limited, 2006, New Delhi,6th Edition, 2010
3. Sunil, S.Rao, "Switchgear Protection and Power Systems (Theory, Practice & Solved Problems", Khanna Publishers Limited, New Delhi, 12th Edition, 2008.

11EE219 CONTROL SYSTEMS

Credits 3:1:0

Course Objective

i. To understand the methods of representation of systems and getting their transfer function models.
ii. To impart adequate knowledge in the time response of systems and steady state error analysis.
iii. To give basic knowledge is obtaining the open loop and closed–loop frequency responses of systems.
iv. To understand the concept of stability of control system and methods of stability analysis.

Unit I: Introduction

Open loop and Closed loop systems – Examples, Control system components. Transfer function of physical systems– Mechanical systems, Translational and Rotational systems, Electrical network, Thermal and hydraulic systems. Transfer function of DC Generator, DC servomotor, AC servomotor and Synchros , Transfer function of overall systems. Impulse Transfer function. Block diagram - reduction techniques. Signal flow graphs –Mason' gain formula.

Unit II: Time Response Analysis
Standard Test signals –Time response of zero, first and second order system, Performance criteria, Type of systems. Steady state error constants – position, velocity and acceleration error constants. Generalized error series – Feedback characteristics of control systems. Controllers – P, PI and PID control modes.

Unit III: Frequency Response Analysis
Frequency domain specifications – peak resonance, resonant frequency, bandwidth and cut-off rate, correlation between time and frequency responses for second order systems. Polar plot, Bode plot – Gain Margin and Phase Margin.

Unit IV: Stability of Systems
Characteristic equation – Location of roots of characteristic equation – Absolute stability and Relative stability. Routh Hurwitz criterion of stability – Necessary and sufficient conditions. Nyquist Stability- Principle of argument – Nyquist path – Nyquist stability criterion – Determination of Nyquist stability – Assessment of relative stability. Bode Plot – Assessment of stability. Root locus concept, Rules for construction of root loci, problems, stability analysis.

Unit V: State Variable Analysis
Introduction to state space analysis – Physical variable, Phase variable and Canonical variables forms. Transfer function from state space representation.

Course Outcome:
At the end of the course, student would be able to:

i. Have a sound knowledge in the basic concepts of control theory
ii. Design closed loop system projects.
iii. Work out the practical problems by using state variable analysis.

Text Books

1. Gopal, M, "Control Systems – Principles and Design" Tata McGraw-Hill Company Limited, New Delhi, 2002.
2. Ogata K., "Modern Control Engineering", Prentice-Hall of India Private Limited., New Delhi, 4th Edition, 2002.

Reference Books

1. Nagrath I.J, & Gopal M, "Control System Engineering", New Age International Publishers Limited, New Delhi, 5th Edition, 2007.
2. Benjamin C. Kuo, "Automatic Control Systems", John Wiley & Sons, Inc., New Jersey, 8th Edition, 2003.
3. Norman S.Nise, "Control System Engineering", John Wiley & Sons Inc., New Jersey, 8th Edition, 2007.
4. Sivanandam S.N., Deepa S.N., "Control System Engineering using MATLAB", Vikas Publishing House Private Limited, New Delhi, 2nd Edition, 2006.

11EE220 LINEAR INTEGRATED CIRCUITS

Credits 3:1:0

Course Objective:

i. To obtain knowledge on Op-Amp characteristics
ii. To study linear and non-linear applications as an amplifier
iii. To study various IC voltage regulators.

Unit I: Operational Amplifier Characteristics

Functional Block Diagram – Symbol, Characteristics of an Ideal Operational Amplifier, Circuit schematic of µA 741, Open loop gain, CMRR-input bias and offset currents, input and output offset voltages, offset compensation techniques, Frequency response characteristics – stability, limitations, frequency compensation, slew rate, Transfer characteristics.

Unit II: Linear Applications of Operational Amplifiers

Inverting and Non-inverting amplifiers – Voltage follower, Summing amplifier, Differential amplifier, Instrumentation amplifier. Integrator and Differentiator – Practical considerations. Voltage to Current and Current to Voltage converters, Phase changers. Sinusoidal oscillators. Active filters – Design of Low pass, High pass, Wide band pass and Band stop Butterworth filters, Narrow band pass and Notch filters.

Unit III: Non Linear Applications of Operational Amplifiers

Comparator – Regenerative comparator, Zero crossing detector, Window detector, Sample and hold circuit, Precision diode, Half and Full wave rectifiers, Active peak detector, Clipper and Clamper, Logarithmic and Exponential amplifiers, Multiplier and Divider, Square and Triangular waveform generators. Voltage Regulators: Need for Single power supply operational amplifiers – LM324, AC Inverting and Non-Inverting amplifiers. Norton Amplifiers – Various configurations.

Unit IV: IC Voltage Regulators & Special Function ICS:

Block diagram of 723 General purpose voltage regulator – Circuit configurations, Current limiting schemes, Output current boosting , Fixed and adjustable three terminal regulators, Switching regulators- SPECIAL FUNCTION ICs**:** 555 Timer Functional block diagram and description – Monostable and Astable operation, Applications, IC566 Voltage Controlled Oscillator, Analog Multiplier, Comparator ICs.

Unit V: A-D and D-A Converters & PLL

Digital to Analog Converters: Binary weighted and R-2R Ladder types – Analog to digital converters: Continuous, Counter ramp, Successive approximation, Single slope, Dual slope and Parallel types – DAC/ADC performance characteristics- PLL Functional Block diagram – Principle of operation, Building blocks of PLL, Characteristics, Derivations of expressions for Lock and Capture ranges, Applications: Frequency synthesis, AM and FM detection, FSK demodulator, Motor speed control.

Course Outcome:

At the end of the course, the student will be able to:

i. Understand the concepts of operational amplifiers.
ii. Design various converters using Op-Amp.
iii. Fundamentals of analysis and design of analog integrated circuits.

Text Books

1. Roy Choudhury, and Shail Jain, "Linear Integrated Circuits", New Age International Limited, 3rd Edition, 2007.
2. Gayakwad, A.R., "OP-Amps and Linear Integrated circuits", Pearson Education India Series, New Delhi, 4th Edition, 2004.

Reference Books

1. Coughlin, F.R., and Driscoll, F.F., "Operational Amplifiers and Linear Integrated Circuits", Prentice Hall of India, New Delhi, 6th Edition, 2009.
2. Salivahanan, "Operational Amplifiers and Linear Integrated Circuits", Tata McGraw Hill Publishing Company, New Delhi, 1st Edition, 2007.
3. Michael Jacob, J, "Applications and Design with Analog Integrated Circuits", Prentice Hall of India, New Delhi, 2nd Edition, 2010.
4. Sedra and Smith, "Microelectronic Circuits", Oxford University Press, London, 5th Edition, 2004.

11EE221 MICROPROCESSORS AND MICROCONTROLLERS

Credits 3:1:0

Course Objective:

i. To study the basics microprocessors and microcontrollers
ii. To know the various applications
iii. To analyze the interfacing with the external device using 8051

Unit I: Microprocessor and Applications

Evolution Of Microprocessors – 8085CPU- Architecture – Instruction Formats – Addressing mode – Instruction Set – Different types of Instructions - Instruction Cycle – Timing Diagram for Moving, Load and call Instruction – ROM Organization – Interrupt Structure – Memory Mapping.

Unit II: Architecture Of 8051

Block diagram of Microcontroller – Comparison with Microprocessor and Microcontroller – Pin details of 8051 – ALU – Special function registers – ROM – RAM – RAM Memory Map (including registers and register banks) – Program Counter – PSW register –Stack - I/O Ports – Timer Interrupt – Serial Port – External memory – Clock – Reset – Clock Cycle –Machine Cycle – Instruction cycle – Instruction fetching and execution - Overview of 8051 family.

Unit III: Instruction Set and Programming

Assembling and running an 8051 program – Instruction set of 8051 – Data transfer instructions – Different addressing modes – Arithmetic Instructions – Signed number concepts and arithmetic operations – Logic and Compare instructions – Rotate instruction and data serialization – BCD, ASCII – Loop and jump instructions – Call instructions – Time delay routines – Program control – Assembler directives – Sample programs.

Unit IV: I/O, Timer, Interrupt and Serial Programming
Bit addresses for I/O and RAM – I/O programming – I/O bit manipulation programming – Programming 8051 Timers – Counter programming – Basics of Serial programming – 8051 connection to RS 232 – 8051 Serial Port Programming – 8051 interrupt – Programming Timer Interrupt – Programming external hardware interrupts – Programming the serial communication interrupt – Interrupt priority in 8051.

Unit V: Interfacing External Device With 8051
8051 interfacing to external memory – 8051 interfacing with the 8255 – (Programs are to be written in Assembly for the following interfacing applications) Relays and opto isolators – Sensors interfacing and signal conditioning – Parallel ADC and Serial ADC interfacing – DAC interfacing - Keyboard interfacing – Seven segment and LCD display interfacing – Stepper Motor interfacing – DC motor interfacing and PWM - RTC Interfacing.

Course Outcome:
At the end of the course, the student will be able to:

i. Implement of projects applying various processors.
ii. To write coding using any of these microcontrollers.
iii. Interface the processor to external devices.

Text Books:

1. Mazidi and D.MacKinlay "8051 Microcontroller and Embedded Systems using Assembly and C", Pearson Education Low Price Edition, New Delhi, 2006.
2. Krishna Kant," Microprocessors and Microcontrollers: Architecture, Programming and System Design 8085, 8086, 8051, 8096", PHI Learning Pvt Ltd, New Delhi, 1st Edition, 2010.

Reference Books

1. Myke Predko," Programming customizing the 8051 Microcontroller", Tata McGraw Hill Publications, New Delhi, 1st Edition 2007.
2. Crisp, "Introduction to Microprocessors and Microcontrollers", Elsevier/ Reed Elsevier India Pvt. Ltd, New Delhi, 2nd Edition, 2009.
3. Kenneth J. Ayala, "8051 Microcontroller", Cengage Learning, New Delhi, 3rd Edition, 2004.

11EE222 MICROPROCESSOR AND MICROCONTROLLER LABORATORY

Credits: 0:0:2

1. Programs for 8/16 Bit Arithmetic Operations using 8085.
2. Programs for Sorting and Searching using 8085.
3. Programs for Code Conversion using 8085.
4. Programs for String Manipulation Operations using 8085.
5. Microprocessor based Stepper Motor control.
6. Microprocessor based Traffic Light Control.

7. Programming using Arithmetic, Logical and Bit Manipulation Instructions of 8051Microcontroller.
8. Interfacing ADC with Microcontroller.
9. Interfacing DAC with Microcontroller.
10. LCD Display interface with 8051.
11. Serial Communication Interface using 8051 Microcontroller.
12. Generation of PWM pulses using 8051 Microcontroller.

11EE223 C++ AND DATA STRUCTURES

Credits 4:0:0

Course Objective:

i. To study the basics of C++ programming
ii. To know various programming methods in C++
iii. To know the various applications using programming language

Unit I: Objects and Classes

A Simple class, C++ objects as physical objects, C++ Objects and Data types, Object as function argument, constructors, as function argument, Overloaded Constructors, Copy Constructors, Returning objects from functions, structures and classes, Static class data, const and classes, Arrays and Strings.

Unit II: Operator Overloading

Overloading Unary and Binary Operator, data conversion, and Pitfalls, Inheritance: derived class and base class, derived class constructors, Overloading member functions, class hierarchies, public and private inheritance, level of inheritance, multiple inheritance. Pointers: address and pointers, pointers and arrays, pointer and c-type strings, new and delete operator, pointers to pointer.

Unit III: Virtual Functions

Virtual functions, Friend functions, Static functions, this pointer. Streams and files: stream classes, stream errors, disk file I/O with streams, file pointers, error handling in file I/O. Templates and exception: function templates, class templates, exceptions.

Unit IV: Introduction to Data Structures

Linked list, Single linked list, Doubly linked list, Circular Linked list, Stack, Queue, Trees

Unit V: Sorting and Searching Techniques

Sorting, Bubble sort, Insertion Sort, Selection Sort, Quick Sort, Heap Sort, Merge Sort. Searching, Binary Tree Search, Linear Search, Binary Search.

Course Outcome:

At the end of the course, the student will be able to:

i. Understand the fundamental concepts of C++ programming
ii. Apply programming skills for various applications including electrical applications.
iii. To have analytical ability by quick programming.

Text Books

1. Robert Lafore, "Object Oriented Programming in C++", BPB Publications, 3rd Edition Pune, 2007.
2. Mark A. Weiss, "Data Structures and Algorithm Analysis in C++", Addison-Wesley, Boston, USA, 3rd Edition, 2007.

Reference Books

1. Balaguruswamy E., "Object-Oriented Programming with C++", Tata McGraw Hill, New Delhi, 2nd Edition, 2004.
2. Adam Drozdek,"Data Structures and Algorithms in C++", Vikas Publishing House, New Delhi 2004.
3. D.S. Malik,"Data Structures Using C++", Cengage Learning, New Delhi, 1st Edition, 2003.

11EE224 C++ AND DATA STRUCTURES LABORATORY

Credits: 0:0:2

1. Basics of C++ Programming
2. Implementation of Classes and Objects
3. Implementation of Constructor and Destructor
4. Implementation of Overloading
5. Implementation of Inheritance
6. Illustration on Pointers
7. Implementation of Abstract Class and Virtual Functions
8. Implementation of Class Template
9. Implementation of Stack and Queue
10. Implementation of Linked List
11. Implementation of Searching Techniques
12. Implementation of Sorting Techniques

11EE225 MEASUREMENTS AND INSTRUMENTATION

Credits 4:0:0

Course Objective:

i. To develop an understanding of the characteristics of experimental measurements. These include concepts such as uncertainty, the dynamic limitations of physical instruments.
ii. To become familiar with the operation and characteristics of several experimental tools including oscilloscope, data acquisition systems and spectrum analyzers.
iii. To gain knowledge of some of basic measuring measurements including temperature, pressure, energy and power.

Unit I: Standards and Indicating Instruments

SI Units – Units for charge, voltage, current, power, energy, flux. Standards – brief Introduction. D'Arsonval Galvanometer. Moving iron: attraction and repulsion type instruments, errors. Moving coil instruments – Permanent magnet moving coil instruments, Dynamometer type moving coil Instruments, Torque equations and errors. Extension of ranges, use of shunts and Instrument Transformers.

Unit II: Measurement of Power and Energy
Dynamometer type wattmeter – Torque expression, Errors. Energy meters, Calibration of energy meters. Measurement of power using Instrument Transformers. Maximum demand indicator, Power factor meter.

Unit III: Measurement of R-L-C
Resistance measurement – Kelvin double bridge, Wheatstone bridge, substitution method, Loss of charge method, Guard Wire method. Measurement of inductance and capacitance – Maxwell, Anderson, Hay's and Schering bridges. Measurement of Earth resistance.

Unit IV: Measurement of Non-Electrical Quantities
Transducers – Classifications, Principle of operation of Resistance potentiometer, Inductive and capacitive transducers, LVDT, Strain Gauge and Piezo-electric transducers. Encoders. Hall effect sensors and photo sensors. Measurement of Pressure – High Pressure and low pressure measurement. Measurement of Temperature – Resistance thermometers, thermistors and thermocouples. Speed measurement- contact and noncontact type.

Unit V: Electronic Laboratory Instruments
Electronic voltmeter – Digital voltmeter of ramp and integrating types. Digital Multimeter – block diagram. Block diagram of dual channel oscilloscope. Spectrum Analyzer. Pulse, signal and function generators. Harmonic distortion analyzer. Strip chart and X-Y recorders, Field Bus Instrumentation.

Course Outcome:
At the end of the course, student would be able to:

i. Know which instrument is to be used to measure one particular quantity.
ii. Calculate various errors that will occur while using an instrument to measure a quantity and they know how to see to that error.
iii. Operate electronic instruments for parameter measurement.

Text Book

1. Sawhney.A.K, "A Course in Electrical & Electronic Measurement and Instrumentation", Dhanpat Rai & Company Private Limited, New Delhi, 18th Edition, 2007.
2. Anand.M.L, "Electrical Measurements and Measuring Instruments", S.K.Kataria & Sons (Publishers), NewDelhi,3rd Edition, 2010

Reference Books

1. Helfrick A.D., "Modern Electronic Instrumentation & Measurements", Prentice –Hall India Private Limited, New Delhi, 2007.
2. Doeblin,E.O., "Measurement Systems : Application And Design", 5th Edition, Tata Mc-Graw Hill Publishing Company Limited , New Delhi, 2004.
3. Golding,E.W., Widdis,F.C., "Electrical Measurements and Measuring Instruments", A H Wheeler & Company, Calcutta, 5thedition, 2003.

4. Rangan,C.S., Sharma, G.R., Mani, V.S., “Instrumentation Devices and Systems”, Tata McGraw- Hill Publishing Company, New Delhi, 2nd Edition, 2002.
5. Roy Choudhury, and Shail Jain, “Linear Integrated Circuits”, New Age International Limited, New Delhi, 2nd Edition, 2003.
6. Oliver, “Electronic Measurements and Instrumentation”, Tata McGraw Hill, New Delhi, 1st Edition, 2008.

11EE226 MEASUREMENTS AND COMPUTER AIDED ELECTRICAL MACHINE DESIGN LAB

Credits 0:0:2

1. Measurement of Resistance using Wheatstone and Kelvin’s bridge
2. Measurement of Inductance using Hays and Anderson Bridge
3. Measurement of Capacitance using Schering and Maxwell Bridge
4. Calibration of Measuring Instruments
5. Study of Resistive, Inductive and Capacitive Transducers.
6. Study of Thermo Electric Transducers
7. Design of D.C Machine using AutoCAD
8. Design of Single and Three Phase Transformer using AutoCAD
9. Design of Single Phase &Three phase Induction Motor using AutoCAD
10. Magnetic analysis of Electrical machines
11. Design of Synchronous Machine using AutoCAD
12. Effect of air gap variation on induction machines performance

11EE227 MATERIAL SCIENCE

Credits 3:0:0

Course Objectives:

i. To gain knowledge on the microstructure, properties, processing and performance of engineering materials and the interrelationships among these qualities.
ii. To imbibe knowledge on material behavior and properties.
iii. To understand the mechanical, physical and chemical properties of materials.

Unit I: Crystallography, Metals and Alloys

Crystallography: Crystal systems, Lattice parameters, Bravais lattice, packing factors of cubic and HCP crystal systems, Miller indices. Linear and planar density of atoms, Debye – Scherrer method of crystal structure. Crystal imperfections-points, line and surface defects and their role in electrical, mechanical and optical properties of materials. Metals and Alloys: Drude Lorentz theory of electrical conduction, Wiede mann Franz law, Band theory of solids, factors affecting resistivity of metals – temperature, alloying, magnetic field and strain. Applications of conductors – strain gauges, transmission lines, conducting materials, precision resistors, heating elements and resistance thermometer.

Unit II: Semi-Conducting Materials and Devices

Elemental and Compound semiconductors, Intrinsic and Extrinsic semiconductors- Properties, carrier concentration in intrinsic semiconductors. Carrier concentration in n type and p type semiconductors, Material preparation – Czochralski’s technique and zone refining technique, Hall effect – Hall coefficient in extrinsic semiconductors, experimental determination of hall coefficient, Application of hall effect, Semiconductor devices – LDR, LED, photodiode, Solar cells and LCD.

Unit III: Dielectric Materials and Devices
Qualitative study of various polarization, Electric dipole moment determination, Effect of temperature and frequency on dielectric constant, Dielectric loss, Ferroelectric materials classification – $BaTiO_3$ and PZT-Piezoelectric materials, Applications of ferroelectric and piezoelectric materials, Breakdown mechanism, Classification of insulating materials on temperature basis.

Unit IV: Magnetic Materials and Devices
Ferro and Ferri magnetic materials – properties , Helesenberg and domain theory of ferromagnetism, Hystersis ferrite- structure and properties , Applications – floppy disks, CD ROM, Magnetic optical recording.

Unit V: Advanced Materials
Nano phase materials - Synthesis techniques, properties, applications, Shape memory alloys-Characteristics, properties of NiTi alloy, applications in MEMs, Superconductivity, Types of superconductors – High Tc superconductors, Comparison with low Tc superconductors, Application of superconductors, Metallic glasses – preparation, properties, and applications.

Course Outcome:
At the end of the course, student would be able to:
i. Design and conduct experiments to study the microstructure and properties of materials.
ii. Identify materials-related problems and formulate plans to solve such problems.
iii. Determine failure of materials, and select appropriate material for a given application.

Textbooks
1. William D Callister Jr, "Material Science and Engineering", John Wiley and Son, New York 2006.
2. R.K.Rajput, "Material Science and Engineering", S.K.Kataria & Sons (Publishers), New Delhi, 2010.

Reference Books
1. S.L.Kakani, Amit Kakani, "Material Science", New Age International Publishers Ltd., New Delhi,1st Edition, 2004.
2. Ian Jones, "Material Science for Electrical & Electronic Engineers", Oxford Publishers, 1st Edition, 2007.
3. R.K.Rajput, "Fundamentals Of Material Science", S.K.Kataria & Sons (Publishers), New Delhi, 2010.
4. O.P.Khanna, "A Text Book Of Material Science and Metallurgy", Dhanpat Rai Publishers, New Delhi, 1st Edition, 2010

11EE229 MOBILE COMMUNICATION

Credits 4:0:0
Course Objectives
i. To learn the fundamental concepts of mobile communication networks.

ii. To give comprehensive introduction of concepts of cellular systems and trunking theory etc
iii. To impart knowledge about different radio propagation models.

Unit I: Wireless Transmission
Frequencies for radio transmission, Signals, Antennas, Signal Propagation, Multiplexing, Modulation, Spread Spectrum, Cellular Systems-Medium Access Control: Motivation, SDMA, FDMA, TDMA, CDMA – Comparison

Unit II: Telecommunication Systems
GSM, DECT, TETRA, UMTS and IMT- 2000- Satellite Systems: Basics - Routing -Localization – Handover

Unit III: Broadcast Systems
Cyclic repetition of data - Digital Audio Broadcasting, Digital Video Broadcasting, Wireless LAN: Infrared VS Radio transmission, Infrastructure and AD-HOC networks, IEEE 802.11, Hyper LAN, Bluetooth.

Unit IV: Wireless ATM
Motivation, Working group, WATM services, reference model, functions, radio access layer, handover, location management, addressing, quality of service, access point control protocol - Mobile Network Layer: Mobile IP, Dynamic host configuration protocol, ADHOC networks.

Unit V: Mobile Transport Layer
Traditional TCP, indirect TCP, snooping TCP, mobile TCP, fast retransmission/ fast recovery, selective retransmission, transaction oriented TCP - Support for Mobility: File systems, World Wide Web, Wireless application protocol.

Course Outcome
At the end of the course, the student will be able to:
i. Understand the Concepts of Mobile Communication Networks
ii. Design simple communication network in mobile environment
iii. Understand fading and multipath channel problems and their solutions.

Text Books
1. Jochen Schiller, "Mobile Communications", Pearson Publishers, 2nd Edition, New Delhi, 2008.
2. Lee W.C.Y., "Mobile communications Engineering: Theory and Applications", McGraw-Hill Education (India) Ltd, New Delhi, 2008.

Reference Books
1. Yi-Bing Lin and Imrich Chlamtac, "Wireless and Mobile Network Architecture", John Wiley and Sons, New Delhi, 2nd Edition, 2001.
2. T.G.Palanivelu, "Wireless and Mobile Communication", PHI Learning, 1st Edition, New Delhi 2008.
3. Behera, "Mobile Communication", Scitech Publications, New Delhi, 1st Edition, 2010.

4. Gordon L. Stuber, “Principles Of Mobile Communication”, Springer (India) Pvt. Ltd., New Delhi, 2nd Edition, 2007.

11EE230 BIOMEDICAL INSTRUMENTATION

Credits 4:0:0

Course Objective

i. To Study various bio potential recorders
ii. To know about the measurement of physiological parameters
iii. To know about various therapeutic and surgical instruments
iv. To know about various Imaging Systems and Telemetry techniques.

Unit I: Electrophysiology and Bio-potential Recorders

Neuron – Axon – Axon potential – Electro physiology of Cardio-vascular system – ECG – Phonocardiography – Neurophysiology – Central nervous system – EEG – Respiratory system – Muscular system - EMG, - Eye – ERG.

Unit II: Measurement and Physiological Parameters

Physiological Transducers - Measurement of Blood pressure – Blood flow – Cardiac output measurement – Heart rate – Respiration rate – Measurement of lung volume – Oximeters– Audiometer.

Unit III: Therapeutic and Surgical Equipments

Electro Surgical Unit – Short wave & Microwave Diathermy – Laser surgical Unit –Anesthesia machine – Pacemakers – Total artificial heart (TAH) – Dialyzer – Heart lung machine – Defibrillators – Ventilators – Nerve stimulators – Laparoscopy – Centralized and Bedside patient monitoring system – Nerve stimulators.

Unit IV: Biomedical Equipments and Patient Safety

Flame photometer – spectrophotometer – Chromatography – PH, PCO2, analysis –Sterilizers Physiological effects of Electric Current – Shock Hazards from Electrical Equipments – Electrical accidents and its preventions.

Unit V: Imaging Systems and Telemetry

Computerized Tomography (CT) – MRI instrumentation – Ultrasound scanner – X-ray machine – Fluoroscopic techniques – angiography – Cardiac Catherisation lab – Echocardiograph – Vector cardiograph – Biotelemetry.

Course Outcome:

At the end of the course, the student will be able to understand:

i. The concepts of biomedical instrumentation.
ii. The concepts of therapeutic and surgical instruments
iii. The concepts of Imaging Systems and Telemetry techniques.

Text Books

1. Arumugam, M., “Biomedical Instrumentation”, Anuradha Agencies, Kumbakonam, 2002.

2. Khandpur, R.S, “Handbook of Biomedical Instrumentation”, Tata Mc-Graw Hill Publishing Company Limited, 2nd Edition New Delhi, 2000.

Reference Books

1. Geddes, L.A., and Baker, L.E.: “Principles of Applied Biomedical Instrumentation”, John Wiley & Sons Limited, New Delhi, 1989.
2. Chendrelekha Goswami, “Handbook of Biomedical Instrumentation”, Manglam Publications, Kottayam, 1st Edition, 2010.

11EE230 VLSI DESIGN

Credits 4:0:0

Course Objectives

i. To introduce the concepts of VLSI technology.
ii. To expose the students of design of various VLSI based systems
iii. To give an exposure to the standard algorithms for VLSI Physical design Automation.

Unit I: Introduction to MOS Technology

MOS technology & VLSI – Basic MOS transistor – depletion & enhancement type –NMOS & CMOS Transistors fabrications – electrical properties of MOS circuits –characteristics – threshold voltage – Trans conductance – pass transistors – NMOSInverter – pull-up pull-down ratio for NMOS Inverter driven by NMOS Inverter &through one or more pass transistors – CMOS Inverter – latch-up-sheet-resistance &capacitance calculation – delay calculation – super buffer – HMOS & native transistors.

Unit II: Layout Design

MOS & CMOS Layers – Stick diagram – design rules & layout – subsystems design:Switch logic – gate logic – other forms of logic – Combinational Logic design example:Passing generator – Bus Arbitration Logic Multiplexers – Gray to Binary code converter–Sequential circuit example: Two Phase clocking – Dynamic Register element –Dynamic Shift Register – Pre charged bus concept – Scaling circuits.

Unit III: Design of System

PLA – Finite state machine – PLA based finite state machine design – design of 4-bit shifter – design of ALU subsystem: Adders – Multiplexers – Memory: Dynamic Shift register – dynamic RAM cells – one transistor dynamic memory cell – 4*4 bit register array – RAM array.

Unit IV: Tools for Design

Grounds rules for successful design – Design styles & Philosophy – CAD tools for design & simulation: Textual entry layout language – Graphical entry layout – Design verification – Design rule checkers – simulators – tests & testability.

Unit V: CMOS Design Projects & Fast VLSI Circuits

Incremental/Decremental – Left/Right – Serial/Parallel shift register – Comparator – GaAs device – Layout design for GaAs devices.

Course Outcome

At the end of the course, the student will be able to:

i. Understand the concepts of VLSI Design Automation Tools

ii. Understand Placement and Routing Algorithms & Floor Planning Algorithms
iii. Understand Simulation and Logic Synthesis Concepts

Text Books

1. Pucknell D.A, Eshraghian K., "Basic VLSI Design", Prentice Hall of India, New Delhi, 2009.
2. Neil,Weste H. E.,Kamran Eshraghian., "Principle of CMOS VLSI Design: A System Perspective", Pearson Education, New Delhi 2nd Edition, 2004.

Reference Books

1. Jan M Rabaey, Chandrakasan A, Nikolic B, " Digital Integrated Circuits", Pearson Education, New Delhi, 3rd Indian Reprint, 2004.
2. Amar Mukherjee, "Introduction to nMOS and CMOS VLSI System Design", Prentice Hall, USA, 1986.
3. Wayne Wolf, "Modern VLSI Design: Systems on Silicon", Pearson Education Indian Reprint, New Delhi, 3rd Edition 2006.

11EE231 EMBEDDED SYSTEM

Credits 4:0:0
Course Objectives:

i. To make students aware of Embedded systems
ii. To learn and understand concepts of RTOS.
iii. To learn and understand concepts of Embedded Programming.

Unit I: Introduction to Embedded Systems
Embedded Systems-Processor Embedded into System-Embedded Hardware Units and Devices in a System-Embedded Software in System-Examples of Embedded Systems-Embedded System-On-Chip (SOC) and Use of VLSI Circuit Design Technology-Complex Systems Design and Processors-Design Processor in Embedded System-Formalization of System Design-Design Process and Design Examples-Classification of Embedded Systems-Skills Required for an Embedded System Designer.

Unit II: Real Time Systems
Introduction-Issues in Real Time Computing-Structure of a Real Time System-Architecture of Real Time Systems-Performance Measures for Real Time Systems-Properties of Performance Measures-Traditional Performance Measures-Performability-Cost Functions And Hard Deadlines-Estimating Program Runtimes.

Unit III: Real Time Operating Systems
Task and Task States, Tasks and Data, Semaphores and Shared Data Operating System Services Application of Semaphores-Message Queues-Timer Function-Events-Memory Management-Real time Embedded System Operating Systems-Interrupt Routines in RTOS environment.

Unit IV: Embedded Software Development Process, Tools and Testing
Introduction to Embedded Software Development Process and Tools-Host and Target Machines-Linking and Locating Software-Getting Embedded Software into the Target System-Issues in

Hardware-Software Design and Co-Design, Testing on Host Machine,Simulators,Laboratory Tools.

Unit V: Design Examples and Case Studies
Case Study of Embedded System Design and Coding for an Automatic Chocolate Vending machine (ACVM) Using Mucos RTOS-Case Study of Digital Camera Hardware and Software Architecture-Case Study of Communication between Orchestra Robots-Embedded Systems in Automobile-Case study of an Embedded System for an Adaptive Cruise Control(ACC)System in a Car-Case study of an Embedded System for a Smart Card-Case Study of a Mobile Phone Software for Key Inputs.

Course Outcome:
At the end of the course, the student will be able to understand:
i. Design simple embedded systems.
ii. Choose effective communication for embedded systems.
iii. Analyze real-time scheduling algorithms & Identify design flows.

Text Books
1. Raj Kamal, "Embedded Systems: Architecture Programming and Design", Mc Graw-Hill International Inc., New York, 2008.
2. Austin Jonathan W, Jonathan W,"Embedded Microcomputer Systems-Real Time Interfacing", Nelson Engineering, Florida 1st Edition, 2007.

Reference Books
1. Jean J.Lab Rosse, "Micro C/OS-II the Real-Time Kernel", CMP Books, New York, 2nd Edition, 2006.
2. Phillip A.Laplante, "Real-Time Systems Design and Analysis", Wiley India Pvt Ltd ,New Delhi, 3rd Edition, 2006
3. Jane W.S.Liu, "Real time Systems", Pearson International Edition,Singapore,1st Indian Reprint,2001

11EE232 VIRTUAL INSTRUMENTATION

Credits 4:0:0
Course Objective:
i. It provides new concepts towards measurement and automation.
ii. It imbibes knowledge about how to control an external measuring device by interfacing a computer.
iii. To become competent in data acquisition and instrument control.

Unit I: Review of Virtual Instrumentation
Historical perspective, advantages, Block diagram, Architecture of a Virtual Instrument, Data Flow Techniques, Graphical programming in data flow, comparison with Conventional programming, Development of Virtual Instrument using GUI, Real-time systems, Embedded Controller, OPC, HMI / SCADA software, Active X programming.

Unit II: VI Programming Techniques
VIS and sub-VIS, loops and charts, arrays, clusters and graphs, case and sequence

structures, formula nodes, local and global variables, string and file I/O, Instrument Drivers, Publishing measurement data in the web

Unit III: Data Acquisition Basics
Introduction to data acquisition on PC, Sampling fundamentals, Input/output techniques and buses, ADC, DAC, DIO, counters & timers, PC Hardware structure, timing, Interrupts DMA, software and hardware installation, Calibration, Resolution, Data acquisition interface requirements.

Unit IV: Common Instrument Interfaces
VI Chassis requirements. Common Instrument Interfaces: Current loop, RS 232C/ RS485, GPIB, System buses, interface buses: USB, PCMCIA, VXI, SCXI, PXI, etc., networking basics for office & Industrial applications, VISA and IVI, Image Acquisition and Processing. Simulation of systems using VI, Development of Control system, Industrial Communication, Image acquisition and processing, Motion control.

Unit V: Use of Analysis Tools
Fourier transforms, power spectrum, correlation methods, windowing & filtering. VI toolsets, Distributed I/O modules. Application of Virtual Instrumentation: Instrument Control, Development of process database management, Biomedical, remote testing of instruments, optical engineering, aerospace.

Course Outcome:
At the end of the course, the student will be able to
i. Acquire knowledge on how virtual instrumentation can be applied for data-acquisition and instrument control.
ii. Identify salient traits of a virtual instrument and incorporate these traits in their projects.
iii. Experiment, analyze and document in the laboratory prototype measurement systems using a computer, plug-in DAQ interfaces and bench level instruments.

Text Books

1. Jerome, Jovitha, "Virtual Instrumentation and Lab view 1Ed", PHI Learning, New Delhi, 1st Edition, 2010.
2. Gupta,"Virtual Instrumentation Using Lab View", Tata McGraw Hill, New Delhi, 1st Edition. 2008.

Reference Books

1. Olansen, "Virtual Bio Instrumentation", Pearson Education, New Jersey, 2nd Edition,2001
2. Gupta, "Virtual Instrumentation Using LabView", Tata McGraw Hill, New Delhi, 1st Edition, 2008.
3. Sanjay Gupta and Joseph John, "Virtual Instrumentation using LabVIEW", Tata Mc Graw Hill Publishing Company Limited, New Delhi, 1st Edition, 2005.

11EE233 OPERATING SYSTEMS

Credits 3:0:0

Course Objective

i. To study the evolution of Operating Systems.
ii. To analyze the concepts of memory management and process management systems.
iii. To understand the procedure of each and every management system and do case study.

Unit I: Introduction

Operating system – Function – Evolutions of Operating System- Serial processing- Batch Processing- Multiprocessing-Time sharing, Advanced Operating Systems –Need for advanced OS-Distributed OS – Multiprocessor OS – Database operating system – Real time OS.

Unit II: Memory Management

Single contiguous allocation – Partitioned allocation – Paging – Virtual memory concepts – Swapping – Demand paging – Page replacement algorithms – Segmentation – Segmentation with paging.

Unit III: Process Management

Introduction to processes –Scheduling objectives- Scheduling Criteria- Types of scheduling algorithms – Performance comparison – Inter process communications- Synchronization – Semaphores – Deadlock-Prevention, Recovery, Detection – Avoidance.

Unit IV: Device and File Management

Principles of I/O hardware – I/O software – Disks – Disk Scheduling Algorithms–File Systems – Files-Directories- File system implementation – Allocation methods -Security – Protection mechanisms.

Unit V: Case Studies:

LINUX – History – Design Principles – Kernel modules – Process Management – Scheduling – Memory Management – File Systems – Input and Output – Inter process Communication – Network Structure – Security. WINDOWS 2000 – History – Design Principles – System Components – Environmental Subsystems – File System – Networking – Programmer Interface.

Course Outcome:

At the end of the course, the student will be able to:

i. Understand the concepts of operating systems.
ii. Gain understanding of memory and process management.
iii. To have a better knowledge on different windows versions and its development.

Text Books

1. Silberschatz A, Galvin. P, G.Gagne, "Operating Systems Concepts", John Wiley & Sons, Singapore, 6th Edition, 2004.
2. Achyut Godbole, "Operating Systems", Tata Mc Graw -Hill Publishing Company Limited, New Delhi, 15th Reprint 2003.

Reference Books

1. Andrew S Tanenbaum, Albert S. Woodhull," The MINIX book Operating Systems: Design and Implementation", Pearson Education India Private Limited, New Delhi, 3rd Edition, 2006.
2. Deitel H M.," An Introduction to Operating Systems", Pearson Education Private Limited, New Delhi, 2nd Edition, 2005.
3. Mukesh Singhal and Niranjan G.Shivaratis, "Advanced Concepts in Operating Systems", Mc Graw -Hill Inc. Limited, New York, 2004.

11EE234 COMPUTER COMMUNICATION

Credits 3:0:0

Course Objectives:

i. To study the communication networks in computer
ii. To know various data communication techniques.
iii. To know the various applications using network protocols

Unit I: Introduction
Computer Networks – A perspective – Goals – Applications – Switching techniques – Circuit switching –Message switching – Packet switching – Network components existing network – ARPANET – Concepts of network protocol – OSI reference model – Basics of Queuing theory – Queuing models – Poisson Statistics – M/M/1 queue. Department of Electrical & Electronics Engineering

Unit II: Local Area Networks
Topologies – Star – Ring, Bus – Ethernet – Transmission media – LAN Access Techniques – Polling Contention – ALOHA – CSMA – CSMA/CD - Token Bus and Token Ring protocols – Delay throughput Characteristics – Token Ring and CSMA/CD Bus – performance.

Unit III: Data Communication Techniques
Asynchronous and synchronous communication – BISYNC, SDLC, HDLC – X.2.5 protocols – Error control coding.

Unit IV: Inter – Networking
Routing Algorithms – Congestion Control Algorithms – Internetworking – TCP/IP - IP Protocol – IP Address.

Unit V: Broadband Networks
ISDN – User Access – Transmission structure - ISDN Protocol – Limitations – B – ISDN – ATM concepts and principles – Introduction to VSAT networks.

Course Outcome:
At the end of the course, the student will be able to :

i. Understand the concepts of Computer Communication
ii. Understand the peripheral connections in a computer.
iii. It also gives broad idea on networking which are available for daily use.

Text Books

1. Andrew Tannenbaum., "Computer Networks", Prentice Hall of India, New Delhi, 4th Edition, 2003
2. Forouzan, "Introduction to Data Communication and Networking", Tata McGraw - Hill Publishing Company Limited, New Delhi, 4th Edition, 2004.

References

1. William, Stallings, "Data and Computer Communication", Prentice Hall of India, New Delhi, 7th Edition, 2003.
2. Keiser, G.E., "Local Area Networks", Galgotia Publications, 2nd Edition, Pune 2002.
3. Uyless Black, "Computer Networks, Protocols, Standards and Interfaces", Prentice Hall International Edition, 2nd Edition, 2002

11EE235 COMPUTER ARCHITECTURE

Credits 3:0:0

Course Objective:

i. To familiarize students about hardware design and behavior of the various functional modules of the computer
ii. To understand and evaluate constraints and tradeoffs in microprocessor design
iii. To highlight the important issues in computer architecture, organization, its performance, design and relation to the system software.

Unit I: Introduction

Register transfer language-register, bus and memory transfers–Arithmetic logic and shift micro operations. Basic Computer Organization: Instruction codes – Instructions – Timing and Control – Instruction Cycle – Fetch and Decode – Execution – Typical register and memory sequence instructions – Input, Output and Interrupt – Design stages.

Unit II: Central Processor Organization

General register organization – Stack organization – Instruction formats – Addressing modes – Data transfer and manipulation – Program control – Control memory – Address sequencer – Data path structure - CISC characteristics, RISC Characteristics, RISC pipeline.

Unit III: Arithmetic Processing

Introduction – Addition, Subtraction, Multiplication and Division algorithms – Floating point Arithmetic operations.

Unit IV: Memory and Input/output Organization

Basic concepts – Memory Hierarchy – Main memory – Auxiliary memory – Associative memory – Cache and Virtual memory concepts – Input – Output interface –Asynchronous Data transfer – Modes of transfer – Direct memory access – I/O processor.

Unit V: Introduction to Parallel Processing

Parallelism in Uni-processor systems – Taxonomy of architectures – SISD, SIMD, MISD, MIMD modes of Memory access - shared memory, distributed memory – typical applications.

Course Outcome:

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

i. Recognize different types of architectures and the difference between computer architecture and organization.
ii. Know how to design a computer system..
iii. Bridge the software, hardware, and firmware gaps.

Text Books

1. Morris Mano, M., "Computer System Architecture", Prentice Hall of India, New Delhi, 3rd Edition, 2000.
2. Stallings W., "Computer Organization and Architecture", Pearson Education, New Delhi, 7th Edition, 2006.

Reference Books

1. Carl Hamacher, V., Vranesic, Z.G., and Zaky, S.G., "Computer Organisation", Mc Graw-Hill International Edition, New York, 5th Edition, 2002.
2. B. Govindarajalu, "Computer Architecture and Organization: Design Principles and Applications", Tata Mcgraw Hill, New Delhi, 1st Edition 2003.
3. Nicholas Carter, Raj Kamal, "Computer Architecture & Organization", Tata Mc Graw Hill, New Delhi, 2009.

11EE236 HIGH VOLTAGE ENGINEERING

Credits: 3:0:0

Course Objective:

i. To understand the design principles and critical elements of a high voltage system.
ii. To know about Ionization and Decay Process.
iii. To learn about the electric breakdown in gases, solids and liquids.
iv. To study the generation of high voltage and high current.

Unit I: Ionization and Decay Process

Introduction- Ionization process- Types of ionization - Electron collision - Photo ionization - Thermal ionization - Electron detachment and recombination - Mobility of gaseous ions and Decay by diffusion - Cathode process.

Unit II: Electric Breakdown in Gases, Solids and Liquids

Properties of insulating gases - Townsend's criterion for break down - Mechanism of spark - Breakdown voltage characteristics in uniform and non uniform fields - Time lag for breakdown – Streamer Theory of breakdown in Gases - Corona discharges - Paschen's law - Dielectric Breakdown In Solids: Intrinsic breakdown - Electromechanical breakdown - Thermal breakdown - Breakdown of composite insulation - Solid dielectrics used in practice, Electric Breakdown In Liquids: Electronic breakdown - Cavitation breakdown - Conduction and breakdown in pure and commercial liquids.

Unit III: Generation of High Voltage and High Currents
Generation of high DC voltages - Cockroft - Walton voltage multiplier circuit - Electrostatic generator - Vande groaf generator - Generation of high AC voltages, Transformers in cascade - Construction of Impulse generator - Generation of Impulse voltages and currents - Tripping and control of Impulse generators.

Unit IV: Measurement of High Voltages and Currents & Non Destructive Testing of Materials and Electrical Apparatus
Measurement of high DC voltages - Measurement of High AC and Impulse voltages - Measurement of High DC, AC and Impulse currents - Surge test oscilloscope.
Destructive Testing Of Materials And Electrical Apparatus: Measurement of Direct Current resistivity – Measurement of Dielectric Constant and Loss Factor – Partial discharge Measurements.

Unit V: High Voltage Testing
Testing of Insulators and Bushings- Testing of isolators and circuit breakers - Testing of surge arrestors - Testing of cables - Testing of power capacitors and transformers - Radio interference measurements.

Course Outcome:
At the end of the Course the student would be able to:
i. Understand the causes of unnecessary electric breakdown.
ii. review the breakdown mechanisms in solid, liquid, gaseous and composite dielectrics
iii. Choose the right surge device to eliminate over voltages for high voltage apparatus.
iv. Select the right technique to measure different types of high voltages.

Text Books:

1. Naidu M. S., Kamaraju V., "High Voltage Engineering", Tata McGraw- Hill Publishing Company Ltd., New Delhi, 4th Edition, 2008.

References:

1. Wadhwa C.L., "High Voltage Engineering", New Age International Private Ltd., 3rd Edition, Reprint, New Delhi, 2010.
2. Ravindra Arora and Wolfgang Mosch, "High Voltage - Insulation Engineering", New Age International Publishers Limited, 1st Edition, Reprint, New Delhi, 2008.
3. Kuffel, E., Zaengl W.S., Kuffel J., "High Voltage Engineering: Fundamentals", Newnes Publishers, New Delhi, 2nd Edition, 2000.
4. Rakosh Das Begamudre, "Extra High Voltage AC Transmission Engineering", New Age International Private Ltd., 3rd Edition, New Delhi, 2010.

11EE236 POWER SYSTEM STABILITY

Credits: 3:1:0
Course Objective:

i. To investigate and understand the stability of power system, with the main focus on stability theories and power system modeling.
ii. To study the steady and transient stability problems.
iii. To examine the power system modeling using simulation tools.

Unit I: Introduction to Stability
Concept of Power system stability - Importance of Stability studies - Steady state and Transient state – Modeling of Synchronous machines for stability studies.

Unit II: Steady State Stability
Models used – power flow equations – steady state stability including composite loads – two machine system and Clarke diagram – multi machine system and stability criteria – factors influencing stability limit.

Unit III: Transient Stability
Single and two machine systems – Swing equation – Solution of swing equation by Modified Euler and Runge - kutta method – Equal area criterion and its application – Graphical integration – state space representation – phase plane method – stability of multi machine system.

Unit IV: Improving Transient Stability
Factor affecting transient stability – Methods of improving stability – Lyapunov method – effect of excitation and speed governing system on transient stability – effect of inertia and damping.

Unit V: Computer Applications
Application of analog computers for stability studies – Digital simulation methods for transient stability studies.

Course Outcome:
At the end of the Course the student would be able to:
i. Analyze the stability problems and clearing of faults by calculating critical clearing times.
ii. Understand the basics of interconnected operations of control areas in a deregulated environment.
iii. Design and calculate the power flow for an N-bus power system using the various simulation methods.

Text Book:
1. Kundur P., "Power System Stability and Control", EPRI Power System Engineering Series, Tata McGraw - Hill Publishing Company Ltd., New Delhi, 5th Reprint, 2008.

References:
1. Padiyar K.R., "Power System Dynamics, Stability and Control", BS Publications, 2nd Edition, Hyderabad, 2003.
2. Peter W., Saucer, Pai M.A., "Power System Dynamics and Stability", Stipes Publishing Company, Illinois, 1st Edition, 2007.
3. Kothari D. P., I. J. Nagrath, "Modern Power System Analysis", McGraw – Hill Education India Ltd., New Delhi, 3rd Edition, 2007.
4. Elgerd O.I., "Electric Energy System Theory: An Introduction", Tata McGraw – Hill Publishing Company Ltd., New Delhi,2nd Edition, 23rd Reprint, 2008.

5. Arrillaga J, Watson N.R., "Computer Modeling of Electrical Power Systems", Wiley India Pvt. Limited, New Delhi, 2nd Edition, 2009.

11EE238 POWER SYSTEM CONTROL

Credits: 4:0:0

Course Objective:

i. To explain the performance of supervision and control systems of electric power and describe their main functions.
ii. To acquaint students with the principles of state estimation.
iii. To acquaint students with the problem of system control centre and automatic control.
iv. To acquaint students with the performance of electronic systems of control and equipments of electrical networks

Unit I: Introduction

Need for voltage and frequency regulation in power system - System load characteristics - Basic P-F and Q-V control loops -Real power and Reactive Power improvement methods.

Unit II: Real Power and Frequency Control

Fundamentals of Speed governing mechanisms and Modeling – Speed – Load characteristics - Control areas – LFC control of a single area – Static and dynamic analysis of uncontrolled and controlled cases - Multi-area systems – Two area system modeling - Static analysis -uncontrolled case - tie line with frequency bias control of two-area and multi-area system – Steady state instabilities.

Unit III: Reactive Power and Voltage Control

Typical excitation system – Modeling – Static and Dynamic analysis – Stability Compensation - Effect of Generator loading - Static Shunt Capacitor/reactor VAR compensator, Synchronous Condenser, Tap-changing transformer - Static VAR system - Modeling – System level voltage control

Unit IV: Computer Control of Power System

Energy control center functions – System hardware configuration SCADA system – Functional aspects – Security monitoring and control – System states and their transition - Various controls for secure operation.

Unit V: Economic Dispatch Control

Incremental cost curve – co-ordination equations with loss and without losses - Solution by iteration method. (No derivation of loss coefficients). Base point and participation factors - Economic controller added to LFC control.

Course Outcome:

At the end of the Course the student would be able to:

i. understand with power system operation, including economic dispatch of generation, frequency and voltage control
ii. analyze the economic dispatch problem in various power plant
iii. Design and introduce new control techniques for power system.

Text Books:

1. Elgerd O.I., "Electric Energy System Theory: An Introduction", Tata McGraw – Hill Publishing Company Ltd., New Delhi,2nd Edition, 23rd Reprint, 2008.
2. Kundur P., "Power System Stability and Control", EPRI Power System Engineering Series, Tata McGraw - Hill Publishing Company Ltd., New Delhi, 5th Reprint, 2008.

References:

1. Kirchmayer .L.K. "Economic Operation of Power System", Wiley India Pvt. Limited, New Delhi, 2010.
2. Allen J.Wood, Bruce F.Woolenbarg, "Power Generation, Operation and Control", Wiley India Pvt. Limited, New Delhi, 2nd Edition, 2006.
3. Kusic, George L., "Computer Aided Power System Analysis and Control", PHI Learning Pvt. Limited, New Delhi, 1st Edition, 2009.
4. Anderson. P.M, Fouad. A. A, "Power System Control and Stability", Wiley India Pvt. Ltd, New Delhi, 2nd Edition, 2008.

11EE239 ILLUMINATION ENGINEERING

Credits: 4:0:0

Course Objective:

i. To design a electrical system including cost estimate and energy efficient lighting systems in residential, commercial and industrial establishments.
ii. To be familiar with the current guidelines in the design, construction, and management of safe and energy-efficient road lighting systems through actual completed projects.
iii. To understand the concept of lighting system maintenance, basic lighting energy audit and economic analysis of lighting.

Unit I: Language of Light & Lighting

Eye & vision, Light & Lighting, Light & Vision, Light & Color , Basic Concepts and Units, Photometry and Measurement, Quantity and Quality of Lighting.

Unit II: Accessories

Light sources: Daylight, Incandescent, Electric discharge, Fluorescent, Arc lamps, Lasers, Neon signs, LED-LCD displays, Luminaries, Wiring, Switching & Control circuits.

Unit III: Calculation and Measurement

Polar curves, Effect of voltage variation on efficiency and life of lamps, Lighting calculations, Solid angle, Inverse square and cosine laws, Illumination from point, line and surface sources. Photometry and Spectro -photometry, photocells.

Unit IV: Interior Lighting

Lighting design procedure for Industrial, Residential, Office, Departmental stores, Indoor stadium, Theaters and Hospitals.

Unit V: Exterior Lighting

Environment and glare, Lighting Design procedure for Flood, Street, Aviation and Transport lighting, Lighting for Displays and Signaling.

Course Outcome:

At the end of the Course the student would be able to:

i. Perform indoor & outdoor lighting design calculations.
ii. Determine appropriate lighting control techniques and equipment to a sample project.
iii. Perform basic lighting energy audit to a sample project.

Text Books:

1. Leon Gaster, John Stewart Dow, "Modern Illuminants And Illuminating Engineering", Nabu Press, Washington DC, 1st Edition, 2010.
2. Jack L. Lindsey, "Applied Illumination Engineering", Prentice Hall of India, 3rd Sub Edition, New Delhi, 2008.

Reference Books

1. Cady, "Illuminating Engineering", General Books, USA, 2010.
2. Kamlesh Roy, "Illuminating Engineering", Laxmi Publications, 2nd Edition, 2006.
3. William Edward Barrows, "Electrical Illuminating Engineering", Bibliolife Publishers, USA, 2010.
4. IES Lighting Handbook, 10th Edition, 2011.

11EE240 AUTOMOTIVE ELECTRONICS

Credits: 4:0:0

Course Objective:

i. To study the concepts of sensors, actuators, drives.
ii. To study Electronics Fuel Injection System.
iii. To study the Lighting system and accessories.
iv. To study the digital control of starting and braking methods in the automobile system.

Unit I: Sensors and Actuators

Introduction, Basic sensor arrangement, types of sensors such as - oxygen sensors, Crank angle position sensors - Fuel metering / vehicle speed sensor and detonation sensor - Altitude sensor, flow sensor. Throttle position sensors, Solenoids, Stepper motors, Relays.

Unit II: Starting System

Condition at Starting, Behavior of starter during starting. Series motor and its Characteristics. Principle & construction of starter motor. Working of different starter drive Units, care & maintenance of starter motor. Starter switches.

Unit III: Electronic Fuel Injection and Ignition Systems

Introduction, Feedback carburetor systems (FBC) Throttle body injection and multi port or point fuel injection, Fuel injection systems, injection system controls. Advantages of electronic ignition systems. Types of solid state ignition systems and their principle of operation, Contact less electronic ignition system, Electronic spark timing control.

Unit IV: Lighting System & Accessories

Insulated & earth return systems. Positive & negative earth systems. Details of Head light & Side light. Head light dazzling & preventive methods. Electrical Fuel Pump, Speedometer, Fuel, Oil & Temperature gauges, Horn, Wiper system, Trafficator.

Unit V: Digital Control Systems
Current trends in modern Automobiles- Open loop and closed loop control systems - Engine cranking and warm up control - Acceleration enrichment - Deceleration leaning and idle speed control. Distributor less ignition - Integrated engine control system, Exhaust emission control engineering. Advanced suspension, electronically controlled electric power steering, 4-wheel steering and electronically controlled electric brakes.

Course Outcome:
At the end of the Course the student will be able to:
i. Design the digital control of drives using sensors and Digital Control Systems.
ii. Design the starting and braking system for the automobiles.
iii. Understand electronic engine control required for the reduction of emissions.
iv. Familiarize with hybrid electric vehicle systems and components.

Text Books:
1. William B. Ribbens, "Understanding Automotive Electronics", Newnes Publisher, New Delhi, 6th Edition, 2011.
2. James D. Halderman and Chase D. Mitchell, "Diagnosis and Troubleshooting of Automotive Electric, Electronic, and Computer Systems", 4th Edition, Prentice Hall, New Delhi, 2006.

Reference Books:
1. James D. Halderman and Chase D. Mitchell, "Automotive Electricity and Electronics", Prentice Hall, New Delhi, 3rd Edition, 2010.
2. Barry Hollembeak, "Automotive Electricity & Electronics Classroom Manual", Cengage Learning Publisher, New Delhi, 5th Edition, 2010.
3. Al Santini, "Automotive Electricity & Electronics", Cengage Learning Publisher, New Delhi, Student Edition, 2003.

11EE241 NETWORK ANALYSIS AND SYNTHESIS

Credits 3:1:0
Course Objectives:
i. To know the concepts and investigate the behavior of electric networks by analytical techniques.
ii. To learn the network topology of DC circuits.
iii. To examine the concepts of network synthesis.
iv. To analyze the concepts of two port networks and passive filters.

Unit I: S-Domain Analysis
S-domain network -driving point and transfer impedances and their properties –transform network analysis -poles and zeros of network functions -time response from pole-zero plots.

Unit II: Frequency Domain Analysis

Amplitude and Phase Characteristics from pole zero plot- Responses due to exponential and sinusoidal sources- Magnitude and phase plots for RL & RC networks- Complex Loci for RL & RC and RLC networks- Plots based on s-plane phasors.

Unit III: Network Topology
Network graph, Tree, incidence matrix – fundamental cut-sets and fundamental loops –tie set and cut-set schedules -v-shift and I-shift - Formulation of equilibrium equation on loop basis and node basis, Formulation of equilibrium equation in matrix form- Duality, Construction of a dual of a network.

Unit IV: Two-Port Networks & Filters
Characterization of two-port networks in terms of z, -y, h-and T, g and inverse T - parameters - Relations between network parameters- Network Equivalents -Analysis of T, π , ladder, bridged-T and lattice networks -Transfer function of terminated two-port networks. Filters and attenuators -Design of constant -k, m-derived and composite filters Design of symmetrical and asymmetrical attenuators (T and π)

Unit V: Elements of Network Synthesis
Realisability of one-port network -Hurwitz polynomials and properties -p. r. functions and properties -synthesis of RL, RC and LC one-port networks.

Course Outcome:
At the end of the course, student would be able to:
i. Synthesis the networks by different methods.
ii. Analyze the networks by s-domain and frequency domain.
iii. Analyze the two port networks.
iv. Evaluate DC and AC circuits using mathematical tools.

Text Book

1. Sudhakar A., "Network Analysis and Synthesis", Tata Mc-Graw Hill Publishing Company Limited, New Delhi, 3rd Edition, 2003

Reference Books

1. Paranjothi,S.R., "Electric Circuit Analysis", New age International Publishers Limited, New Delhi, 4th Edition, 2011.
2 Wadhwa C. L., "Network Analysis and Synthesis: Including Linear System Analysis", Anshan Pub publisher, 32nd Edition, 2009.
3 Sinha, "Network Analysis and Synthesis", Sataya Prakasan Publishers Limited, New Delhi, 5th Edition, 2010.
4 Sivanandam.S.N., "Electric Circuit Analysis", Vikas Publishing House Private Limited, New Delhi, 2001

11EE242 ENERGY STYSTEMS

Credits: 4:0:0
Course Objectives:
i. To provide a broad introduction to the area of electric energy systems
ii. To impart knowledge about the various non conventional energy sources.

iii. To understand concept of illumination systems, heating and welding systems..
iv. To learn the requirements of traction systems.

Unit I: Solar and Wind Energy Source
Solar Thermal Systems: Principle of solar thermal power generation Solar Photovoltaic Systems: Solar cells and their characteristics – Influence of insolation and temperature - PV arrays – Series and parallel connections – Synchronized Operation with grid supply - Stand alone PV systems – Charge controllers – Wind Energy: Nature and Power in the wind - Basic principle of wind energy conversion – Blade element Theory – Components of a wind energy conversion system - Classification of WECS – Wind Turbines – Types - Horizontal axis and vertical axis wind turbines – Generator control – Load control.

Unit II: Miscellaneous Energy Source
Energy from Oceans**:** Ocean thermal energy conversion systems - Energy from tides Ocean Waves – MHD Energy Conversions: Magneto Hydro Dynamic (MHD) power generation – Types - Fuel cells – Types – Energy from fusion Hybrid Systems**:** Range and type of Hybrid systems – Case studies of Diesel-PV and Wind-PV systems.

Unit III: Illumination, Electric Heating & Welding
Lighting calculations – determination of MHCP and schemes – polar curves of different types of sources – Rousseau's construction – photometers – lighting schemes – design of lighting schemes – factory & flood lighting – electric lamps – gaseous discharge construction and application – control equipment, efficiency and losses – resistance heating, induction heating – furnaces – high frequency dielectric heating, resistance welding arc welding.

Unit IV: Electric Traction
Requirements of traction system – Systems of traction – speed time curves – tractive effort calculations – power of traction motor – specific energy consumption – series, parallel control of DC motor, open circuited, shunt and bridge traction – electric braking.

Unit V: Generation of High Voltages and Currents and Its Measurements
Generation of high DC voltage uses voltage multiplier circuits – Van de Graff generator – generation of high alternating voltages using cascade transformers – High DC voltage measurement techniques – methods of measurement for power frequency AC voltage – sphere gap measurement technique – use of CRO for impulse voltage and current measurements.

Course Outcome:
At the end of the Course the student would be able to:
i. Explain the technological basis for harnessing these renewable energy sources including their possibilities and limitations.
ii. Recognize the effects that current energy systems based on fossil fuels have over the environment and the society.
iii. Overcome climate change and other sustainable development goals and an insight into the possible solutions to sustainable energy usage.

Text Books:

1. Khan B.H., “Non-Conventional Energy Resources”, Tata McGraw-hill Education Private Limited, New Delhi, 2nd Edition, 2006.
2. Open Shaw Taylor E., “Utilization of Electric Energy in SI Units”, Orient Longman Ltd, New Delhi, Eleventh reprint, 2007.

Reference Books:

1. Wadhwa C.L., “High Voltage Engineering”, New Age International (P) Ltd., New Delhi,3rd Edition, 2010.
2. Rao S and Paruklekar, “Energy Technology – Non Conventional, Renewable and Conventional”, Khanna Publishers, New Delhi, 3rd Edition, 2005.
3. Gupta J.B., “Utilization of Electric Power and Electric Traction”, S.K.Kataria and Sons (Publishers), New Delhi, Reprint 2010.
4. Partab H., “Art and Science of Utilization of Electrical Energy”, Dhanpat Rai and Co, New Delhi, 2004.

11EE243 MICRO ELECTRO MECHANICAL SYSTEMS

Credits: 4:0:0

Course Objectives:

i. To know the concepts in micro electro mechanical systems and understand the various sensors.
ii. To gain knowledge on different mechanics of MEMS design
iii. To learn about electrostatic actuators.
iv. To understand the RF and optical MEMs equipments.

Unit I: Introduction to MEMS

MEMS and Microsystems, miniaturization, Typical products, Micro sensors, micro actuation, MEMS with micro actuators, micro accelerometers, and Micro fluidics, MEMS materials, Micro fabrication.

Unit II: Mechanics for MEMS Design

Elasticity, Stress, strain and material properties, Bending of thin plates, spring configurations, torsional deflection, Mechanical vibration, Resonance, Thermo mechanics- actuators, force and response time, Fracture and thin film mechanics, material, physical vapour deposition(PVD), chemical mechanical polishing(CMP)

Unit III: Electrostatic Design

Electro statistics-basic theory, electrostatic instability, surface tension, gap and finger pull up, Electrostatic actuators, Comb generators, gap closers, rotary motors, bistable actuators.

Unit IV: Circuit and System Issues

Electronic interfaces, Feedback systems, Noise, Circuit and System issues, Case studies-Capacitive accelerometer, Piezo electric pressure sensor, Thermal sensors, Radiation sensors, mechanical sensors, bio-chemical sensors, Modeling of MEMS systems, CAD for MEMS.

Unit V: Introduction to Optical and RF MEMS

Optical MEMS, system design basics- Gaussian Optics, matrix operations, Resolution, Case studies, MEMS scanners and retinal scanning display, Digital Micro mirror devices, RF MEMS-Design basics, Case study- Capacitive RF MEMS switch, Performance issues.

Course Outcome:

At the end of the course, student would be able to:

i. Design micro electro mechanical systems process modules.
ii. Model the micro electro mechanical systems.
iii. Implement the micro electro mechanical systems and use the various sensors.

Text Book

1. Stephen Santeria, “Microsystems Design”, Kluwar publishers, Boston(USA), 2000

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(USA), 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, New Delhi2002.
5. James J.Allen, “Micro electro mechanical system design”, CRC press ,Baco Raton(USA), 2005.

11EE244 ADVANCED CONTROL SYSTEMS

Credit: 3:1:0

Course Objectives:

i. To incite a wide knowledge on the description and stability of non-linear system.
ii. To examine the conventional technique of non-linear system analysis.
iii. To solve the analysis discrete time systems using conventional techniques.
iv. To understand the analysis of digital control system using state-space formulation.
v. To look at the formulation and analysis of multi input multi output (MIMO) system.

Unit I: State Space Analysis Of Continuous Time Systems

State variable representation – Conversion of state variable form to transfer function and vice versa – Eigen values and Eigenvectors – Solution of State Equation – Controllability and observability – Pole placement design – Design of State observer

Unit II: Z Transform and Sampled Data Systems

Sampled data theory – Sampling process – Sampling theorem – Signal reconstruction – Sample and hold circuits – z Transform – Theorems on z Transforms – Inverse z Transforms – Discrete systems and solution of difference equation using z transform – Pulse transfer function – Response of sampled data system to step and ramp Inputs – Stability studies – Jury’s test and bilinear transformation

Unit III: State Space Analysis of Discrete Time Systems

State variables – Canonical forms – Digitization – Solution of state equations – Controllability and Observability – Effect of sampling time on controllability – Pole placement by state feedback – Linear observer design – First order and second order problems

Unit IV: Non-Linear Systems

\Types of non linearity – Typical examples – Phase plane analysis – Singular points – limit cycles – Construction of phase trajectories – Describing function method – Basic concepts – Dead Zone – Saturation – Relay – Backlash – Liapunov stability analysis – Stability in the sense of Liapunov – Definiteness of scalar functions – Quadratic forms – Second method of Liapunov – Liapunov stability analysis of linear time invariant systems and nonlinear system

Unit V: MIMO Systems

Models of MIMO system – Matrix representation – Transfer function representation – Poles and Zeros – Decoupling – Introduction to multivariable Nyquist plot and singular values analysis – Model predictive control

Course Outcome:

At the end of the course, student would be able to:

i. Gain knowledge in analysis of non-linear system and digital control of linear system.
ii. Implement the concept of MIMO system.
iii. Find non-linear system stability using the trajectory methods.

Text Book:

1. Nagrath I.J., Gopal M., 'Control Systems Engineering', New Age International Publishers, 5th Edition, New Delhi 2003.

Reference Books:

1. Raymond T. Stefani, Bahram Shahian, Clement J. Savant and Gene Hostetter , 'Design of feedback Control systems', Oxford University Press, New York,4th Edition, *2002*.
2. Katsuhiko Ogata, "Discrete-Time Control Systems", New Age International, New Delhi, 4th Edition, 2007.
3. Gopal M, "Digital Control and State Variable Methods", Tata McGraw Hill, New Delhi, 3rd Edition. 2008
4. Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", Pearson Education, New Delhi, 8th Edition, 2004

11EE245 PLC AND AUTOMATION

Credits: 4:0:0

Course Objectives:

i. To learn the basics of PLC.
ii. To study the programming of PLC and HMI systems.
iii. To examine the difference between SCADA and DCS.
iv. To understand the basic concepts of Intelligent Automation.

Unit I: Programmable Logic Controllers

Basics of PLC – Architecture of PLC – Advantages – Types of PLC – Introduction to PLC Networking – Protocols – Field bus – Process bus and Ethernet.

Unit II: Programming of PLC & HMI Systems Programming of PLC

Types of Programming – Simple process control programs using Relay Ladder Logic and Boolean logic methods – PLC arithmetic functions **HMI systems:** Necessity and Role in Industrial Automation – Text display – Operator panels & Touch panels – Panel PCs – Integrated displays (PLC & HMI)

Unit III: Distributed Control Systems (DCS)
Difference between SCADA system and DCS – Architecture – Local control Unit – Programming language – Operator interface – Engineering interfaces.

Unit IV: Applications of PLC & DCS
Case studies of Machine automation – Process automation – Introduction to SCADA – Comparison between SCADA and DCS

Unit V: Automation
Factory Automation: Flexible Manufacturing Systems concept – Automatic feeding lines – ASRS – Transfer lines – Automatic inspection – Computer Integrated Manufacture – CNC – Intelligent automation – Wireless controls.

Course Outcome:
At the end of the Course the student would be able to:

i. Identify, formulate, and solve problems related to PLC.
ii. Design a system, component, or process to meet desired needs of the industrial requirement.
iii. implement a complete SCADA project relating to an industrial process or operation

Text Books:

1. Webb, John W.Reis, Ronald A., "Programmable Logic Controllers Principles and Application", PHI Learning, New Delhi, 5th Edition, 2009.
2. Dieter K. Hammer, Lonnie R. Welch, Dieter K. Hammer, "Engineering Of Distributed Control Systems", Nova Science Publishers, USA, 2001.

Reference Books:

1. Gary Dunning, "Introduction to Programmable Logic Controllers", Thomson Business Information, New Delhi, 2nd Edition, 2009.
2. Bolton. W, "Programmable Logic Controllers", Elsevier India Private Limited, 5th Edition, New Delhi, 2010.
3. Mikell P. Groover, "Automation Produciton systems and Computer Integrated Manufacturing", PHI Learning Ltd., 3rd Edition, New Delhi, 2009

11EE246 DISTRIBUTED CONTROL SYSTEM

Credits: 4:0:0
Course Objectives

i. To understand the basic industrial communication protocols.
ii. To know the industrial application of PLC, SCADA, and open systems.
iii. To impart knowledge about PLC and the programming
iv. To give adequate information in the interfaces used in DCS.

Unit I: Introduction to Automation

Plant Automation and Control Systems Strategy, Evolution of instrumentation and control, Role of automation in industries, Benefits of automation, Introduction to automation tools PLC, DCS, SCADA, Hybrid DCS/PLC, Automation strategy evolution, Performance criteria and Safety Systems**.**

Unit II: Programmable Logic Controller (PLC)
Basics of PLC – Architecture of PLC – Advantages – Types of PLC-Applications of PLC's-Specifications of advanced PLC's. PLC Programming – Simple process control programs are using Relay Ladder Logic and Boolean logic methods – Structured text, Sequential flow chart, State diagrams. System configuration hardware, system sizing and selection, wiring diagram, PLC installation, interfacing to PC.

Unit III: Introduction to DCS
DCS- Basic Packages Introduction, analog control, direct digital control, distributed process Control, DCS configuration with associated accessories, control console equipment, control Unit (Relay Rack mounted equipments), local control units and attributes of DCS & DCS Flow Sheet symbols. DCS System Integration I/O hardware stations, Set-point station control, Supervisory Computer Tasks & configurations, system integration with PLCs and computers.

Unit IV: Industrial Protocol
Instrumentation Standard Protocols, HART Protocol, frame structure, programming, implementation examples, Benefits, Introduction, Advantages and Limitations of Field bus, FDS configuration, Comparison with other field bus standards including Device net, Profibus, Controlnet, CAN, Industrial Ethernet, MAP and TOP.

Unit V: Applications
Industrial applications of PLC, SCADA, DCS and open systems for following plants; Cement plant, Thermal power plant, Steel Plant, Glass manufacturing plant, Paper and Pulp plant.

Course Outcome
At the end of the course, student would be able to:

i. Apply the various automation techniques involved in process industries
ii. Select suitable automation techniques for industrial application
iii. Control remote sites equipped with PLC to measure various parameters.

Text Books:

1. Dieter K. Hammer, Lonnie R. Welch, Dieter K. Hammer, "Engineering of Distributed Control Systems", Nova Science Publishers, USA, 2001.
2. John Mcbrewster, Frederic P.Miller, Agnes F.Vandome, "Distributed Control System", Alphascript publishers, Mauritius, 2010.

Reference Books:

1. Gary Dunning, "Introduction to Programmable Logic Controllers", Thomson Business Information, New Delhi, 2nd Edition, 2009.
2. Bolton. W, "Programmable Logic Controllers", Elsevier India Private Limited, 5th Edition, New Delhi, 2010.

3. Mikell P. Groover, “Automation Produciton systems and Computer Integrated Manufacturing”, PHI Learning Ltd., 3rd Edition, New Delhi, 2009.

11EE247 VIRTUAL INSTRUMENTATION

Credits 3:0:0

Course Objectives:

i. It provides new concepts towards measurement and automation.
ii. It imbibes knowledge about how to control an external measuring device by interfacing a computer.
iii. To become competent in data acquisition and instrument control.

Unit I: Review of Virtual Instrumentation

Historical perspective, advantages, Block diagram, Architecture of a Virtual Instrument, Data Flow Techniques, Graphical programming in data flow, comparison with Conventional programming.

Unit II: VI Programming Techniques

VIS and sub-VIS, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O

Unit III: Data Acquisition Basics

ADC, DAC, DIO, counters & timers, PC Hardware structure, timing, Interrupts DMA, software and hardware installation.

Unit IV: Common Instrument Interfaces

Current loop, RS 232C/ RS485, GPIB, System buses, interface buses: USB, PCMCIA, VXI, SCXI, PXI, etc., networking basics for office & Industrial applications, VISA and IVI, Image Acquisition and Processing. Motion control.

Unit V: Use of Analysis Tools

Fourier transforms, power spectrum, correlation methods, windowing & filtering. VI applications in various fields –Biomedical engineering, optical engineering, remote testing of instruments, aerospace engineering.

Course Outcome:

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

i. Acquire knowledge on how virtual instrumentation can be applied for data-acquisition and instrument control.
ii. Identify salient traits of a virtual instrument and incorporate these traits in their projects.
iii. Experiment, analyze and document in the laboratory prototype measurement systems using a computer, plug-in DAQ interfaces and bench level instruments.

Text Books

1 . Jerome, Jovitha, “Virtual Instrumentation and LABVIEW”, PHI Learning, New Delhi, 1st

Edition, 2010.
2. Gupta, "Virtual Instrumentation Using Lab View", Tata McGraw Hill, New Delhi, 1st Edition, 2008.

Reference Books:

1. Ronald W. Larsen, "LabVIEW for Engineers", Prentice Hall Ltd, USA Jan 2010.
2. LabVIEW: Basics I & II Manual, National Instruments, 2005.
3. Sanjay Gupta and Joseph John, " Virtual Instrumentation using LabVIEW", Tata Mc Graw – Hill Publishing Company Limited, New Delhi, 1st Edition, 2005.

11EE248 ILLUMINATION ENGINEERING

Credits: 3:0:0

Course Objectives:

i. To design a electrical system including cost estimate and energy efficient lighting systems in residential, commercial and industrial establishments.
ii. To be familiar with the current guidelines in the design, construction, and management of safe and energy-efficient road lighting systems through actual completed projects.
iii. To understand the concept of lighting system maintenance, basic lighting energy audit and economic analysis of lighting.

Unit I: Language of Light & Lighting
Eye & vision – Light & Lighting – Light & Vision –, Light & Color – Basic Concepts and Units – Photometry – Measurement and Quality of Lighting.

Unit II: Accessories
Light sources: Daylight, Incandescent – Electric Discharge – Fluorescent – Arc lamps – Lasers – Neon signs – LED-LCD displays – Luminaries – Wiring.

Unit III: Calculation and Measurement
Polar curves – Effect of voltage variation on efficiency and life of lamps – Lighting calculations – Illumination from point, line and surface sources – Photometry and Spectro – photometry – photocells.

Unit IV: Interior Lighting
Lighting design procedure for Industrial – Residential – Office – Departmental stores – Indoor stadium – Theatres – Hospitals.

Unit V: Exterior Lighting
Environment and glare – Lighting Design procedure for Flood – Street – Aviation and Transport lighting – Lighting for Displays and Signaling.

Course Outcome:
At the end of the Course the student would be able to:

i. Perform indoor & outdoor lighting design calculations.
ii. Determine appropriate lighting control techniques and equipment to a sample project.

iii. Perform basic lighting energy audit to a sample project.

Text Books:

1. Leon Gaster, John Stewart Dow, "Modern Illuminants And Illuminating Engineering", Nabu Press, Washington DC, 1st Edition, 2010.
2. Jack L. Lindsey, "Applied Illumination Engineering", Prentice Hall of India, 3rd Sub Edition, New Delhi, 2008.

Reference Books:

1. Cady, "Illuminating Engineering", General Books, USA, 2010.
2. Kamlesh Roy, "Illuminating Engineering", Laxmi Publications, 2nd Edition, 2006
3. William Edward Barrows, "Electrical Illuminating Engineering", Bibliolife Publishers, USA, 2010.
4. IES Lighting Handbook, 10th Edition, 2011.

11EE249 AUTOMOTIVE ELECTRONICS

Credits 3:0:0

Course Objectives

i. To study the concepts of sensors, actuators, drives.
ii. To study Electronics Fuel Injection System.
iii. To study the Lighting system and accessories.
iv. To study the digital control of starting and braking methods in the automobile system.

Unit I: Sensors and Actuators

Introduction, Basic sensor arrangement, types of sensors such as - oxygen sensors, Crank angle position sensors - Fuel metering / vehicle speed sensor and detonation sensor - Altitude sensor, flow sensor. Throttle position sensors, Solenoids, Stepper motors, Relays.

Unit II: Starting System

Condition at Starting, Behavior of starter during starting. Series motor and its Characteristics. Principle & construction of starter motor. Working of different starter drive Units, care & maintenance of starter motor. Starter switches.

Unit III: Electronic Fuel Injection and Ignition Systems

Introduction, Feedback carburetor systems (FBC) Throttle body injection and multi port or point fuel injection, Fuel injection systems, injection system controls. Advantages of electronic ignition systems. Types of solid state ignition systems and their principle of operation, Contact less electronic ignition system, Electronic spark timing control.

Unit IV: Lighting System & Accessories

Insulated & earth return systems. Positive & negative earth systems. Details of Head light & Side light. Head light dazzling & preventive methods. Electrical Fuel Pump, Speedometer, Fuel, Oil & Temperature gauges, Horn, Wiper system, Trafficator.

Unit V: Digital Control Systems

Current trends in modern Automobiles- Open loop and closed loop control systems – Engine cranking and warm up control - Acceleration enrichment - Deceleration leaning and idle speed control. Distributor less ignition - Integrated engine control system, Advanced suspension, electronically controlled electric power steering, electronically controlled electric brakes.

Course Outcome

During the end of this course, the student will be able to,

i. Design the digital control of drives using sensors and Digital Control Systems.
ii. Design the starting and braking system for the automobiles.
iii. Do research in field of automotive electrical applications.

Text Book

1. William B.Ribbens, "Understanding Automotive Electronics", Butterworth, Heinemann Woburn, New York, 6^{th} Edition, 2003.

Reference Books:

1. James D. Halderman and Chase D. Mitchell, "Diagnosis and Troubleshooting of Automotive Electric, Electronic, and Computer Systems", Prentice Hall, New Jersey, 4^{th} Edition, 2006.
2. James D. Halderman and Chase D. Mitchell, "Automotive Electricity and Electronics", Prentice Hall of India, New Delhi, 2004.
3. Robert Bosch "Automotive Hand Book", SAE (5th Edition), 2000.
4. Ganesan.V. "Internal Combustion Engines", Tata McGraw-Hill Publishing Co., New Delhi, 2003
5. James D.Halderman, "Automotive electricity and Electronics", Prentice Hall, 4^{th} Edition, 2010.

11EE250 BASICS OF ELECTRIC AND HYBRID VEHICLE

Credits: 3:0:0

Course Objectives:

i. To understand the concepts of electric and hybrid vehicle
ii. To analysis various battery Module by performing Power, Energy, and temperature testing
iii. To know the necessity of alternative and novel energy sources
iv. To study the various machines and controller used in electric and hybrid vehicle.

Unit I: Introduction

Electrical Vehicle History- Battery electric vehicles- Hybrid vehicle- Fuelled electric vehicles-Solar powered vehicles-Electric vehicles which use flywheels or super capacitors.

Unit II: Batteries

Introduction- Battery Parameter-Self-discharge rates-Battery temperature, heating and cooling needs -Battery life- Introduction to Lead Acid Batteries, Nickel-based Batteries, Lithium Batteries. Use of Batteries in Hybrid Vehicles.

Unit III: Alternative Energy Sources and Storage Devices

Introduction -Solar Photovoltaic -Wind Power- Flywheels- Super Capacitors-Supply Rails-

Hydrogen Fuel Cells: Basic Principles-Hydrogen storage methods.

Unit IV: Electric Machines and Their Controllers
Operation of the basic DC motor-Brushless Electric Motors-Switched reluctance motors-The induction motor . Electrical Machines for Hybrid Vehicles. General Issues in Design.

Unit V: Design of Ancillary Systems
Introduction- Heating and Cooling Systems -Design of the Controls -Power Steering -Choice of Tires-Wing Mirrors, Aerials and Luggage Racks -Electric Vehicle Recharging and Refueling.

Course Outcome:
At the end of the Course the student would be able to:

i. Develop a hybrid vehicle with existing renewable system.
ii. design a new controller for hybrid electric vehicle.
iii. apply control techniques to store the energy.
iv. analyze the performance ancillary systems.

Text Books:

1. Iqbal Husain, "Electric and Hybrid Vehicles Design Fundamentals", CRC Press, Newyork, USA. 2nd Edition, 2010.
2. Mehrdad Ehsani ,Yimin Gao, Sebastien E. Gay, Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC press, Newyork, USA, 2008.

Reference Books:

1. Seth Leitman, Bob Brant, "Build Your Own Electric Vehicle", Professional Edition:Ebook , McGraw-Hill, New york, 2nd Edition, 2008.
2. James Larminie , John Lowry, "Electric Vehicle Technology Explained", Wiley publications, India, 3rd Edition 2007.
3. Austin Hughes, "Electric Motors and Drives: Fundamentals, Types and Applications" McGraw-Hill, New York, USA, 3rd Edition, 2006.
4. Carl Vogel, "Build Your Own Electric Motorcycle", McGraw-Hill, New york, USA, 2nd Edition 2009.
5. David Linden, Thomas B. Reddy, "Handbook Of Batteries", McGraw-Hill,New york, USA, 2nd Edition,2008.

11EE251 BUILDING AUTOMATION

Credits: 3:0:0
Course Objectives:

i. To understand about the building automation and its management system.
ii. To study about the security and safety systems in smart building.
iii. To suggest suitable possibilities to integrate system and its managements for intelligent building.

Unit I: Introduction to Building Automation System

Introduction – Features, Characteristics, and Drawbacks of Building Automation system – Building Management System: Introduction, HVAC, Sensors & Transducers – Temperature, Pressure, Level and Flow – Meaning of Analog & Digital Signals, Valves and Actuators – Concept of Controller IOs – Cable Selection – Earthing.

Unit II: Energy Management System
Energy Meters Types – Meter Networking – Monitoring Energy Parameters, Analysis of Power Quality – Instantaneous Power, Active Power, Reactive Power, Power Factor, Voltage, Current – Effect of Power Quality on Energy Consumption – Energy Conservation, Importance of Energy Saving.

Unit III: Safety Systems
Introduction – Fire Development Stages – Fire Sensors & Detectors – Detector Placement – Fire Extinguishing Principles & Its Classification – Fire Alarm System –Pre-alarm, Alarm – Cable Selection – Installation Guidelines – Best Installation Practices.

Unit IV: Security Systems & Video Management
Introduction, Access Control – Concept Generic Model – Card Technologies – Concept of Antipass back – Biometrics – Video Door phone – Intrusion Detection System – Sensors – **Video Management:** Introduction, CCTV Camera Basics – Digital Video Recording, Features – Digital Vs Analog Recording – Digital Video Management System – TCP/IP Networking.

Unit V: Integrated Systems
Introduction – Energy Management System – Safety System – Security Systems – Video Management – Benefits of Integrated Systems, Challenges – Future Prospects of Integrated Systems.

Course Outcome:
At the end of the Course the student would be able to:
i. Construct and design structured building system by enabling integrated system connections.
ii. Apply the building automation system and telecommunication facilities in modern intelligent buildings; and apply networking technologies in building automation.
iii. Evaluate the comprehensive specifications of an importance of energy conservation components for a modern commercial building.

Text Books:
1. Shengwei Wang, "Intelligent Buildings and Building Automation", Spons Architecture Price Book, New York, 1st Edition, 2009.
2. Jong-jin Kim, "Intelligent Buildings", Butterworth-Heinemann, Illustrated Edition, London, 2006.

References:

1. Derek Clements - Croome, "Intelligent Buildings: Design Management and Operation", Thomas Telford Ltd., UK, Illustrated Edition, 2004.
2. Reinhold A. Carlson Robert A. Di Giandomenico, 'Understanding Building Automation Systems: Direct Digital Control, Energy Management, Life Safety, Security Access

Control, Lighting, and Building", Means, R. S. Company, Incorporated (Publisher), New Delhi, 1st Edition, 1991.

3. In Partnership with Nijatc, "Building Automation: Control Devices and Applications", Amer Technical Publishers, New York, 1st Edition, 2008.

11EE252 FUNDAMENTALS OF ELECTRICAL SAFETY

Credits: 3:0:0

Course Objectives

i. To exhibit knowledge of safety rules and regulations, and demonstrate awareness of hazards in the workplace.
ii. To explain the use of personal protective equipment.
iii. To understand the various reasons for electrical accidents
iv. To learn various method to calculate electric bill.

Unit I: Introduction to Electrical Safety

Basic Definitions and Nomenclature-Fundamentals of Electrical Safety- Mathematical Principles of Electrical Safety-The Earth- Effects of Electric Currents Passing Through the Human Body, and Safety Requirements

Unit II: Study of Electrical Safety Components

Introduction to conductors and insulators- Wire Characteristics- Ampacity, Insulation Type , Wire Size, Cables & Cords – Electrical Standards- Safety against Over voltages- Safety Against Static Electricity.

Unit III: Indoor and Outdoor Safety Precautions

Indoor safety-Check Equipment, Wet/Damp Areas, Metal Objects, Electrical Emergencies. Outdoor safety-Overhead Power Lines, Underground Power Lines, Outdoor Equipment, Antennas/Ladders, Recreational Safety, Job Site Hazards, Electrical Emergencies

Unit IV: Electrical Hazards

Main Factors in Electrical Accidents-Electrical Shock- Definition- Arc Flash-Arc Flash Burn Injuries -Arc Blast Pressure - Inhalation Injuries- Determining Safe Approach Distance Determining Arc Hazard Category.

Unit V: Calculating Electric Bills

Ohms Law-Watt's Law- Fuel cost-calculating Energy use and cost-Estimating, Meter-disc revolution, check meter- study of kWh meter. Estimation of usage of power. Estimated rate-Actual rate- Rates classes and rate schedule – Electrical Bill component- Fuel cost adjustment-demand rate-power factor penalty, Smart Meters, architecture of Smart Meter, Smart metering schemes and Power Quality Measurements using Smart meters.

Course Outcome

At the end of the course the students will be able to

i. Describe hazards and prevention practices.
ii. Demonstrate proper safety procedures.
iii. Demonstrate proper use of hand and power tools.

iv. Identify various trades used in the construction industry.
v. Select and use the power tools and hand tools

Text Books:

1. Dr. Massimo A. G. Mitolo, "Electrical Safety of Low-Voltage Systems", McGraw-Hill, USA, 2nd Edition, 2008.
2. John Cadick, Mary Capelli-Schellpfeffer, Dennis K. Neitzel, 'Electrical Safety Hand book, McGraw-Hill, New york, USA, 3rd Edition, 2005.
3. David J. Marne, "National Electrical Safety Code (NESC) Handbook", McGraw-Hill, Newyork, 2nd Edition, 2007.

Reference Books

1. Kenneth G. Mastrullo, Ray A. Jones,"The Electrical Safety Program Book", Jones and Bartlett Publishers, London, First Edition, 2003.
2. Wayne C. Turner, Steve Doty," Energy Management hand book", 6th Edition, The Fair Mont press, Georgia, 2006.
3. Albert Thumann, William J.Younger , Terry Niehus, " Handbook of Energy Audits", CRC Press Newyork, Eighth Edition, 2009.
4. Palmer Hickman, "Electrical Safety-Related Work Practices", Jones & Bartlett Publishers, London, Second Edition, 2009.

11EE301 POWER SEMICONDUCTOR DEVICES

Credits: 4:0:0

Course Objectives:

i. To understand various static and dynamic performances of static switches.
ii. To familiarize the student on switching and steady state characteristics power electronic devices.
iii. To analyze the control circuits and switching losses in power devices.

Unit I: Introduction
Status of Development of power semiconductor Devices - Types of static switches - Controlled and uncontrolled - Ideal and real switches - Static and dynamic performance - Use of heat sinks - Switching losses. Power Diodes: Types - Electrical rating - Switching and steady state characteristics - switching aid circuits - Series and parallel operation - Schotky diodes - Fast recovery diodes.

Unit II: Thyristors
Physics of device operation - Electrical rating - Switching and steady state characteristics - Gate circuit requirements - Protection - Series and parallel operation - Driver circuit - Types of Thyristors: Asymmetrical Thyristor - Reverse conducting Thyristor - Light fired Thyristor - switching losses.

Unit III: Special Types of Thyristors
TRIACs, GTOs and MCTs: Electrical rating - Switching and steady state characteristics - protection - Gate circuit requirements-Turn ON and Turn OFF methods – Series, Parallel operation of GTO Thyristors.

Unit IV: Power Transistors & Power MOSFETs
Types - Ratings - Static and switching characteristics - Driver circuit - Switching aid circuit - Power Darlington. Power MOSFETS: Types - Comparison with BJTs - Structure - Principle of operation - Switching losses - Driver circuit - Switching aid circuit.

Unit V: IGBTs & Emerging Devices
Comparison with power BJT and MOSFET - Structure, Principle of working - Switching characteristics - Gate drive requirements. Emerging Devices: SITs-characteristics - Power Integrated circuit - Characteristics - Field Controlled Thyristors - New semiconductor materials for devices - Intelligent power modules.

Course Outcome:
At the end of the Course the student would be able to:

i. Design switching using power semiconductor devices.
ii. Specify design criteria (power, efficiency, ripple voltage and current, harmonic distortions, power factor).
iii. Select components, interpret terminal characteristics of the components, model components, design circuit, and understanding operation of power electronics circuits.

Reference Books:

1. B. Jayant Baliga, "Fundamentals Of Power Semiconductor Devices", Springer-Verlag Publication, New Delhi , 1st Edition, 2008.
2. Robert Perret, "Power Electronics Semiconductor Devices", Wiley-ISTE Publications, New Delhi , New Edition, 2009.
3. Joseph Vithayathil, "Power Electronics :Principles and Applications", McGraw – Hill Education India, New Delhi, 2010.
4. Muhammad H. Rashid, "Power Electronics - Circuits, Devices and Applications", Academic Press, New Delhi, 2nd Edition, 2006.
5. Mohan, Ned. et.al, "Power Electronics Converters, Applications and Design", Wiley India Pvt. Ltd., New Delhi, 3rd Edition 2007.
6. Muhammad H. Rashid, "Power Electronics Hand Book", Academic Press, New Delhi, 1st Edition, 2001.

11EE302 LINEAR SYSTEMS

Credits: 3:1:0
Course Objectives

i. To understand the state model of LTI (Linear time invariant) system.
ii. To give basic knowledge in obtaining decomposition of transfer function from state model.
iii. To understand the concepts of controllability and Observability
iv. To provide adequate knowledge in the Liapunov stability analysis.

Unit I: State Space Analysis
Limitations of conventional control theory - Modern control theory: Concepts of state, state variables and state model - State model for linear time invariant systems: State space representation using physical - Phase and canonical variables - Solution of state equation - State transition matrix.

Unit II: Decomposition Methods
Transfer function from state model - Transfer matrix - Decomposition of transfer functions: Direct, cascade and parallel decomposition techniques.

Unit III: State Space Representation for Discrete System
State space representation of linear time invariant discrete time systems - Solution of discrete time state equation. - Discretization of continuous time state equations. Eigen Values And Eigen Vectors: Characteristic equation, Eigen values, Eigen vectors - Invariance of Eigen values - Diagonalization - Jordan canonical form.

Unit IV: Concepts of Controllability and Observability
Kalman's and Gilbert's - Controllable and observable phase variable forms - Effect of pole-zero cancellation on controllability & observability. State Estimators: Pole placement by state feedback - State estimators -Open loop and asymptotic state estimators.

Unit V: Liapunov Stability Analysis
Stability in the sense of Liapunov - Definiteness of Scalar Functions - Quadratic forms - Second method of Liapunov - Liapunov stability analysis of linear time invariant system.

Course Outcome:
At the completion of the subject, the Student has
i. Very good knowledge in the basic concepts of linear control theory and design of control system.
ii. Gained the knowledge about the controllability & Observability.
iii. Solved the stability analysis problems.

Reference Books:
1. Katsuhiko Ogata, "Modern Control Engineering", Prentice Hall of India Private Limited., New Delhi, 4th Edition, 2002.
2. Nise S. Norman, "Control Systems Engineering", John Wiley & Sons Inc, New Delhi, 3rd Edition, 2000.
3. Nagrath I.J, & Gopal M, "Control System Engineering", New Age International Publishers Limited, New Delhi, 5th Edition, 2007
4. John J. D'Azzo, Constantine H. Houpis, "Linear Control System Analysis and Design", CRC Press, USA , 5th Edition,2003
5. Shankar P. Bhattacharyya, Aniruddha Datta, Lee H. Keel,"Linear control theory :structure ,robustness and optimization" CRC Press, USA , 2009

11EE303 ADVANCED DIGITAL SIGNAL PROCESSING

Credits :4:0:0
Course Objectives:
i. To have an overview of signals and systems and DFT & FFT Transforms.
ii. To study the design of IIR & FIR filters.
iii. To study the applications of DSP techniques in processors.

Unit I: Review of Discrete Time Systems

Discrete time Signals-Sequences –Stability and Causality –Frequency domain Representation of Discrete time Systems and Signals –Two-dimensional Sequences and Systems –Z-Transform –Z-Transform Theorems and Properties –Two-dimensional Z Transform. Structures for discrete time system – Direct, cascade and parallel forms –Lattice structure.

Unit II: Discrete Fourier Transform
Representation of Periodic Sequences-the Discrete Fourier Series –Properties of the discrete Fourier series –Sampling, Z-transform –discrete Fourier transform –properties of discrete Fourier Transform –Linear Convolution –Decimation –in- Time and Decimation in- Frequency –FFT Algorithms

Unit III: Digital Filter Design Techniques
Introduction – Design of IIR Digital Filters from Analog Filters –Analog –Digital Transformation –Properties of FIR Digital Filters –Design of FIR Filters Using Windows –A Comparison of IIR and FIR Digital Filters.

Unit IV: Finite Register Length Effects
Introduction - Effects of coefficient on Quantization –Quantization in Sampling -Analog Signals - Finite Register Length effects in realizations of Digital Filters – discrete Fourier Transform Computations.

Unit V: Advanced DSP Processors
Commercial DSP devices – TMS C240 processor, TMS320C, ADSP 2181 processor – Architecture – Addressing modes – Program control – Instruction and programming –Simple programs.

Course Outcome:
At the end of the course, the student will be able to:
i. Understand types of digital signals and Transforms and its application to signals and systems.
ii. Design of IIR & FIR filters.
iii. Understand different DSP processors and basic programming skills.

Reference Books:
1. Emmanuel C. Ifeachor, Barrie W. Jervis, “Digital Signal Processing: A Practical Approach”, Pearson Education India Series, New Delhi, 2nd Edition, 2004
2. Sanjit K Mitra, “Digital Signals Processing: A Computer Based Approach”, Tata McGraw- Hill Publishing Company Limited, New Delhi 2nd Edition, 2004.
2. Alan Oppenheim. V and Ronald W.Schafer, “Digital Signal Processing”, Prentice Hall of India Private. Limited. New Delhi,2 nd Edition 1989.
3. John G. Proakis and Manolakis. D.G, “Digital Signal Processing: Principles Algorithms and Applications,” Prentice Hall of India, New Delhi, 2004.
4. Avatar Singh and Srinivasan. S , “ Digital Signal Processing: Implementation using DSP Microprocessors with Examples from TMS 320C54XX, Thompson Brooks/Cole, Florence, USA 2004.

11EE304 SIMULATION OF POWER ELECTRONIC SYSTEMS

Credits: 3:1:0

Course Objectives:

i. To study the basics of static and dynamic models of power electronic switches.
ii. To learn usage of the software tools like MATLAB, PSPICE & PSIM for various power electronic devices
iii. To understand the different types of power electronic converters using the above mentioned tools in real time applications.

Unit I: Introduction

Need for simulation - Challenges in simulation - Classification of simulation programs - Overview of PSpice, MATLAB and SIMULINK. Mathematical Modelling of Power Electronic Systems: Static and dynamic models of power electronic switches - Static and dynamic equations and state space representation of Power Electronic systems.

Unit II: PSpice

File formats - Description of circuit elements - Circuit description - Output variables - Dot commands - SPICE models of Diode, Thyristors, Triac, BJT, Power MOSFET, IGBT and Power S-Functions - Converting S-Functions to blocks.

Unit III: MATLAB and SIMULINK

MATLAB – Intro Variables – Matrix representation and operation, Trigonometric functions, Logical relations, Exponential Complex Numbers – m file – Function – For loop – While – If else. Graphics – 2D Plots. SIMULINK: Intro – Basic Block – Sources and Sinks model analysis using SIMULINK - S-functions - converting S-functions to blocks.

Unit IV: Introduction to PSIM

General Information – Power Circuit Components – Control Circuit & Other Components – Analysis specification – Circuit Schematic Design – Waveform Processing – Error and Warning messages.

Unit V: Simulation using PSpice, PSIM, MATLAB and Simulink

Diode rectifiers - controlled rectifiers - AC voltage controllers - DC choppers - PWM inverters - voltage source and current source inverters - Resonant pulse inverters - Zero current switching and zero voltage switching inverters.

Course Outcome:

At the end of the Course the student would be able to:

i. use the various functional blocks available in the simulation packages for the problems specified.
ii. design and simulate any power electronic circuits by comparing the performance with other simulation software's.
iii. to do the mathematical modeling of power devices by analyzing their steady state and dynamic performances.

Reference Books:

1. Rashid .M.H., "SPICE for Power Electronics and Electric Power", CRC Press, New Delhi, 2nd Edition, 2005.
2. Ned Mohan, "Power Electronics, Computer Simulation Analysis and Education using PSPICE", Wiley, 3rd Edition, New Jersey, 2002.
3. Stephen Philip Tubbs, "PSPICE Power Electronic and Power Circuit Simulation", Stephen P. Tubbs Publisher, New Jersey, 2008.
4. Patil M. B., Chandorkar M. C., Ramanarayanan V., Ranganathan V. T., "Simulation of Power Electronic Circuits", Alpha Science International Ltd, United Kingdom, 2009.

11EE305 POWER ELECTRONICS APPLICATIONS TO POWER SYSTEMS

Credits: 3:1:0

Course Objectives:

i. To understand the safe and secure operation of simple power system.
ii. To suggest suitable possibilities to extend power system operation.
iii. To understand the recent advancements in power systems using the power electronic systems.

Unit I: Introduction

High power devices for power system controllers - Characteristics - Converters configurations for large power control-Single and three phase converters: Properties - Current and voltage harmonics - Effects of source and load impedance - Choice of best circuit for power systems.

Unit II: Converter Control

Gate control - Basic means of control - Control characteristics - Stability of control - Reactive power control - Power flow analysis: Component models - Converter model - analysis of converter - Transient and dynamic stability analysis – protection.

Unit III: Wind Energy Conversion System

Basic components - Generator control - Harmonics - Power factor improvement. PV Conversion Systems: Different schemes - DC and AC power conditioners - Synchronized operation with grid supply.

Unit IV: HVDC Systems

Application of converters in HVDC systems - Static VAR control - Sources of reactive power - Harmonics and filters

Unit V: FACTS

Concept of Flexible AC Transmission System (FACT) - Static VAR compensators - Thyristor Controlled Reactor - Thyristor Switched Capacitor - Static Condenser - Controllable Series Compensation.

Course Outcome:

At the end of the Course the student would be able to:

i. Find the solutions for eliminating harmonics and EMI present in the output due to fast switching devices.
ii. Apply power system fundamentals to the design of a system that meet specific needs

iii. Design necessary filter circuit require to the distributed network.
iv. Maintain the power system stable and secure by selecting proper FACTS devices.

Reference Books:

1. Padiyar. K.R., "HVDC Power Transmission System", New Age International Private Limited, New Delhi, Reprint 2010.
2. Erich Uhlmann, "Power Transmission by Direct Current", Springer International Edition, New Delhi, 1st Indian Reprint 2004.
3. Rai, G.D., "Solar Energy Utilization", Khanna Publishers Limited, New Delhi, 2000.
4. Kimbark, E.X., "Direct Current Transmission", Wiley Interscience, New York, 1971.
5. Rao S., "EHV-AC, HVDC Transmission and Distribution Engineering (Theory, Practice and Solved Problems)", Khanna Publishers, New Delhi, 2006.

11EE306 NEURO FUZZY CONTROLLERS FOR ELECTRIC DRIVES

Credits: 4:0:0

Course Objectives:

To impart knowledge on

i. The fundamental concept of neurons and their artificial models,
ii. The Structure of fuzzy logic controller and its application to electric drives
iii. To provide comprehensive knowledge of fuzzy logic control and adaptive fuzzy logic
iv. The various application of adaptive neuro controllers and hybrid neuro fuzzy controllers

Unit I: Introduction to Neural Network

Introduction - Biological neurons and their artificial models - Learning, adaptation and neural network's learning rules - Types of neural networks- Single layer, multiple layer- Feed forward, feedback networks; Back propagation -Learning and training –Hopfield network.

Unit II: Neuro Controller

Neural network. for non-linear systems -Schemes of Neuro control- System identification forward model and inverse model- Indirect learning neural network control applications.

Unit III: Introduction to Fuzzy Logic

Fuzzy sets- Fuzzy operation -Fuzzy arithmetic -Fuzzy relations- Fuzzy relational equations - Fuzzy measure -Fuzzy functions -Approximate reasoning -Fuzzy propositions - Fuzzy quantifiers - if-then rules.

Unit IV: Fuzzy Controller

Structure of fuzzy logic controller -Fuzzification models- Data base -Rule base –inference engine defuzzification module - Non-linear fuzzy control-PID like FLC- sliding mode FLC -Sugeno FLC -adaptive fuzzy control - Fuzzy control applications.

Unit V: Applications to Electric Drives

Neuro controllers for AC Drives - Fuzzy Controllers for AC Drives – Hybrid Neuro- Fuzzy Controllers for BLDC motors – Adaptive Neuro – Fuzzy Controllers for Switched Reluctance Motor Drives.

Course Outcome:

On completion of this course students will be able to

i. Explain the various learning algorithms derived from the biological neurons
ii. Apply the concept of neural network for optimisation of any system problem
iii. Use appropriate network for fault diagnosis and pattern recognition

Reference Books

1. Jang Jyh-shing Roger, Sun Chuen-tsai, Mizutani Eiji," Neuro-Fuzzy And Soft Computing: A Computational Approach To Learning And Machine Intelligence" PHI Learning,2009
2. Jacek M Zurada, "Introduction to Artificial Neural Systems", Jaico Publishing House, New Delhi, 2001.
3. Timothy Ross, "Fuzzy Logic with Engineering Applications", Willey & Sons, New Delhi, 2008.
4. Laurene Fausett, "Fundamentals of Neural Networks", Pearson Education of India, New Delhi, 2004.
5. Driankov, Hellendroon, "Introduction to Fuzzy Control", Narosa Publishers Limited, New Delhi.2001
6. Sivanandam S.N., Sumathi. S and Deepa S.N., "Introduction to Neural Networks using MATLAB 6.0", Tata Mc Graw-Hill Publishing Company Limited, New Delhi, 2006.
7. Sivanandam S.N., Sumathi. S and Deepa S.N., "Introduction to Fuzzy Logic using MATLAB 6.0", Springer Verlag Publisher, Germany, 2007.

11EE307 GENERALISED THEORY OF ELECTRICAL MACHINES

Credits:3:1:0

Course Objectives

To impart knowledge on

i. The key principles in Analysis of electrical machines
ii. The Generalized Representation and steady state analysis of Synchronous Machines
iii. The generator and motor operation in steady state and transient conditions
iv. The analysis of harmonics in Ac machines
v. The generalized representation of special machines

Unit I: Generalised Theory

Conversions - Basic two pole machines - Transformer with movable secondary -Transformer voltage and speed voltage - Kron's primitive machine - Analysis of electrical machines.

Unit II: Linear Transformations

Invariance of Power - Transformations from displaced brush axis, three phases to two phase, Rotating axes to stationary axes-Transformed impedance matrix – Torque calculations.

Unit III: DC Machines

Generalized Representation - Generator and motor operation - Operation with displaced brushes - Steady state and transient analysis - Sudden short circuit - Sudden application of inertia load - Electric braking of DC motors.

Unit IV: AC Machines

Synchronous Machines: Generalized Representation - Steady state analysis – Transient analysis - Electromechanical transients. Induction Machines: Generalized representation performance equation - steady state analysis - Transient analysis - Double cage machine - Harmonics - Electric braking.

Unit V: Special Machines

Generalized Representation and steady state analysis of Reluctance Motor – Brushless DC Motor – Variable Reluctance Motor – Single phase series motor.

Course Outcome

Students will be able to describe

i. The Generalized Representation of machines and their analysis
ii. The steady state analysis and transient analysis of various machines
iii. The performance of special machines and their representation

Reference Books:

1. Gupta J B.” Theory & Performance Of Electrical Machines”, S. K. Kataria & Sons, New Delhi, 2010
2. Bimbhra P.S., “Generalized Circuit Theory of Electrical Machines”, Khanna Publishers Limited, 5th Edition, 4th Reprint, New Delhi, 2000.
3. John Salmon **“** Applications of General Theories to Electrical Machines Contributions to their Design and Performance”, Troubador Publishing Ltd, Leicester, 2008.
4.Bandyopadhyay M. N., “Electrical Machines: Theory And Practice” PHI Learning,NewDelhi,2009

11EE308 SPECIAL MACHINES AND CONTROLLERS

Credits: 4:0:0

Course Objectives

To impart knowledge on

i. The construction ,principle of operation and the control techniques of stepper motor
ii. The constructional features of Switched reluctance motors
iii. Characteristics of permanent magnet brushless Dc motor
iv. Control methods of permanent magnet synchronous motors
v. Control application of linear and servomotors

Unit I: Stepper Motors

Constructional features, Principle of operation, Modes of excitation torque production in Variable reluctance (VR) stepping motor, Dynamic characteristics, Drive systems and circuit for open loop control, Closed loop control of stepping motor, Intelligent control techniques

Unit II: Switched Reluctance Motors

Constructional features, Principle of operation. Torque equation, Characteristics, Control Techniques, Drive Concept, Sensorless control

Unit III: Permanent Magnet Brushless DC Motors

Commutation in DC motors, Difference between mechanical and electronic commutators, Hall sensors, Optical sensors, Multiphase Brushless motor, Square wave permanent magnet brushless motor drives, Torque and emf equation, Torque-speed characteristics, Sensorless control

Unit IV: Permanent Magnet Synchronous Motors
Principle of operation, EMF, power input and torque expressions, Phasor diagram, Power controllers, Torque speed characteristics, Self control, Vector control, Current control schemes.

Unit V: Servomotors & Linear Motors
Servomotor – Types – Constructional features – Principle of Operation – Characteristics -Control – Microprocessor based applications. Linear Motors: Linear Induction Motor (LIM) classification – Construction – Principle of operation – Concept of Current sheet –Goodness factor – DC Linear Motor (DCLM) types – Circuit equation – DCLM control applications.

Course Outcome
On completion of this course the student will be able to
i. Differentiate the working of different drives and perfomance
ii. Select a suitable special machine drive based on the application.
iii. Incorporate an appropriate control scheme for the application specified

Reference Books:

1. Venkataratnam K., "Special Electrical Machines", University Press, Hyderabad, 2008
2. Krishnan Ramu, R. Krishnan, "Switched Reluctance Motor Drives", CRC Press, Boca Raton, U.S.A., Jan 2001
3. Kenjo, T, "Stepping Motors And Their Microprocessor Control", Clarendon Press, Oxford, 1989.
4. Naser A And Boldea I, "Linear Electric Motors: Theory, Design And Practical Application", Prentice Hall Inc., New Jersey,1987
5. Floyd E Saner,"Servo Motor Applications", Pittman USA, 1993.
6. Kenjo, T, Naganori, S "Permanent Magnet And Brushless Dc Motors", Clarendon Press, Oxford, 1989.

11EE309 POWER ELECTRONICS IN WIND AND SOLAR POWER CONVERSION

Credits: 4:0:0

Course Objectives:
i. To study the basics of various photovoltaic energy conversion.
ii. To analyze the performance of self-excited and grid related problems.
iii. To learn the Wind energy system and stand alone power supply systems.

Unit I: Introduction
Trends in energy consumption - World energy scenario - Energy sources and their availability - Conventional and renewable sources - need to develop new energy technologies.

Unit II: Photovoltaic Energy Conversion
Photovoltaic Energy Conversion: Solar radiation and measurement - solar cells and their characteristics - influence of insulation and temperature - PV arrays - Electrical storage with

batteries - solar energy availability in India - Switching devices for solar energy conversion - Maximum power point tracking. DC Power conditioning converters - maximum power point tracking algorithms - AC power conditioners - Line commutated inverters - synchronized operation with grid supply - Harmonic problem –Applications.

Unit III: Wind Energy Conversion (WEC)
Basic Principle of wind energy conversion - nature of wind - wind survey in India - Power in the wind - components of a wind energy - conversion system - Performance of induction generators for WECS - classification of WECS.

Unit IV: Self-Excited & Grid Connected WECS
Self excited induction generator for isolated power generators - Theory of self-excitation - Capacitance requirements - Power conditioning schemes - Controllable DC Power from Self excited induction generators (SEIGs) - system performance. Grid Connected WECS: Grid connectors concepts - wind farm and its accessories - Grid related problems - Generator control - Performance improvements - Different schemes - AC voltage controllers - Harmonics and PF improvement .

Unit V: Stand Alone Power Supply Systems
Wind/solar PV integrated systems - Optimization of system components - storage - Reliability evolution- .

Course Outcome:
At the end of the Course the student would be able to:
i. Understand various factors which affect the wind energy conversion system.
ii. Design isolated power generators used in wind energy conversion system.
iii. design PV cells to meet the requirement of battery operated vehicle and other related applications

Reference Books:

1. Rai, G.D., "Non-conventional Energy Sources", Khanna Publishers Limited, New Delhi, 1st Edition, 2004.
2. Rai, G.D., "Solar Energy Utilization", Khanna Publishers Limited, New Delhi, 2000.
3. Mukund R Patel, "Wind and Solar Power Systems", Taylor & Francis Group, 2nd Edition, United Kingdom, 2005.
4. Thomas Markvart and Luis Castaser, "Practical Handbook of Photo Voltaics", Elsevier Science & Technology, New Delhi, 2003.
5. Hermann-josef Wagner, Jyotirmay Mathur, "Introduction To Wind Energy Systems: Basics, Technology And Operation", Springer International, United Kingdom, 2009.

11EE310 HVDC TRANSMISSION

Credits: 4:0:0
Course Objectives:
i. The course aims at use of high voltages as the key to efficient transmission and distribution of electrical power.
ii. To have an overview about different forms of insulation and their behavior, over voltage conditions and protection of equipments.
iii. To analyze the malfunctioning of converters and protection.

Unit I: DC Power Transmission Technology
Historical development – HVAC and HVDC links – Comparison – Economic Technical Performance – Reliability – Limitations.

Unit II: Analysis of HVDC Converters
Single and three phase converters – Analysis with gate control but no overlaps – With overlaps less than 60 degree – With overlap greater than 60º – Complete characteristics of rectifier and Operation of Inverter.

Unit III: Converter and HVDC System Control
Basic means of Control – Gate Control – Power reversal – Constant Current Vs Constant Voltage – Control characteristics – Stability of Control – Frequency control – Multi terminal lines.

Unit IV: Misoperation of Converters & Protection
Converter disturbance – By pass action in bridge – Short circuit on a rectifier – Commutation failure Protection: Basics of protection – DC reactors – Voltage and current oscillations – Clearing line faults and re-energizing – Circuit breakers – Over voltage protection.

Unit V: Harmonics and Filters
Characteristics and uncharacteristic harmonics – Troubles due to harmonics – Means of reducing harmonics – Harmonic filters – Telephone interface.

Course Outcome:
At the end of the Course the student would be able to:

i. facilitate a basic understanding about high voltage insulators, cables, bushings, occurrence of over voltages and protection of HV equipments from failure due to over voltage
ii. outline the benefits of using DC transmission , terminal converters its operation and control.
iii. analyze the Challenges and its solutions available in High voltage engineering.

Reference Books:

1. Padiyar. K.R, "HVDC Power Transmission System", New Age International Private Limited, New Delhi, 2nd Edition, 2010.
2. Erich Uhimann, "Power Transmission by Direct Current", Springer / BS Publication, New Delhi, 1st Edition, 2004.
3. Jos Arrillaga, Neville R. Watson, Y. H. Liu Arrilaga J., "Flexible Power Transmission - The HVDC Options", John Wiley & Sons, New Delhi, 2007.
4. Rao S., "EHV-AC, HVDC Transmission and Distribution Engineering (Theory, Practice and Solved Problems)", Khanna Publishers, New Delhi, 3rd Edition, 2001.
5. Chan-Ki Kim, Vijay K. Sood, Gil-Soo Jang, Seong-Joo Lim, Seok-Jin Lee, "HVDC Transmission: Power Conversion Applications in Power Systems", Wiley-IEEE Press, New Delhi, Illustrated Edition, 2009.

11EE311 ADVANCED TOPICS IN POWER ELECTRONICS

Credits: 4:0:0

Course Objectives:

i. To understand the concept of resonant switch converters.
ii. To analyze the factors affecting harmonics and electromagnetic Interference.
iii. To understand the concepts of FACTS and their usage in power systems.
iv. To learn the advanced Power Electronic Devices and their applications.

Unit I: Resonant Converters

Zero voltage and Zero current switching – Classification of Resonant converters – Basic Resonant circuit concepts – Load resonant converters – Resonant switch converters – Zero voltage switching, clamped voltage topologies – Resonant DC link inverters and Zero voltage switching – High frequency link integral half cycle converters – Application in SMPS and lighting.

Unit II: Improved Utility Interface

Generation of current harmonics – Current harmonics and power factor – Harmonics standards and recommended practices – Need for improved utility interface – Improved single phase utility interface – Improved three phase utility interface – Electromagnetic interference.

Unit III: FACTS and Custom Power

Introduction – principles of reactive power control in load and transmission line compensation – Series and shunt reactive power compensation – Concepts of flexible AC transmission system (FACTS) – Static Var Compensator (SVC) – Thyristor Controlled Reactor – Thyristor Switched Capacitor. Solid state power control – Static condensers – Controllable series compensation – Thyristor controlled phase angle regulator and unified power flow control

Unit IV: FACTS Analysis & Protection

Modelling and methods of analysis of SVC and FACTS controllers – System control and protection – Harmonics and filters – Simulation and study of SVC and FACTS under dynamic conditions.

Unit V: Emerging Devices and Circuits

Power Junction Field Effect Transistors – Field Controlled Thyristors – JFET based devices VS other power devices – MOS controlled Thyristors – Power Integrated Circuits-New semiconductor materials for power devices.

Course Outcome:

At the end of the Course the student would be able to:

i. derive the mathematical models of resonant converters to reduce harmonics electromagnetic interference.
ii. perform modelling and simulation of specific FACTS controllers.
iii. analyze the impact of FACTS devices on power system stability.

References:

1. Muhammad H. Rashid, "Power Electronics - Circuits, Devices and Applications", Academic Press, New Delhi, 2nd Edition, 2006.

2. Mohan, Ned. et.al, "Power Electronics Converters, Applications and Design", Wiley India Pvt. Ltd., New Delhi, 3rd Edition 2007.
3. Joseph Vithayathil, "Power Electronics - Principles and Applications", McGraw Hill Education India, New Delhi, 2010.
4. Tagare D. M., "Reactive Power Management", McGraw – Hill Education, 5th Reprint, New Delhi, 2007.
5. Narain G. Hingorani, "Understanding FACTS", Standard Publishers Distributors, New York, 2001.

11EE312 ROBOTICS AND FACTORY AUTOMATION

Credits: 4:0:0

Course Objectives:

i. To acquire knowledge regarding the various parts of robots and field of robotics.
ii. To understand about the various sensors used in robotic design.
iii. To get brief knowledge on the basic concept of PLC and uses of PLC in automation.

Unit I: Fundamentals Concepts of Robotics

History, Present status and future trends in Robotics and automation – Laws of Robotics – Robot definitions – Robotics systems and robot anatomy – Specification of Robots – resolution, repeatability and accuracy of a manipulator – Robotics applications.

Unit II: Robot Drives and Power Transmission Systems

Robot drive mechanisms, hydraulic – electric – servomotor – stepper motor – pneumatic drives, Mechanical transmission method – Gear transmission, belt drives, cables, Roller chains, Link – Rod systems – Rotary –to-Rotary motion conversion, Rotary-to-Linear conversion, Rack and Pinion drives, Lead screws, Ball Bearing screws, End effectors – Types.

Unit III: Sensors

Sensor characteristics, Position sensors – Potentiometers – Encoders – Resolvers – LVDT, Velocity sensors – Tacho generators – Encoders – Proximity sensors, Limit switches – Tactile sensors – Touch sensors – Force and torque sensors. Vision Systems for Robotics: Robot vision systems, image capture – cameras – vidicon and solid state, Image representation – Gray scale and colour images, image sampling and quantization –Image processing and analysis – Image data reduction – Segmentation – Feature extraction – Object Recognition – Image capturing and communication – JPEG, MPEGs and H.26x standards, packet video, error concealment – Image texture analysis.

Unit IV: Transformations and Kinematics

Homogeneous coordinates – Coordinate reference frames – Homogeneous transformations for the manipulator – The forward and inverse problem of manipulator kinematics – Motion generation – Manipulator dynamics – Jacobian in terms of D-H matrices – Controller architecture.

Unit V: PLC & Factory Automation

Building blocks of automation, Controllers – PLC –Role of PLC in FA – Architecture of PLC – Advantages – Types of PLC – Types of Programming – Simple process control programs using Relay Ladder Logic and Boolean logic methods – PLC arithmetic functions. Factory

Automation: Flexible Manufacturing Systems concept – Automatic feeding lines, ASRS, transfer lines, automatic inspection – Computer Integrated Manufacture – CNC, intelligent automation, Industrial networking, bus standards, HMI Systems, DCS and SCADA, Wireless controls.

Course Outcome:
At the completion of the subject,

i. It provides Comprehensive knowledge of robotics in the design, analysis and control point of view.
ii. The course will support to development the concept of factory automation.
iii. It also helps to understand the robot motion analysis.

Reference Books:

1. Seth Hutchinson , M. Vidyasagar, "Robot Modeling and Control", John Wiley & Sons, India, First Edition, 2005.
2. Thomas R. Kurfess, "Robotics and Automation Handbook", CRC Press,US, first edition,2004.
3. A.K. Gupta , S.K. Arora, "Industrial Automation and Robotics", Laxmi Publications, Chennai, First Edition, 2007.
4. Ganesh S. Hegde , "A Textbook on Industrial Robotics", Laxmi Publications, Chennai, Second Edition , 2008.
5. Jesus Aramburo and Antonio Ramirez Trevino , "Advances in Robotics, Automation and Control"InTech,2008

11EE313 MICROCONTROLLERS AND APPLICATIONS

Credits: 4:0:0
Course Objectives:

i. To make students aware of various microcontrollers
ii. To learn and understand the architecture of 8051, 68HC11 and PIC microcontrollers.
iii. To understand the design and interfacing of microcontroller based embedded systems.

Unit I: Intel 8051
Architecture of 8051- Memory organization- Register Banks- Bit addressable area- SFR area-Addressing modes- Instruction set- Programming examples. Interrupt structure-Timer modules-Serial features- Port structure- Power saving modes- MCS51 family features:8031/8051/8751.

Unit II: Motorola 68HC11
Controller features – Different modes of operation and memory map – Functions of I/O Ports in single chip and expanded multiplex model – Timer System. Input Capture,Output compare and pulsed accumulator features of 68HC11 – Serial peripheral and serial communications interface – Analog to digital conversion features – Watchdog feature.

Unit III: PIC Microcontrollers
Program memory – CPU Registers – Register file structure – Block diagram of PIC 16C74 – I/O Ports.

Unit IV: Features of PIC
Timers 0,1 and 2 features – Interrupt Logic – Serial Peripheral Interface – I2C Bus – ADC

– UART – PIC family parts.

Unit V: Typical Applications
Stepper motor control – DC motor control – AC Power control – Introduction to Microcontroller developments tools.

Course Outcome:
At the end of the course, the student will be able to:

i. Design simple Microcontroller based systems.
ii. Write simple program using various Microcontrollers
iii. Interface / Apply in standard applications.

Reference Books:

1. John B Peatman, "Design with PIC Micro Controllers", Pearson Education India Series, New Delhi, 2005.
2. Myke Predko," Programming and Customizing the PIC Microcontroller" Tata McGraw Hill, New Delhi, 2008.
3. Raj kamal, "The concepts and feature of micro controllers 68HC11, 8051 and 8096"; S Chand Publishers, New Delhi, 2004.
4. Muhammad Ali Mazidi ,Janice Gillispie Mazidi, Rolin McKinlay, "8051 Microcontroller and embedded Systems using Assembly and C", Pearson/Prentice Hall Ltd, 2 nd Edition, New Delhi,2007

11EE314 COMPUTER NUMERICAL CONTROL

Credits: 4:0:0
Course Objectives
To study:
i. The principles, techniques and applications of computer numerically controlled machine tools.
ii. Concepts of Computer Aided Manufacturing(CAD)
iii. Basic types of CNC machine tools.
iv. About Programmable logic controllers and its role in CNC machines.

Unit I: Numerical Control
Introduction Need of NC machine tool, CNC – Principle of Operation, Advantages and Features of CNC, block diagram of CNC, Types of CNC machine, DNC – Types of DNC, Advantage and Disadvantage, Classifications of machine tool control systems.

Unit II: Types of CNC Machines
Major types of CNC machine tools and their constructional features – Lathe, machining centres, grinding machines, EDMs, turret punch press, laser and water jet cutting machines, Design considerations – Axis representations, Various operating modes of a CNC machine. NC Part Programming Process: Axis notation, EIA and ISO codes, Explanations of basic codes. Tooling concepts, machining methods, part geometry and writing of tool motion statements. Canned cycles. Development of simple manual part programs for turning operations. Post processors – CNC part programming with CAD/CAM systems.

Unit III: Input Output Units

Keyboard, Tape reader, Hand held terminals, PC interfacing, Display devices and Ethernet communication. Drive Units: Axis drive arrangements, ball screw, timing belts and couplings, AC & DC servomotors, Stepper motors, Hydraulic Servo, AC permanent magnet synchronous motor for spindle drives Characteristics and drive schemes for these motors.

Unit IV: Feedback Elements

Absolute and incremental encoders, Resolvers, linear optical encoders, Proximity switches, limit switches – Transducer placement measuring schemes using these feedback devices. Control Units: Functions of CNC, system hardware, Contouring control –Digital differential analyzer, Linear and circular interpolation, software development process, Open architecture systems.

Unit V: Programmable Logic Controllers

Hardware, programming techniques, Ladder logic programming of PLCs using basic functions – Timers and counters – Advanced programming with control and arithmetic instructions. Role of PLC in CNC machines. Microprocessor in CNC machines, Sensors for Adaptive Control of CNC machine tools. New developments in CNC technology.

Course Outcome

At the completion of the course, the student will be able to:

i. Control machine using PLC.
ii. Do projects on machine control using CAD/CAM systems.
iii. Know types of CNC machine tools and there by knows which one is suited for a particular operation.

Reference Books

1. Quesada, "Computer Numerical Control: Machining and Turning Centers", Pearson, 1st Edition, 2007.
2. Jon Stennerson, Kelly Curran, "Computer Numerical Control: Operation and Programming", PHI Learning, Delhi, 3rd Edition, 2007.
3. Niit, "Fundamentals of Computer Numerical Control", Phi Learning, New Delhi, 1st Edition, 2009.
4. Peter Smith, "CNC Programming Handbook", Industrial Press Inc., New York, 2000.
5. Kundra T. K., Rao P.N., Tewari N. K, "Numerical Control and Computer Aided Manufacturing", Tata McGraw-Hill Publishing Company, New Delhi, , 2001
6. Sinha S.K., CNC Programming Using Fanuc Custom Macro B", Mcgraw-hill Professional Publishing Limited, London, 2010

11EE315 EMBEDDED SYSTEMS

Credits: 4:0:0

Course Objectives:

i. To make students aware of Embedded systems
ii. To learn and understand concepts of RTOS.
iii. To understand the Performance issues of an embedded system.

Unit I: Introduction

Introduction to embedded systems – hardware and software components – Types –Examples – Characteristics – Challenges in Embedded computing system design –Embedded system design processes.

Unit II: Architecture of Embedded System
Hardware components – SOC – Processors – CPU – Types of memory – Memory management – I/O devices and interfacing – Software components – Interpreter –Compiler and Assembler – Cross Assembler – RTOS – Languages for embedded applications – Hardware and software architecture. Examples: Cell phone, Smartcard, Digital Thermometer.

Unit III: OS for Embedded Systems
Introduction to real time theory – Operating System Services – Real time Operating System Concepts – Basic design using a RTOS - Underground tank monitoring system. Introduction to Micro C/OS-II operating system and its uses.

Unit IV: Performances Issues of an Embedded System
CPU performance – CPU Power Consumption – Analysis and Optimization of CPU Power Consumption program execution time – Analysis and optimization of energy and power – Analysis of program size – Hardware accelerators.

Unit V: Design Examples
Personal Digital Assistants – Set Top Boxes – Ink Jet Printers – Telephone PBX.

Course Outcome:
At the end of the course, the student will be able to:
i. Design simple embedded systems.
ii. Choose effective communication for embedded systems.
iii. Analyze real-time scheduling algorithms and identify design flaws.

Reference Books:

1. Wayne Wolf, "Computer as Components – Principles of Embedded Computing System Design", Harcourt India Private Limited. New Delhi, 2001.
2. David E Simon, "An Embedded Software Primer", Pearson Education, Singapore, 2004.
3. Sriram V Iyer, Pankaj Gupta, "Embedded Real-time Systems Programming", Tata Mc Graw- Hill Publishing Company Limited, New Delhi, 2004.
4. Prasad K.V.K.K., "Embedded Real-time Systems: Concepts, Design and Programming", Dreamtech Press, 2004.
5. Raj Kamal, "Embedded System: Architecture, Programming and Design" Mc Graw-Hill International Inc., New York, 2005.

11EE316 SCADA AND DCS

Credits: 4:0:0
Course Objectives:
i. To learn basics of SCADA
ii. To develop skills to work on SCADA features
iii. Aims to build good understanding about the basics of industrial automation using

SCADA, PLC and HMI.

Unit I: Introduction

Introduction to Factory & Process Automation, PLC – Networking standards. Vertical Integration of Industrial Automation – field bus and Ethernet. HMI Systems: Necessity and Role in Industrial Automation, Text display – operator panels – Touch panels – Panel PCs – Integrated displayers (PLC & HMI).

Unit II: Supervisory Control and Data Acquisition

Supervisory Control and Data Acquisition (SCADA) – Overview – Developer and runtime packages – architecture – Tools – Tag – Internal & External graphics, Alarm logging – Tag logging – structured tags – Trends – history – Report generation, VB & C Scripts for SCADA application.

Unit III: Communication Protocols of SCADA

Proprietary an open Protocols – OLE/OPC – DDE – Server/Client configuration – Messaging – Recipe – User administration – Interfacing of SCADA with PLC, drive and other field devices.

Unit IV: Distributed Control Systems

Distributed Control Systems (DCS) – Difference between SCADA system and DCS – architecture – Local control Unit – Programming language – Communication facilities – Operator interface – Engineering interfaces.

Unit V: Applications of SCADA & DCS

Applications of SCADA & DCS – Case studies of Process plants using SCADA & DCS – Advanced features / options in SCADA & DCS – Role of PLC in DCS and SCADA – Comparison – field devices (Transducers, drives etc) in DCS/SCADA.

Course Outcome:

Upon completion of this course students will:

i. Able to control remote sites equipped with RTU or PLC to measure various parameters.
ii. Develop skills to work on SCADA features and to enable them to work efficiently in the field of industrial automation.
iii. Know how to monitor and control distributed equipments using DCS

Reference Books:

1. Stuart A. Boyer, "SCADA: Supervisory Control and Data Acquisition", International Society of Automation, 4th Edition, 2009.
2. Dieter K. Hammer, Lonnie R. Welch, Dieter K. Hammer, "Engineering of Distributed Control Systems", Nova Science Publishers, USA, 1st Edition, 2001.
3. James Northcote-green, Robert G. Wilson, "Control and Automation of Electrical Power Distribution Systems", Taylor & Francis Group, London, 2006.
4. H. S. Tzou, L. A. Bergman, "Dynamics and Control of Distributed Systems", Cambridge University Press, New Delhi, New Edition, 2007.
5. John Mcbrewster, Frederic P. Miller, Agnes F. Vandome, "Distributed Control System", Alphascript Publishing, 2010.

11EE317 POWER QUALITY MANAGEMENT

Credits: 3:1:0

Course Objectives:

i. To describe various equipment used for power monitoring.
ii. To learn the effects of harmonics on various power system components.
iii. To examine the methods of reducing excessive harmonics using advanced modeling technique.

Unit I: Introduction

Definition of Power Quality –Power Quality issues: Short/Long duration voltage variations, Transients, Waveform distortion, Voltage imbalance/fluctuation, Power frequency variations – Sources and Effects of Power Quality problems –Power Quality and Electro Magnetic Compatibility (EMC) Standards.

Unit II: Short & Long Interruptions

Introduction – Origin of short interruptions: Voltage magnitude events due to reclosing, Voltage during the interruption – Monitoring of short interruptions – End user issues – Utility system fault clearing issues – Single phase tripping – Voltage during fault and post fault period, Current during fault period – Prediction of short Interruptions-Long Interruptions: Origin of interruptions – Causes of long interruptions – Voltage regulating devices, Applications: Utility side, End-User side.

Unit III: Voltage Sag & Transients

Definition – Characterization – Causes of Voltage Sag – Three Phase Unbalance – Phase angle jumps – Load influence on voltage sags – Equipment behavior – Stochastic assessment of voltage sags – Overview of mitigation methods. Transients: Definition – Power system transient model – Principles of over voltage protection – Types, causes of transients and devices for over voltage protection – Utility capacitor switching transients – Utility lightning protection – Transients from load switching.

Unit IV: Waveform Distortion, Wiring & Grounding

Definition and terms – Harmonics, Harmonics indices, Inter harmonics, Notching – Voltage Vs Current distortion – Harmonics Vs Transients – Sources and effects of harmonic distortion – System response characteristics – Principles of controlling harmonics – Standards and limitation – Mitigation and control techniques. Wiring and Grounding: Definitions and terms – National Electrical Code (NEC) grounding requirements – Utility power system grounding – Telecommunication system grounding – End-User power system grounding – Wiring and grounding problems – Solutions to wiring and grounding problems.

Unit V: Power Quality Solutions

Introduction – Power quality monitoring: Evolution, Deregulation effect – Brief introduction to power quality measurement equipment and power conditioning equipments – Planning, Conducting and Analyzing power quality survey.

Course Outcome:

At the end of the Course the student would be able to:

i. Recognize the cause and source of power system disturbances.

ii. Calculate harmonic voltages and currents by analyzing types of electrical systems loads and their power quality considerations.
iii. Mitigate any existing and potential problems, thereby minimizing equipment disoperation and process downtime.

Reference Books:

1. Roger C. Durgan, Mark F. McGranaghan and H.Wayne Beaty, "Electrical Power Systems Quality", Tatat McGraw-Hill, 2nd Edition, New York, 2008.
2. Barry W.Kennedy, "Power Quality Primer", McGraw-Hill Publishing Company Limited, New York, 2000.
3. Sankaran.C, "Power Quality", CRC Press, Washington D.C., 2002.
4. Math H.J.Bollen, "Understanding Power Quality Problems: Voltage Sags and Interruptions", Standard Publishers Distributors, New Delhi, 2001.
5. Arrilaga.J, Watson.N.R and Chen.S, "Power System Quality Assessment", John Wiley &Sons Limited., England, 2000.

11EE318 FLEXIBLE AC TRANSMISSION SYSTEMS

Credits: 4:0:0

Course Objectives:

i. To learn about the basic concepts of FACTS devices and its Principle of operation.
ii. To understand the implementation of UPFC and also designing the FACTS controllers.
iii. Introduction to New FACTS devices.

Unit I: Introduction

FACTS-a toolkit, Basic concepts of Static VAR compensator – Resonance damper – Thyristor controlled series capacitor – Static condenser – Phase angle regulator – other controllers**.**

Unit II: Series Compensation Schemes

Sub-Synchronous resonance – Torsional interaction – torsional torque – Compensation of conventional ASC – NGH damping schemes – Modelling and control of Thyristor controlled series compensators.

Unit III: Unified Power Flow Control (UPFC)

Introduction – Implementation of power flow control using conventional Thyristors – Unified power flow concept – Implementation of unified power flow controller.

Unit IV: Design of FACTS Controllers

Introduction to VSC – Approximate multi-model decomposition – Variable structure FACTS controllers for Power system transient stability – Non-linear variable-structure control – variable structure series capacitor control – variable structure resistor control.

Unit V: Modern FACTS Devices

Basic concepts – Centre Node Unified Power Flow Controller (C-UPFC) – Fault Current Controller (FCC) – Interlined Power Flow Controller (IPFC) – location of FACTS.

Course Outcome:

At the end of the Course the student would be able to:

i. identify, formalize, model and analyze problems in a power network
ii. Select the suitable FACTS devices to enhance the security, capacity and flexibility of power transmission systems.
iii. Increase existing transmission network capacity while maintaining or improving the operating margins necessary for grid stability.

Reference Books:

1. Xiao-ping Zhang, Christian Rehtanz, Bikash Pal, "Flexible Ac Transmission Systems: Modelling and Control", Springer-verlag Publisher, New Delhi, 1st Edition, 2006.
2. Narain G. Hingorani, "Understanding FACTS", Standard Publishers Distributors, New Delhi, 1st Edition, 2001.
3. Padiyar.K.R., "Facts Controllers In Power Transmission And Distribution", Anshan Publisher, Kent (United Kingdom), 1st Edition, 2009.
4. Song Yong Hua, " Flexible AC Transmission Systems", Shankar's Book Agency Pvt. Ltd., Kolkata, 2009.
5. R. Mohan Mathur, Rajiv K. Varma, Mathur, "Thyristor-Based Facts Controllers For Electrical Transmission Systems", IEEE Computer Society Press, New Delhi,
6. Annotated Edition, 2002.

11EE319 INDUSTRIAL ELECTRONICS AND INSTRUMENTATION

Credits: 4:0:0

Course Objectives

i. To understand the concepts of Conventional and Digital Transducers
ii. To study the concepts of Industrial heating, Photoelectric devices and Smart Transducers
iii. To study the Microprocessor based instrumentation

Unit I: Review Of Conventional Transducers

Review of variable resistance transducers – Variable inductance transducers – Variable capacitance transducers – Piezoelectric transducers.

Unit II: Digital Transducers

Direct digital transducers – Absolute and incremental displacement transducers – Moiré Fringe transducers – Transducers with frequency output for the measurement of force and pressure – IC sensors for measurements of temperature and pressure.

Unit III: Industrial Heating & Photoelectric Devices

Industrial Heating using high frequency dielectric heating – Photoelectric devices and their application for industrial measurement and control – Introduction to PLC based industrial control.

Unit IV: Microprocessor Based Instrumentation

Detection of zero crossing of an alternating waveform – microprocessor based triggering of a Thyristor – Microprocessor based Voltmeter and Ammeter – Microprocessor based Speed monitoring Unit to provide protection against over speed – Microprocessor based phase difference and power factor monitoring Unit – Microprocessor based over and under voltage and over current protection.

Unit V: Smart Transducers
Concept of smart/intelligent transducer – comparison with conventional transducers – self diagnosis and calibration features – measurement of flow, pH with smart transducers.

Course Outcome:
At the end of the course, the student will be able to understand:
i. Select the type of transducer for the Industrial application.
ii. And apply in case studies and mini projects in industries.
iii. Design the Microprocessor based Controllers.

Reference Books

1. Biswas S.N, "Industrial Electronics", Dhanpat Rai & Company (P) Ltd.,New Delhi, 2nd Edition, 2008.
2. Murty.D.V.S., "Transducers and Instrumentation", PHI Learning, New Delhi, 2nd Edition, 2009.
3. Paul Biswanath., "Industrial Electronics & Control: Including Programmable Logic Controller", PHI Learning, New Delhi, 2nd Edition, 2009.
4. Doebelin E.O, "Measurement Systems, Application and Design", Mc -Graw Hill Publishing Company Ltd., New Delhi, 5th Edition, 2002.
5. Webb, John W.Reis, Ronald A., "Programmable Logic Controllers Principles and Application", PHI Learning, 5th Edition, 2009.
6. Ram. B., "Fundamentals of Microprocessors & Microcontrollers", Dhanpat Rai (P) Ltd., New Delhi 2008.

11EE320 RESTRUCTURED POWER SYSTEMS

Credits: 4:0:0
Course Objectives:
i. To provide in-depth understanding of operation of deregulated electricity market systems
ii. To examine topical issues in electricity markets and how these are handled world-wide in various markets
iii. To analyze various types of electricity market operational and control issues using new mathematical models

Unit I: Fundamentals of Electricity Markets And Energy Auctions
Supply and demand functions – Market equilibrium – Types of electricity markets – Competitive gencos in electricity markets – Price-based Unit Commitment – Strategic Bidding – Market power and its mitigation – Imperfect electricity markets – Imperfect competition- Bertrand and Cournot Games – Nash Equilibrium Solution – Country cases- market structures across the globe.

Unit II: Transmission Open Access
Transmission Open Access – Transmission Cost Components Analysis – Transmission Pricing Paradigms- embedded cost and incremental cost based methods – Distribution Factors in Transmission Pricing – Power Tracing Based Methods for Transmission Pricing – Locational Marginal Pricing – Transmission Capacity Definitions – Available Transfer Capacity (ATC) Calculations – Review of Transmission Pricing Practices Worldwide.

Unit III: Transmission Congestion Management and Transmission Rights

Transmission Congestion Management Methods – Congestion Management Models – Financial Transmission Rights (FTR) – FTR Auction Markets.

Unit IV: Ancillary Services and System Security in Deregulation

Ancillary Services Classifications and Definitions – Frequency Control: Primary Regulation and AGC Frequency Control Practices in Deregulation – NERC Control Performance Standards – CPS1 and CPS2 Reactive Power as an Ancillary Service – Country Practices in Reactive Power Pricing and Management System Security in Deregulation – NERC Reliability Standards.

UNIT V: System Planning in Deregulation

Regulatory Economics- Introduction – Investing in Generation – Cost of Capital, Risk and Return Investing in Transmission –Value Based Transmission Expansion.

Course Outcome:

At the end of the Course the student would be able to:

i. analyze the market strategy the power scenario
ii. perform cost optimization in the distributed system
iii. design as smart grid for the specified requirement of the electricity market

Reference Books:

1. Bhattacharaya K., Bollen M.H.J., Daader J.E., "Operation of Restructured Power Systems", Kluwer Academic Publishers, New Delhi, 1st Edition, 2001.
2. Shahidehpour M., Yamin H., Li Z, "Market Operations in Electric Power Systems", Wiley Interscience, New Delhi, 2002.
3. Kirschen D. S., Strbac G., "Fundamentals of Power System Economics", John Wiley & Sons, New Delhi, 2004.
4. Rothwell G., Gomez T., "Electricity Economics: Regulation and Deregulation", Wiley Inter-Science, New Delhi, 2003.
5. Khaparde S. A., Abhyankar A. R., "Restructured Power Systems", Alpha Science International Ltd., London, UK, 2009.
6. Xiao-ping Zhang, "Advances in Intelligent Computing", Springer -Verlag, New Delhi, 1st Edition, 2005.

11EE321 POWER ELECTRONICS LABORATORY

Credits: 0:0:2

1. Characteristics of Power Semiconductor Devices – MOSFET, IGBT
2. Design, Testing of Single Phase Semi & Full Converter Bridge on R & R – L Load
3. Design, Testing of MOSFET based DC Chopper on R & R – L Load
4. Design, Testing of Single Phase AC Voltage Controller with R & R – L Load
5. Design, Testing of Three Phase AC Voltage Controller with R & R – L Load
6. Design, Testing of Single Phase Inverter with R & R – L Load
7. Design, Testing of IPM based Three Phase Inverter with R & R – L Load

8. Design, Testing of Single Phase Cyclo-converter with R & R – L Load
9. Simulation of Semi & Full Bridge Converter using PSIM
10. Simulation of Inverter using PSIM
11. Simulation of Four Quadrant Chopper using MATLAB
12. Simulation of AC Voltage Controller using MATLAB

11EE322 ELECTRIC DRIVES AND CONTROLS LABORATORY

Credits: 0:0:2

1. IGBT Based Inverter Fed Induction Motor Drive
2. Chopper Fed DC Motor Drive
3. Multilevel Inverter Fed Induction Motor Drive
4. DSP (TMS320F2812) Based Switched Reluctance Motor Drive
5. Simulation of Vector Control of Induction Motor Drive using MATLAB
6. Three Phase Rectifier Fed DC Motor Drive
7. Three Phase AC Voltage Controller Fed Induction Motor Drive
8. Matrix Converter Fed Induction Motor Drive
9. DSP (TMS320F2407) Based Permanent Magnet Synchronous Motor Drive
10. Control of DC Motor using dSPACE ACE 1103 Control Kit
11. BLDC Motor Drive
12. FPGA Based Motor Control

11EE323 POWER ENGINEERING SIMULATION LABORATORY

Credits: 0:0:2

1. Simulation of Buck-Boost Converter using PSIM
2. Simulation of Synchronous Rectifier using PSIM
3. Simulation of Three Phase SVPWM Inverter using PSIM
4. Simulation of Soft Switching Converters using PSIM
5. Simulation of Multilevel Inverter using MATLAB
6. Simulation of SRM Drive using MATLAB
7. Formation of BUS Admittance Matrix using Direct Inspection Method using MATLAB
8. Determination of BUS bar Voltages using FDLF Method using MATLAB
9. Automatic Load Frequency Control using MATLAB
10. Load Flow Studies using ETAP
11. Simulation of SMIB using ETAP
12. Fault Analysis of AC Power System using PSCAD / EMTDC

11EE324 PHOTOVOLTAIC SYSTEMS

Credits: 4:0:0
Course Objectives:

i. To provide necessary knowledge about the modeling, design and analysis of various PV systems
ii. To show that PV is an economically viable, environmentally sustainable alternative to the world's energy supplies.

iii. To understand the power conditioning of PV system's power output.

Unit I: Introduction to Photovoltaic (PV) Systems

Historical development of PV systems- Overview of PV usage in the world-Overview of PV usage in India- Solar Map-Solar energy potential for PV- irradiance, solar radiation and spectrum of sun- geometric and atmospheric effects of sunlight-Photovoltaic effect-conversion of solar energy into electrical energy.

Unit II: Solar Cells and Arrays

Behavior of solar cells-basic structure and characteristics: types - equivalent circuit-modeling of solar cells including the effects of temperature, irradiation and series/shunt resistances on the open-circuit voltage and short-circuit current-Solar cell arrays- PV modules-PV generators-shadow effects and bypass diodes- hot spot problem in a PV module and safe operating area-Terrestrial PV module modeling- Interfacing PV modules with different loads.

Unit III: Energy Storage Alternatives for PV Systems

Storage batteries- lead-acid- nickel-cadmium- nickel-metal-hydride and lithium type batteries. Small storage systems employing ultra capacitors- properties- modeling of batteries.

Unit IV: Inverters for PV Systems

Inverter control topologies for stand-alone and grid-connected operation-Analysis of inverter at fundamental frequency and at switching frequency-Feasible operating region of inverter at different power factors for grid connected systems and stand-alone PV systems. Consumer applications-residential systems-PV water pumping-PV powered lighting-rural electrification.

Unit V: Power Conditioning of PV Systems

Power conditioning and maximum power point tracking (MPPT) -Maximum power point tracking (MPPT) algorithms-Grid connected PV systems-Active power filtering with real power injection-Modeling and simulation of complete stand-alone and grid-connected PV systems.

Course Outcome:

After studying this course the students will be able to

i. model, analyze and design various photovoltaic systems
ii. know the feasibility of PV systems as an alternative to the fossil fuels
iii. design efficient stand alone and grid connected PV power systems

References:

1. Goetzberger, Hoffmann V. U., "Photovoltaic Solar Energy Generation", Springer-Verlag, Berlin, 2005.
2. Castaner L., Silvestre S., "Modeling Photovoltaic Systems Using PSpice", John Wiley & Sons, England, 2002.
3. Komp R.J., "Practical Photovoltaics: Electricity from solar cells", 3^{rd} Edition, Aatec Publications, Michigan, 2001.
4. Patel M. R., "Wind and Solar Power Systems Design, Analysis, and Operation", CRC Press, New York, 2^{nd} Edition, 2005.
5. Jenny Nelson, "The Physics of Solar Cells", Imperial College Press, London,2004.

11EE325 POWER ELECTRONIC CIRCUITS

Credits: 3:1:0

Course Objectives:

i. To impart the knowledge of various conversion techniques of electrical energy using power electronic components.
ii. To establish the link between efficient usage of power and conservation of energy resources of the world.
iii. To provide the design details of various power electronic converters.

Unit I: Power Semiconductor Switches

Classification of power converters-Ideal switch and rectifier-Semiconductor power switching devices used in power electronic circuits: Diode, bipolar junction transistor (BJT), silicon controlled rectifier (thyristor), Gate turn-off thyristor (GTO), MOSFET, insulated gate bipolar transistor (IGBT), integrated gate commutated thyristor (IGCT)- I-V characteristics, operation principles, maximum voltage and current ratings. Gating circuits for controlled semiconductor switches- Series and parallel commutation circuits for turning-off of thyristors.

Unit II: AC to DC Converters

Single phase and three phase bridge rectifiers, half controlled and fully controlled converters with RL, RLE loads, Freewheeling diode, Dual Converter. Evaluation of performance parameter, Input harmonics and output ripple, smoothing inductance, power factor, effect of source impedance, overlap, Design of converter circuits – Snubber circuit design – Control circuit strategies.

Unit III: DC to DC Converters

DC Choppers: Step down dc chopper with R, RL and RLE loads – Control strategies – Continuous and discontinuous current operations – Two quadrant and four quadrant DC chopper – Multiphase DC chopper – Switching mode regulators: Buck, Boost, Buck-Boost and CUK regulators – Chopper circuit design – Control circuit strategies.

Unit IV: Inverters & Resonant Converters

Single phase and Three phase bridge inverters – Evaluation of performance parameters – Voltage control and Waveform improvement Techniques – Current source inverters – Inverter circuit design.

Resonant Switch: Introduction – Classification – Resonant Switch – Quasi-Resonant Converters – Multi resonant Converters.

Unit V: AC Phase Converter

Principle of phase control, single-phase bidirectional controllers with R, L and R-L loads, 3-phase bidirectional Controllers, different Configurations, Analysis with pure R and L loads. Principle of operation – single phase and three phase cyclo converters – Control circuit strategies.

Course Outcome:

At the end of the course, the students will be able to

i. understand the significance of the characteristics of various power semiconductor switches
ii. design of power electronic conversion systems
iii. understand various modulation (control) techniques such as pulse width modulation and selective harmonic elimination.

Reference Books:

1. Rashid M.H., "Power Electronics Circuits, Devices and Applications", Prentice Hall India, New Delhi, 2003.
2. Sen P.C., "Modern Power Electronics", Tata McGraw Hill, New Delhi, 2004.
3. Ned Mohan, Tore M. Undeland, William P Robbins, "Power Electronics: Converters, Applications, and Design", John Wiley and Sons Inc., New York, 2003.
4. Joseph Vithayathil, "Power Electronics", New Age International (P) Limited, New Delhi, 2010.
5. Singh M.D., Khanchandani K B, "Power Electronics", Tata McGraw Hill, 2nd Edition, New Delhi, 2006.

11EE326 SOLAR THERMAL ENERGY CONVERSION

Credits: 4:0:0

Course Objectives:

i. To provide a comprehensive engineering basics for solar thermal system and its design
ii. Know about the different technologies of solar thermal systems.
iii. Know about the different types of solar heating & coolings.

Unit I: Radiative Properties and Characteristics of Materials

Reflection from ideal specular, ideal diffuse and real surfaces, Selective Surfaces: Ideal coating characteristics; Types and applications; Anti-reflective coating; Preparation and characterization. Reflecting Surfaces and transparent materials.

Unit II: Flat-plate Collectors

Energy balance for Flat Plate Collectors; Thermal analysis; Heat capacity effect; Testing methods; Types of Flat Plate Collectors: Liquid Flat Plate Collectors, Air flat-plate Collectors-Thermal analysis; Evacuated tubular collectors.

Unit III: Solar Thermal Energy Storage

Types: Sensible storage; Latent heat storage; Thermo-chemical storage. Design of storage system.

Unit IV: Concentrating Collector

Classification, design and performance parameters; Tracking systems; Compound parabolic concentrators; Parabolic trough concentrators; Concentrators with point focus; Heliostats; Comparison of various designs: Central receiver systems, parabolic trough systems; Solar power plant; Solar furnaces.

Unit V: Solar Heating & Cooling System

Solar water heating systems, Liquid based systems for buildings, solar air heating systems, Methods of modeling and design of solar heating system, Cooling requirements of buildings, Vapour absorption refrigeration cycle; Water, ammonia & lithium bromide-water absorption refrigeration systems; solar desiccant cooling.

Course Outcome:

At the end of the course, Students will be able to

i.calculate the Solar Radiation on Horizontal and Tilted Surfaces
ii.analyze the performance of Different Solar Collectors
iii.choose the right type of solar collector for an application.
iv.design Solar Heating and Cooling Systems.

Reference Books:

1. Yogi Goswami D., Frank Kreith, “Energy Conversion”, CRC Press, New York, 2008.
2. "ASHRAE Handbook Authors and Revisers Guide", ASHRAE Inc., Atlanta, 2007.
3. Duffie J.A., Beckman W.A., Solar Engineering of Thermal Processes, Wiley-Interscience, New York, 2006.
4. Kalogirou S. A., “Solar Thermal Collectors and Applications,” Progress in Energy and Combustion Science, Elsevier Journal, Vol. 30, pp. 231–295, 2004.
5. Yogi Goswami D., Frank Kreith, “Principles of Solar Energy”, Taylor and Francis, Phildelphia, 2000.

11EE327 ADVANCED CONTROL TECHNIQUES FOR INDUCTION GENERATORS

Credits: 3:1:0

Course Objectives:

i. To understand the transient and steady state modeling of induction generators.
ii. To give an in-depth knowledge about the different control techniques of induction generators.
iii. To enhance the students’ perspective on optimized control of induction generators which are widely used in renewable energy systems.

Unit I: Modeling of Induction Generators

Steady State Model of Induction Generator: Classical Steady State Representation – Generated Power – Induced Torque – Representation of Induction Generator Losses -Transient Model of Induction Generator: Induction Machine in Transient State – State Space Modeling – Partition of the SEIG State Matrix with an RLC load.

Unit II: Operation of Induction Generators

Self Excited Induction Generator: Performance, Voltage Regulation – Magnetizing Curves and Self Excitation – Mathematical Expression. Wound Rotor Induction Generator Systems: Features - Sub and Super synchronous modes - Operation

Unit III: Scalar Control of Induction Generators

Scalar Control background – Scalar Control Schemes –Open control schemes – closed loop control schemes– Problems

Unit IV: Vector Control of Induction Generators

Vector Control – Axis Transformation – Space Vector Notation – Field Oriented Control – direct vector control- indirect vector control-Problems

Unit V: Optimized Control of Induction Generators
Optimization Principles – Application of Hill Climbing Control (HCC) for Induction Generators-HCC based Maximum Power Search – Fuzzy Logic Controller based Maximum Power Search - Problems

Course Outcome:
Students will be able to
- understand the complex control concepts
- model the induction generators
- design control strategies for Induction generators

Reference Books:

1. Godoy Simões M., Farret F. A., "Renewable Energy Systems: Design and Analysis with Induction Generators," CRC Press, Boca Raton, 2007.
2. Vladislav Akhmatov, "Induction Generators for Wind Power", Multi-Science Publishing Company, UK, 2007.
3. Gilbert M. Masters, "Renewable and Efficient Electric Power Systems", John Wiley & Sons Inc., New Jersey, 2004.
4. Frede Blaabjerg, Zhe Chen, "Power Electronics for Modern Wind Turbines" Morgan & Claypool Publishers, USA, 2006.
5. Loi Lei Lai, Tze Fun Chan, "Distributed Generation: Induction and Permanent Magnet Generators", John Wiley & Sons, England, 2007.

11EE328 ENERGY ENGINEERING

Credits: 4:0:0
Course Objectives:
i. To create environment-friendly energy systems.
ii. To deal with actively harnessing renewable natural resources like solar energy and utilizing materials that cause the least possible damage to the global commons – water, soil, forests and air.
iii. To deal with global and Indian energy scenario.

Unit I: Introduction to Energy
Definition and Units of energy, power, Forms of energy, Conservation of energy, Energy flow diagram to the earth. Conventional and nonconventional energy sources- Origin of fossil fuels, time scale of fossil fuels, Renewable Energy Resources, Role of energy in economic development and social transformation. Commercial and non-commercial forms of energy, energy consumption pattern and its variation as a function of time,

Unit II: National and Global Energy Scenario
Energy resources available in India, urban and rural energy consumption, nuclear energy - promise and future, energy as a factor limiting growth, need for use of new and renewable energy sources. Energy consumption in various sectors, projected energy consumption for the

future, exponential increase in energy consumption, energy resources, coal, oil, natural gas, nuclear power and hydroelectricity, impact of exponential rise in energy consumption on global economy, future energy options.

Unit III: Various Renewable Energy Systems
Introduction and overview of solar, wind, bio-mass, geothermal, oceanic energy systems. Hydrogen and Fuel cells – types stand-alone power generations- Issues related to grid-connections- Global and National Policies, Funding Agencies.

Unit IV: Environmental Impact
Kyoto protocol- Environmental degradation due to energy production and utilization, Primary and secondary pollution, air, thermal and water pollution, depletion of ozone layer, global warming, biological damage due to environmental degradation. Pollution due to thermal power station and their control. Pollution due to nuclear power generation, radioactive waste and its disposal. Effect of hydroelectric power stations on ecology and environment.

Unit V: Smart Grids
Electric grid operation - evolution of Smart Grids, electric system design and operation, technical and tariff changes - integration between utilities and Regional Transmission Organizations. Smart Grid components- metering, demand response, virtual power plants, dynamic pricing, grid enhancement funding, demand analysis, promotion of "green" resources, governmental regulation, network standards, network integration, loan guarantees, consumer privacy -Risks to the Smart Grid - protective measures – Wireless Sensor Networks and its applications.

Course Outcome:

At the end of this course, the students will be able to

i. gain knowledge about the current energy scenario.
ii. gain the knowledge about smart grids
iii. understand the problems about the pollution, ozone layer and global warming.

Reference Books:

1. Vaclav Smil, Energy: A Beginner's Guide, One world Publications, Oxford, 2006.
2. Narendra Jadhav, Rajiv Ranjan, Sujan Hajra, "Re-Emerging India - A Global Perceptive", The ICFAI University Press, Hyderabad, 2005.
3. Eric Jeffs, "Green Energy: Sustainable Electricity Supply with Low Environmental impact" CRC Press, USA, 2010.
4. Kishore V. V .N., "Renewable Energy Engineering and Technology Principles and Practice", Earthscan Publications Ltd, UK, 2009
5. Stuart Borlase, "Smart Grids: Infrastructure, Technology, and Solutions" Taylor and Francis, Boca Raton, 2010

11EE329 WIND ENERGY

Credits: 3:1:0

Course Objectives:

i. To develop a detailed understanding of the issues associated with the development of wind energy for electrical energy supply.

ii. To know the current state of wind energy development domestically and internationally
iii. To understand the issues of location and grid connection of wind energy power plants

Unit I: Role of Wind Energy
World's energy requirements- Role of wind energy in Electricity production Renewable energy policy – National and International; The role of wind energy in greenhouse gas abatement- Economics of Wind Energy- Commercial and regulatory issues - Energy trading, green credits and carbon taxes; Economic assessment of wind energy systems- Funding of wind energy projects

Unit II: Wind Energy Resources
Characteristics of wind energy resources- Wind energy data collection and analysis- Wind measurement and instrumentation- Wind turbine representation and wind energy assessment- Overview of wind data in India- On-shore and off-shore installations- Site selection- Environmental impacts of wind energy systems – Avian, Visual, Noise, Electromagnetic, Land Use.

Unit III: Analysis and Design of Wind Turbines – Mechanical Aspects
Classification of wind turbine Elements of a wind turbine system- Modelling of the ideal turbine rotor- Airfoil and aerodynamics- Blade shape-performance-Loads on wind turbines-Wind turbine topologies- Mechanical design and control – Shafts, gearing, brakes, etc- Rotor and blade design; Power curve of turbine- Requirements of control systems for wind turbines.

Unit IV: Electrical Aspects of Wind Turbines
Electrical machines as applied to wind turbines- Synchronous, induction and double-fed generators- Fixed speed and variable speed operation- Stand-alone configurations- Transmission and distribution network interfaces- Power converters- On-shore and off-shore wind farms- Ancillary electrical equipment – Cables, protection, circuit breakers, capacitors

Unit V: Siting of Wind Turbines and Integration into Supply Networks
Wind turbine site selection- Operational issues of wind turbines- Embedded generation and wind turbines- Impacts of wind turbines on electrical supply networks- Network issues – frequency control, voltage control, fault levels- Quality of supply issues associated with wind turbines- Control of network interface- Supervisory control- Backup supply- Energy storage- Integration with other energy sources – Hybrid systems

Course Outcome:
At the end of the course, the Students will be able to
i. understand the role which wind energy plays and can play in the electricity supply system and its role in meeting the country's obligations in terms of greenhouse gas abatement
ii. gain knowledge regarding wind energy resources and the ability to assess that resource
iii. gain knowledge of construction, characteristics, control and performance of wind turbines

Reference Books:

1. Manwell, J.F., McGowan, J.G. and Rogers A.L., "Wind Energy Explained – Theory, design and application", John Wiley & Sons, UK, 2009.

2. Heier, S., “Grid Integration of Wind Energy Conversion Systems” 2nd ed., John Wiley & Sons, Chichester, 2006.
3. Burton, T., Sharpe, D., Jenkins N. and Bossanyi, E., “Wind Energy Handbook”, John Wiley & Sons, Chichester, 2001.
4. Ackermann, T., “Wind Power in Power systems“, John Wiley& Sons, Chichester 2006.
5. Olimpo Anaya-Lara, Nick Jenkins , Janaka Ekanayake , Phill Cartwright, Michael Hughes, “Wind Energy Generation: Modelling and Control, John Wiley& Sons, Chichester 2009.

11EE330 HYDROGEN AND FUEL CELLS

Credits: 4:0:0

Course Objectives:

i. To understand hydrogen energy technology
ii. To understand fuel cell technology
iii. To enlighten the student community on various technological advancements, benefits and prospects of utilizing hydrogen/fuel cell for meeting the future energy requirements.

Unit I: Hydrogen – Basics and Production Techniques
Hydrogen – physical and chemical properties, salient characteristics- Production of hydrogen – steam reforming – water electrolysis – gasification and woody biomass conversion – biological hydrogen production – photo dissociation – direct thermal or catalytic splitting of water.

Unit II: Hydrogen Storage and Applications
Hydrogen storage options – compressed gas – liquid hydrogen – Hydride – chemical Storage – comparisons- Hydrogen transmission systems- Applications of Hydrogen.

Unit III: Fuel Cells
History – principle - working - thermodynamics and kinetics of fuel cell process – performance evaluation of fuel cell – comparison on battery vs fuel cell

Unit IV: Fuel Cell - Types
Types of fuel cells – AFC, PAFC, SOFC, MCFC, DMFC, PEMFC – relative merits and demerits

Unit V: Application of Fuel Cell and Economics
Fuel cell usage for domestic power systems- large scale power generation- Automobile, Space. Economic and environmental analysis on usage of Hydrogen and Fuel cell- Future trends in fuel cells.

Course Outcome:
At the end of the course, the students will be able to

i. know detail on the hydrogen production methodologies, possible applications and various storage options.
ii. know the working of a typical fuel cell, its types and to elaborate on its thermodynamics and kinetics
iii. analyze the cost effectiveness and eco-friendliness of Fuel Cells.

Reference Books:

1. Rebecca L., Busby, "Hydrogen and Fuel Cells: A Comprehensive Guide", Penn Well Corporation, USA,2005
2. Bent Sorensen, "Hydrogen and Fuel Cells: Emerging Technologies and Applications", Elsevier Science Technology, United Kingdom, 2005
3. Jeremy Rifkin, "The Hydrogen Economy", Penguin Group, New York, 2002
4. Viswanathan B., Aulice Scibioh M, "Fuel Cells – Principles and Applications", Universities Press, India, 2006.
5. Thomas B.Johansson, Henry Kelly, Amulya K.N.Reddy, Robert.H.Williams, "Renewable Energy Sources for Fuels and Electricity", Island Press, Washington DC, 2009.

11EE331 ENERGY MANAGEMENT AND AUDIT

Credits: 3:1:0

Course Objectives:

- To understand various energy management techniques
- To understand energy auditing techniques
- To understand the importance of energy conservation

Unit I: Energy Management

Energy management: concepts, energy demand and supply, economic analysis, duties and responsibilities of energy managers. Energy conservation: concepts, energy conservation in – household-transportation-agricultural, service and industrial sectors, lighting, HVAC systems. Energy Conservation act.

Unit II: Energy Audit

Definition-needs-types-approaches; energy costs, bench marking, energy performance, matching energy supply to requirement, fuel and energy substitution, energy audit instruments, duties and responsibilities of energy auditors

Unit III: Planning

Key elements, force field analysis, energy policy- purpose, perspective, contents, formulation, ratification; location of energy management, top management support, managerial function, energy manager-accountability, motivation- information system-strategies- marketing and communicating- training and planning.

Unit IV: Monitoring and Targeting

Definition – elements, data and information analysis; techniques, enery consumption, production, cumulative sum of differences, energy service companies, energy management information systems, SCADA

Unit V: Electrical Energy Management

Supply side: Methods to minimize supply-demand gap, renovation and modernization of power plants, reactive power management, HVDC and FACTS, Demand Side: conservation in motors, pumps and fan systems, energy efficient motors, lighting.

Course Outcome:

At the end of the course, the students will be able to

i. become efficient energy managers

ii. know different energy auditing methods and the implementation procedures
iii. plan for the energy requirement

Reference Books:

1. Steve Doty, Wayne C. Turner, "Energy Management Handbook" Fairmont Press, Lilburn, 2009.
2. Barney L. Capehart, Wayne C. Turner, William J. Kennedy, "Guide to Energy Management", Fairmont Press, Lilburn, 2008.
3. Clive Beggs, "Energy: Management, Supply and Conservation " Butterworth-Heinemann Publications, Oxford, 2009
4. Albert Thumann, William J. Younger, Terry Niehus, "Handbook of Energy Audits" Fairmont Press, Lilburn, 2010.
5. Moncef Krarti, "Energy Audit of Building Systems: An Engineering Approach" Taylor & Francis, Boca Raton, 2010

11EE332 BIO-MASS ENERGY

Credits: 4:0:0

Course Objectives:

i. To deal about the thermal biomass conversion and biological pathways.
ii. To provide an introduction about the power generation techniques, through Biomasss
iii. To deal with the Design, Selection, Construction and Operation of Biogas Plants.

Unit I: Introduction

Biomass resources and their classification - chemical constituents and physicochemical characteristics of biomass - Biomass conversion processes - Thermo chemical conversion: direct combustion, gasification, Pyrolysis and liquefaction - biochemical conversion: anaerobic digestion, alcohol production from biomass - chemical conversion process: hydrolysis and hydrogenation. Biogas - generation - types of Biogas Plants.

Unit II: Thermal Biomass Conversion

Combustion, Pyrolysis, Gasification and Liquefaction - Biological Conversion - Methanol, Ethanol Production - Fermentation - Anaerobic Digestion Biodegradation and Biodegradability of Substrate - Hydrogen Generation from Algae – Biological Pathways.

Unit III: Power Generation Techniques

Through Fermentation and Gasification - Biomass Production from different Organic Wastes - Effect of Additives on Biogas Yield - Biogas production from Dry Dung Cakes - Industrial Application - Viability of Energy Production - Wood Gasifier System, Operation of Spark Ignition and Compression Ignition with Wood Gas. Operation and Maintenance

Unit IV: Economics and Environmental Aspects

Energy Effectives and Cost Effectiveness - History of Energy Consumption and Cost - Environmental Aspects of Bio energy Conversion- Economic analysis of bio energy options.

Unit V: Design, Selection, Construction and Operation of Biogas Plants

Design of the digester – design based on end user requirements – scaling of biogas plants – digester sizing – optimal design – design of fixed dome digester – Electricity Production from biomass.

Course Outcome:
At the end of this course, the students will be able to
- i. understand the thermal biomass conversion.
- ii. understand about the Pyrolysis, Gasification and Liquefaction and fermentation process
- iii. design the biogas plants by the students.

Reference Books:

1. Mital K.M, "Biogas Systems: Policies, Progress and Prospects", first edition, New Age International Pvt Ltd, New Delhi, 2006.
2. N.H.Ravindranath, Hall D.O., "Biomass, Energy and Environment", Reprinted Edition, Oxford University Press, Oxford, 2002.
3. Chawla O.P., "Advances in biogas technology", Publications and Information Division, Indian Council of Agricultural Research, New Delhi, 2009.
4. Nijaguna, B.T, "Biogas Technology", First Edition, New Age International Pvt Ltd, New Delhi , 2009.
5. Mital, K.M, "Biogas Systems: Principles and Applications", First Edition, New Age International Pvt Ltd, New Delhi, 2009.

11EE333 ENERGY MODELLING, ECONOMICS AND PROJECT MANAGEMENT

Credits: 3:1:0
Course Objectives:
- i. To impart greater understanding of energy modeling in renewable energy technology.
- ii. To throw light on the economic aspects involved in renewable energy technology.
- iii. To enlighten the students on the various techniques involved in project management.

Unit I: Models and Modeling Approaches
Macroeconomic Concepts - Measurement of National Output - Investment Planning and Pricing - Economics of Energy Sources - Reserves and Cost Estimation.

Unit II: Input-Output Analysis
Multiplier Analysis - Energy and Environmental Input / Output Analysis - Energy Aggregation – Econometric Energy Demand Modeling - Overview of Econometric Methods.

Unit III: Energy Demand Analysis and Forecasting
Methodology of Energy Demand Analysis - Methodology for Energy Technology Forecasting - Methodology for Energy Forecasting - Sectoral Energy Demand Forecasting.

Unit IV: Economics of Stand-alone Power Systems

Solar Energy - Biomass Energy - Wind Energy and other Renewable Sources of Energy - Economics of Waste Heat Recovery and Cogeneration - Energy Conservation Economics.

Unit V: Project Management – Financial Accounting
Cost Analysis - Budgetary Control - Financial Management - Techniques for Project Evaluation.

Course Outcome:
At the end of this course, the students will be able to
i. Gain clear perspective on energy economy.
ii. Forecast the energy demand and plan wisely.
iii. Become excellent managers of the energy resources.

Reference Books:

1. Munasinghe M., Meier P., "Energy Policy Analysis and Modeling", Cambridge University Press, New York, 2008.
2. Spyros Makridakis, Steven C. Wheelwright, Rob J. Hyndman, "Forecasting Methods and Applications", Wiley, Singapore, 2008.
3. James Stock, Mark Watson, "Introduction to Econometrics", 2nd ed., Pearson Education, New Delhi, 2006.
4. Kurt Campbell, Jonathon Price, "The Global Politics of Energy", The Aspen University, Washington, 2008.
5. Bob Shivley, John Ferrare, "Understanding Today's Electricity Business", Enerdynamics, Laporte, 2010

11EE334 SOLAR ENERGY LAB

Credits: 0:0:2
Course Objectives
i. To understand the basics of solar energy measurements and forecasting practically
ii. To understand the various control and operating strategies for stand alone and grid connected PV systems.
iii. To understand Solar Thermal System.

Course Outcome
Students will be able to
i. use simulation tools effectively to study the Solar Energy System
ii. design and construct Solar Applications
iii. analyze the PV and solar thermal system for various external and internal distribution.

1. Solar Energy Measurement
2. Solar Energy Forecasting
3. Solar Panel Modeling and Simulation
4. Characteristics of PV Panel
5. Perturb and Observe MPPT Technique
6. Fuzzy Logic based DC-DC Converter for PV System
7. Neural Network based DC-DC Converter for PV System
8. Simulation of Stand-alone PV systems using Matlab -Simulink.
9. Simulation of Grid Connected PV systems using Matlab -Simulink.

10. Study of the Effects of Partial Shading on PV Array Characteristics
11. Thermal Modeling and Simulation of a Building
12. Modeling and Simulation of Solar Water Heater

11EE335 WIND ENERGY LAB

Credits: 0:0:2

1. Wind Turbine Modeling and Simulation
2. Permanent-magnet Synchronous Generator Modeling and Simulation
3. Fuzzy Logic based Wind Energy Forecasting
4. ANN based Wind Energy Forecasting
5. Wind Power Curve Estimation
6. Maximum power tracking of a wind energy system
7. Fuzzy logic control based maximum power tracking of a wind energy system
8. Modeling and Simulation of wind turbine grid connection.
9. Simulation of a phasor model of a squirrel-cage induction generator driven by a variable pitch wind turbine
10. Simulation of a phasor model of a variable speed doubly-fed induction generator driven by a wind turbine
11. Simulation of model of a variable pitch wind turbine
12. Reactive power control in wind power plants

11EE336 SOLAR PASSIVE ARCHITECTURE

Credits: 4:0:0

Course Objectives:

- to understand the Building Laws and architectural Design.
- to understand the designing of a building, with an emphasis on the climate and other environmental conditions.
- to understand the concepts of a comfortable thermal environment and how to apply passive solar design principles, passive ventilation and solar shading to create a comfortable thermal environment.

Unit I: Introduction

Introduction to architecture; Architecture as the art of science of designing buildings; Building science and its significance; Energy management concept in building.

Unit II: Thermal Analysis and Design for Human Comfort

Thermal comfort; Criteria and various parameters; Psychometric chart; Thermal indices, climate and comfort zones; Concept of sol-air temperature and its significance; Calculation of instantaneous heat gain through building envelope; Calculation of solar radiation on buildings; building orientation; Introduction to design of shading devices; Overhangs; Factors that effects energy use in buildings; Ventilation and its significance; Air-conditioning systems; Energy conservation techniques in air-conditioning systems.

Unit III: Passive Cooling and Heating Concepts

Passive heating concepts: Direct heat gain, indirect heat gain, isolated gain and sunspaces; Passive cooling concepts: Evaporative cooling, radiative cooling; Application of wind, water and earth for cooling; Shading, paints and cavity walls for cooling; Roof radiation traps; Earth air-tunnel.

Unit IV: Heat Transmission in Buildings
Surface co-efficient: air cavity, internal and external surfaces, overall thermal transmittance, wall and windows; Heat transfer due to ventilation/infiltration, internal heat transfer; Solar temperature; Decrement factor; Phase lag. Design of day lighting; Estimation of building loads: Steady state method, network method, numerical method, correlations; Computer packages for carrying out thermal design of buildings and predicting performance.: Central receiver systems, parabolic trough systems; Solar furnaces.

Unit V: Bioclimatic Classification
Bioclimatic classification of India; Passive concepts appropriate for the various climatic zones in India; Typical design of selected buildings in various climatic zones; Thumb rules for design of buildings and building codes.

Course Outcome:
At the end of the course, the students should be able to:

i. analyze the site and its context in preparation for designing a building, particularly with respect to climate and other environmental conditions.
ii. Design and build environments that are both thermally comfortable and thermally delightful by utilizing passive solar design principles.
iii. utilize the combined site-specific potentials of sun, light, wind and rain for creating a sustainable, comfortable and delightful built environment.

Reference Books:

1. Daniel D. Chiras," The Solar House: Passive Heating and Cooling", Chelsea Green Publising Company, Vermont, 2002.
2. Colin Porteous, Kerr Macgregor, "Solar Architecture in Cool Climates", Earthscan Publications Ltd., UK, 2005.
3. James Kachadorian, "Passive Solar House" Chelsea Green Publising Company, Vermont, 2006.
4. Daniel D. Chiras, "The Natural House", Chelsea Green Publishing Company, Vermont, 2001.
5. Daniel D. Chiras, "The New Ecological Home", Chelsea Green Publishing Company, Vermont, 2004.

11EE337 GREEN BUILDING

Credits: 4:0:0

Course Objectives

i. To learn green building concepts and ecological design concepts applicable to modern buildings
ii. Acquaint students with the principle theories of materials and construction techniques to create green buildings

iii. To provide exposure to various national and international rating systems as compliance requirements for green buildings

Unit I: Green Building Process and Ecological Design

Conventional versus green building delivery systems - Green building project execution - the integrated design process - green building documentation requirements - design versus ecological design - historical perspective - contemporary ecological design - future ecological design - green design to regenerative design.

Unit II: Green Building Systems

Sustainable sites and landscaping – enhancing ecosystems - building envelop – selection of green materials - products and practices - passive design strategy – internal load reduction – indoor environment quality – building water and waste management – relevance to LEED / IGBC standards.

Unit III: Green Building Implementation

Site protection planning - health and safety planning - construction and demolition waste management - reducing the footprint of construction operations - maximizing the value of building commissioning in HVAC System, lighting and non mechanical Systems - costs and benefits relevance to LEED / IGBC standards.

Unit IV: Green Building Assessment

USGBC LEED building assessment standard - LEED certification process – green globes building assessment protocol- international building assessment systems - LEED-NC Platinum / gold / silver building case studies – trends in building rating systems – IGBC standards – ECBC compliances.

Unit V: Economics of Green Buildings

Business case for high-performance green buildings - the economics of green building - benefits - managing initial costs - cost barrier in project management - long-term environment benefits.

Course Outcome

At the end of the course, the student will be able to:

i. understand and actively participate in the overall iterative and multidisciplinary process of conceptualizing and designing an environmentally friendly building
ii. choose and size building components, as well as energy and environmental systems suitable for different categories of buildings, and different climate zones.
iii. evaluate the economic performance of buildings as related to their resource-consumption and environmental performance.

Reference Books:

1. Jerry Yudelson, “Green building A to Z, Understanding the Language of Green Building”, New Society Publishers, Canada, 2007.
2. Green building guidelines: Meeting the demand for low-energy, resource-efficient homes. Sustainable Buildings Industry Council, Washington, D.C., 2004.
3. Jerry Yudelson, Green Building through Integrated Design, McGraw Hill, USA, 2009
4. Means, R.S., Green building: Project Planning & Cost Estimating, Wiley, Kingston, 2006.

5. Charles J. Kibert, Sustainable Construction: Green Building Design and Delivery, 2nd Edition, Wiley, New Jersey, 2007.

11EE338 DATA MINING FOR RENEWABLE ENERGY TECHNOLOGY

Credits: 3:1:0
Course Objectives:
- To enlighten the students on the basic concepts of data mining.
- To improve the students competence in the algorithms and learning schemes of data mining.
- To enable the students to exploit the data mining techniques for research in renewable energy.

Unit I: Introduction
Data Mining – Kinds of Data – Functionalities – Classification – Primitives – Major Issues – Data Preprocessing – Descriptive Data Summarization - Data Cleaning – Data Integration and Transformation - Data Reduction

Unit II: Data Warehouse: An Overview
Data Warehouse – Multidimensional Data Model – Data Warehouse Architecture – Data Warehouse Implementation – From Data Warehousing to Data Mining. Mining Frequent Patterns, Associations: Basic Concepts and a Road Map – Efficient and Scalable Frequent Item set -Mining Methods- Mining Multilevel Association Rules

Unit III: Classification and Prediction
Issues regarding classification and prediction - Decision tree Induction - Bayesian Classification – Lazy Learners – Other Classification Methods – Prediction – Accuracy and Error Measures.

Unit IV: Cluster Analysis
Types of Data – Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical Methods. Mining Stream, Time-Series and Sequence Data Mining- Data Streams – Mining Time-series- Data- Mining Sequence Patterns in Transactional Databases

Unit V: Applications in Renewable Energy Technology
Application of Data Mining in Wind Power System -Wind Power Prediction- Modeling and Forecasting of Solar Radiation Data - Analyzing Solar Power Plant Performance

Course Outcome:

At the end of this course, the students will be able to

i. understand the importance of data-driven performance optimization of renewable energy technology.
ii. exploit the vast data base available in the renewable energy sector and devise ways to make renewable energy a competitive source of supply.
iii. explore new data mining techniques for renewable energy applications

Reference Books:

1. Jiawei Han, Micheline Kamber, “Data Mining : Concepts and Techniques”, II Edition, Morgan Kaufmann Publishers, San Francisco, 2006
2. Ian Witten, Eibe Frank, “Data Mining: Practical Machine Learning Tools and Techniques”, III Edition, Morgan Kaufmann Publishers, San Francisco 2011.
3. Sumathi S., S. N. Sivanandam, “Introduction to Data Mining and its Applications”, Springer-Verlag Berlin Heidelberg 2006.
4. David Hand, Heikki Mannila, Padhraic Smyth, “Principles of Data Mining”, A Bradford Book, The MIT Press, Cambridge, Massachusetts London, England, 2001.
5. Michael J A Berry, Gordon S Linoff, “Data Mining Techniques”, II Edition, Wiley India, 2004.

11EE339 SOFT COMPUTING TECHNIQUES

Credits: 3:1:0

Course Objectives:

i. To develop a detailed understanding of various soft computing techniques.
ii. To analyze the mechanisms of different AI techniques and modern heuristics algorithms.
iii. To develop skills to apply the soft computing techniques for various practical optimization problems.

Unit I: Introduction

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

Unit II: Artificial Neural Networks

Concept of Artificial Neural Networks and its basic mathematical model- McCulloch-Pitts neuron model-simple perceptron, Adaline, Madeline, 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, recurrent network. Neural Network based controller

Unit III: Fuzzy Logic System

Introduction to crisp sets and fuzzy sets- basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control-. Fuzzification, inference 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 IV: Modern Heuristic Algorithms

Basic concept of Genetic algorithm (GA) and detail algorithmic steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. Concept of tabu search (TS), evolutionary programming (EP) and ant-colony optimization (ACO) techniques for solving optimization problems.

Unit V: Applications

GA, TS, EP and ACO applications to power system and power electronics optimization problem, Case studies: Identification and control of linear and nonlinear dynamic systems using Matlab-

Neural Network toolbox. Stability analysis of Neural-Network interconnection systems. Implementation of fuzzy logic controller using Matlab fuzzy-logic toolbox- Stability analysis of fuzzy control systems.

Course Outcome:

At the end of the course, the students will be able to

i. state the mechanisms of various soft computing techniques.
ii. understand the mechanisms of various modern heuristic optimization algorithms.
iii. apply the soft computing techniques for practical applications.

Reference Books:

1. Jacek. M. Zurada, "Introduction to Artificial Neural Systems", Jaico Publishing House, Mumbai, 2006.
2. Kosko,B. "Neural Networks And Fuzzy Systems: A Dynamical Systems Approach To Machine Intelligence", Prentice-Hall of India Pvt. Ltd., New Delhi, 2008.
3. Zimmerman H.J. "Fuzzy set theory-and its Applications", Kluwer Academic Publishers, Dordrecht, 2001.
4. D. Driankov, H. Hellendoorn, M. Reinfrank, "Introduction to Fuzzy Control", Narosa Publising houses, New Delhi, 2001.
5. Kalyanmoy Deb, "Optimization for Engineering Design" Prentice-Hall of India Pvt. Ltd., New Delhi, 2003.

LIST OF SUBJECTS

Sub. Code	Name of the Subject	Credits
12EE101	Basic Electrical Engineering	3:0:0
12EE102	Basic Electrical and Electronics Engineering	4:0:0
12EE201	Electric Circuits and Networks	3:1:0
12EE202	Electromagnetic Fields	3:1:0
12EE203	Electron Devices	3:0:0
12EE204	Circuits and Devices Laboratory	0:0:2
12EE205	Electronic Circuits	3:0:0
12EE206	Electronic Circuits Laboratory	0:0:2
12EE207	DC Machines and Transformers	3:1:0
12EE208	DC Machines and Transformers Laboratory	0:0:2
12EE209	Induction and Synchronous Machines	3:1:0
12EE210	AC Machines and Control System Laboratory	0:0:2
12EE211	Electrical Machine Design	3:1:0
12EE212	Power Electronics	3:0:0
12EE213	Power Electronics Laboratory	0:0:2
12EE214	Electric Drives and Control	3:0:0
12EE215	Generation, Transmission and Distribution	3:1:0
12EE216	Power System Analysis	3:1:0
12EE217	Computer Aided Power System Analysis Laboratory	0:0:2
12EE218	Power System Protection and Switchgears	3:0:0
12EE219	Control Systems	3:1:0
12EE220	Digital Electronics	3:1:0
12EE221	Linear Integrated Circuits	3:0:0
12EE222	Linear and Digital IC Laboratory	0:0:2
12EE223	Microprocessors and Microcontrollers	3:1:0
12EE224	Microprocessor and Microcontroller Laboratory	0:0:2
12EE225	Digital Signal Processing	3:1:0
12EE226	Digital Signal Processing Laboratory	0:0:2
12EE227	C++ and Data Structures	3:0:0
12EE228	C++ and Data Structures Laboratory	0:0:2
12EE229	Measurement and Instrumentation	3:0:0
12EE230	Measurements and Computer Aided Electrical Machine Design Laboratory	0:0:2
12EE231	Material Science	3:0:0
12EE232	Energy Systems	3:0:0
12EE233	Communication Engineering	3:0:0
12EE234	Biomedical Instrumentation	3:0:0
12EE235	Embedded System	3:0:0
12EE236	Special Electrical Machines	3:0:0
12EE237	Virtual Instrumentation	3:0:0
12EE238	Illumination Engineering	3:0:0
12EE239	Automotive Electronics	3:0:0
12EE240	Renewable Energy Sources	3:0:0
12EE241	Digital System Design	3:0:0
12EE242	Power System Stability	3:0:0

12EE243	Power System Control	3:0:0
12EE244	Neural Network and Fuzzy Systems	3:0:0
12EE245	Micro Electromechanical Systems	3:0:0
12EE246	Computer Architecture	3:0:0
12EE247	Operating System	3:0:0
12EE248	Computer Communication	3:0:0
12EE249	Grid Computing	3:0:0
12EE250	Nanocomputing	3:0:0
12EE251	Basics of Medical Electronics	3:0:0
12EE252	Basics of Electric And Hybrid Vehicle	3:0:0
12EE253	Building Automation	3:0:0
12EE254	Fundamentals of Electrical Safety	3:0:0
12EE255	Artificial Organs & Rehabilitation Engineering	3:0:0
12EE256	Advanced Control System	3:0:0
12EE257	High Voltage Engineering	3:0:0
12EE258	Electrical and Electronics Workshop Practice	0:0:2
12EE259	Design Laboratory	0:0:2
12EE260	Power Engineering Simulation Laboratory	0:0:2
12EE261	Control Systems Laboratory	0:0:2
12EE262	HVDC Transmission	3:0:0
12EE263	HVDC and FACTS	3:0:0
12EE301	Power Semiconductor Devices	4:0:0
12EE302	Power Converter Analysis – I	3:1:0
12EE303	Power Converter Analysis – II	3:1:0
12EE304	Solid State DC Drives	3:1:0
12EE305	Solid State AC Drives	3:1:0
12EE306	Generalized Theory of Electrical Machines	3:1:0
12EE307	Special Machines and Controllers	4:0:0
12EE308	Advanced Digital Signal Processing	4:0:0
12EE309	DSP Based Control of Electric Drives	4:0:0
12EE310	Advanced Topics in Power Electronics	4:0:0
12EE311	Power Electronics Laboratory	0:0:2
12EE312	Electric Drives And Control Laboratory	0:0:2
12EE313	Photovoltaic Systems	4:0:0
12EE314	Power Electronic Circuits	3:1:0
12EE315	Solar Thermal Energy Conversion	4:0:0
12EE316	Advanced Control Techniques for Induction Generators	3:1:0
12EE317	Energy Engineering	4:0:0
12EE318	Wind Energy	3:1:0
12EE319	Hydrogen and Fuel Cells	4:0:0
12EE320	Energy Management and Audit	3:1:0
12EE321	Bio-Mass Energy	4:0:0
12EE322	Energy Modelling, Economics and Project Management	3:1:0
12EE323	Solar Energy Lab	0:0:2

12EE324	Wind Energy Lab	0:0:2
12EE325	Simulation of Power Electronics Systems	3:1:0
12EE326	Power Electronics Applications to Power Systems	3:1:0
12EE327	Neuro – Fuzzy Controllers for Electric Drives	4:0:0
12EE328	Power Electronics in Wind and Solar Power Conversion	4:0:0
12EE329	HVDC Transmission	4:0:0
12EE330	PLC and Automation	4:0:0
12EE331	Electric and Hybrid Vehicles	3:1:0
12EE332	Electromagnetic Interference and Compatibility	4:0:0
12EE333	Optimization Techniques	3:1:0
12EE334	Power Engineering Simulation Laboratory	0:0:2
12EE335	Flexible AC Transmission Systems	4:0:0
12EE336	Industrial Electronics and Instrumentation	4:0:0
12EE338	Passive Solar Architecture	4:0:0
12EE339	Green Building	4:0:0
12EE340	Data Mining for Renewable Energy Technology	3:1:0
12EE341	Soft Computing Techniques	3:1:0
12EE342	Oceanic Energy	4:0:0
12EE343	Geothermal Energy	4:0:0
12EE344	Optimal Control of Wind Energy Systems	4:0:0
12EE345	Wind Resource Assessment and Forecasting Methods	4:0:0
12EE346	Design of Turbines for Renewable Energy System	3:1:0
12EE347	Computer Networks and Protocols	4:0:0
12EE348	Microcontrollers Application in Power Electronics	4:0:0

12EE101 BASIC ELECTRICAL ENGINEERING

Credits: 3:0:0

Course Objective

- To impart the basic knowledge about the Electric and Magnetic circuits.
- To understand the working of various Electrical Machines.
- To know about various measuring instruments and house wiring.

Course Outcome

- Predicting the behavior of any electrical and magnetic circuits.
- Identifying the type of electrical machine used for a particular application.
- Wiring any circuit depending upon the requirement.

Unit I

BASICS OF DC CIRCUITS: Electrical Quantities – Definitions – SI Units and abbreviation – Electrical Energy and its Applications - Circuit Elements – Current and Voltage source – Ohm's Law and Kirchhoff's laws – Resistive Circuits: Resistance in series and Parallel, Voltage and Current Division – Source Transformation – Star and Delta Transformation.

Unit II

BASICS OF MAGNETIC CIRCUITS: Magnetic flux- flux density – reluctance – permeance- magnetic effect of electric circuit-Law of Electromagnetic induction – induced emf – self and mutual inductance – coupling co-efficient – inductance in series and parallel - Magnetic Materials.

Unit III

BASICS OF AC CIRCUITS AND POWER SYSTEM: Generation of Alternating EMF – Equation of alternating voltage – Introduction to Alternating Quantities - Average and RMS value – Form and Peak factor – Phasor representation of alternating Quantity – Sources of Electrical Energy - Thermal, Hydro and Nuclear power generating station – Transmission and Distribution – Types – Comparison of OHL and UGC – Introduction to Three phase system.

Unit IV

BASIC OF ELECTRICAL MACHINES: Working principle, operation and application of DC Generator, DC Motor, Transformer, Three Phase Induction motor, single phase Induction motor, Alternator, Stepper Motor. (Quantitative approach).

Unit V

BASICS OF MEASURING INSTRUMENTS AND DOMESTIC WIRING: Classification of Instruments – Principle of Analog instrument – Deflecting, Controlling and Damping Mechanism - Moving Coil instrument – Moving Iron Instrument – Induction type Energy meter – Megger – Measurement errors. Wiring materials and accessories – Types of wiring – Specification of Wiring – Stair case wiring - Fluorescent lamp wiring – Basics of Earthing – layout for a residential building.

Text Book

1. Muraleedharan K. A, Muthusubramanian R & Salivahanan S, "Basic Electrical, Electronics & Computer Engineering", Tata McGraw- Hill Limited, New Delhi, 2010.

Reference Books

1. Jegathesan .V, Vinoth Kumar.K and Saravanakumar.R, "Basic Electrical & Electronics Engineering", Wiley India Private Limited, New Delhi, 2011.
2. Surajit Chattopadhyay, Samarjit Sengupta, "Basic Electrical Engineering", Narosa Publishing House Private Ltd, New Delhi, 1st Edition, 2010.
3. Mehta,V.K, Rohit Mehta, "Principles of Electrical Engineering", S. Chand Group, 1st Edition, 2007.

12EE102 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

Credits: 4:0:0

Course Objective
- To impart the basic knowledge about the DC and AC circuits.
- To understand the working of various Electrical Machines.
- To inculcate the understanding about the fundamentals of semiconductor devices, Transducers and Measuring Instruments.

Course Outcome
- Predicting the behavior of any DC and AC circuits.
- Identifying the type of electrical machine used for that particular application.
- Knowing the different types of transducers depending upon the requirement.

Unit I
BASICS OF DC CIRCUITS: Electrical Quantities – Definitions – SI Units and abbreviation – Electrical Energy and its Applications - Circuit Elements – Current and Voltage source – Ohm's Law and Kirchhoff's laws – Resistive Circuits – Resistance in series and Parallel – Voltage and Current Division – Source Transformation.

Unit II
BASICS OF AC CIRCUITS: Generation of Alternating EMF – Equation of alternating voltage – Introduction to Alternating Quantities - Average and RMS value – Form and Peak factor – Introduction to Two phase and Three Phase systems – Star and Delta Connection – Comparison.

Unit III
BASICS OF ELECTRICAL MACHINES: Working principle, operation and application of DC Generator, DC Motor, Transformer, Three Phase Induction motor, Single phase Induction motor, Alternator, Stepper Motor. (Quantitative approach)

Unit IV
BASICS OF SEMICONDUCTOR DEVICES: Energy Band Structure of Conductors – Insulators and Semiconductors – Properties – Classification of Semiconductors – V-I Characteristics of PN Junction Diode – Zener diode, FET, MOSFET, SCR, UJT - Introduction to Integrated Circuits- Operation Amplifier – Boolean algebra – Logic Gates.

Unit V

BASICS OF TRANSDUCERS AND MEASURING INSTRUMENSTS: Basic requirements of Transducers – Classifications – Displacement Transducers - Temperature Transducers – Piezoelectric Transducers – Hall effect Transducers - Classification of Instruments – Principle of Analog instrument – Deflecting, Controlling and Damping Mechanism - Moving Coil instrument – Moving Iron Instruments.

Text Book

1. Jegathesan .V, Vinoth Kumar .K and Saravanakumar .R, "Basic Electrical & Electronics Engineering", Wiley India Private Limited, New Delhi, 2011.

Reference Books

1. Surajit Chattopadhyay, Samarjit Sengupta, "Basic Electrical Engineering", Narosa Publishing House Private Limited, New Delhi, 1st Edition, 2010.
2. Mehta V.K, Rohit Mehta, "Principles of Electrical Engineering", S. Chand Group, 1st Edition, 2007.
3. Mittle. V.N., "Basic Electrical and Electronics Engineering", Tata McGraw- Hill Publishing Company, New Delhi, 1st Edition, 2007.

12EE201 ELECTRIC CIRCUITS AND NETWORKS

Credits: 3:1:0

Course Objective

- To develop the ability to apply the basic laws and theorems to analyze a DC and AC electric circuit.
- To use mathematical methods such as Laplace and Fourier transforms and some linear algebra techniques and differential equations to solve circuits problems
- To synthesize a network with stable condition.

Course Outcome

- Ability to analyze simple circuits applying Ohm's and Kirchhoff's laws
- Ability to analyze first-order response of RL, RC and RLC circuits.
- Ability to design any non linear network, filters and attenuators for an application

Unit I

CIRCUIT ANALYSIS: System of Units-Electrical Quantities-Circuit elements-Independent and Dependent sources-Ohm's Law-Kirchhoff's Laws-Analysis of circuits using Kirchhoff's law, Source transformation, Wye-Delta transformation – dual network - Matrix representation and solution of AC and DC networks, Node and Loop basis analysis of AC and DC.

Unit II

NETWORK THEOREMS: Thevenin, Norton, Superposition, Reciprocity, Substitution, and Maximum Power Transfer Theorems - Problems

Unit III

TRANSIENT RESPONSE OF ELECTRIC CIRCUITS: Transient Concepts – Singularity functions-unit step, unit impulse-transient response of simple RL, RC and RLC series and parallel circuits for step input and sinusoidal excitation-Laplace transform application to the solution of RL, RC & RLC circuits: initial and final value theorem and applications – Concept of complex frequency – Driving point and transfer impedances –Poles and zeros of network function.

Unit IV

COUPLED CIRCUITS AND THREE PHASE CIRCUITS: Coupled circuits – coefficient of coupling – self and mutual inductances – analysis of coupled circuits – single and double tuned coupled circuits – Three phase circuits – balanced circuits - star and delta connected loads - phase sequence - unbalanced circuits - solution of unbalanced star and delta connected loads – power measurement by two wattmeter method.

Unit V

TWO PORT NETWORKS AND FILTERS: Driving point and transfer impedance/admittance - voltage and current ratios of two port networks - admittance, impedance, hybrid, transmission and image parameters for two port networks – impedance matching – equivalent π and T networks – passive filters as a two port network – characteristics of ideal filter – low pass and high pass filters.

Text Books

1. Navhi, Edminister J A, "Theory and Problems of Electric circuits" Tata McGraw- Hill Education India Private Limited, New Delhi, 2007.
2. Sudhakar, Shyammohan S Palli, "Circuits and Networks – Analysis and Synthesis", Tata McGraw- Hill Education India Private Limited, New Delhi, 2007.

Reference Books

1. Charles K Alexander and Mathew N O Sadiku, "Fundamentals of Electric Circuits", Tata Mc Graw Hill Publishing Company Limited, New Delhi, 2007.
2. Jack E Kemmerly, Steven M Durbin and William H. Hayt Jr., "Engineering Circuit Analysis", Tata Mc Graw Hill Publishing Company Limited, New Delhi, 2006.
3. Sivanandam.S.N., "Electric Circuit Analysis", Vikas Publishing House Private Limited, New Delhi, 2001.

12EE202 ELECTROMAGNETIC FIELDS

Credits 3:1:0

Course Objective

- To understand the concept of charge, current and fields.
- To calculate electromagnetic field distribution for various configurations.
- To impart knowledge on electrostatic, and magnetostatic fields, electromagnetic fields and electromagnetic waves.

Course Outcome

- Knowledge on vector fields will be gained.
- Ability to solve the advanced EMF problems.
- Knowledge of Electromagnetic waves and its travelling through various medium will be gained.

Unit I

GENERAL PRINCIPLES: Review of vector algebra-Coordinate systems-Rectangular, Cylindrical and Spherical Coordinate Systems- Coordinate transformation-Differential Line, Surface and Volume Elements-Line, Surface and Volume Integrals- Gradient, Divergence and Curl Operators - Divergence Theorem- Stokes' Theorem.

Unit II

ELECTROSTATIC FIELDS: Field concept – Charge Distributions – Coulomb's Law – Electric Field Intensity-Determination of Electric Field due to Discrete and Line charges, Electric Potential- Relationship between Electric Field Intensity and Electric Potential–Potential due to Electrical Dipole-Potential due to an Infinite Uniformly Charged Line-Electric Flux and Flux Density- Gauss' Law- Relation Between Electric Flux and Electric Field Intensity-Electrostatic Energy- Laplace's and Poisson's Equations – Dielectrics –Capacitance - parallel plate capacitance and cylindrical capacitor-Applications of electrostatic fields .

Unit III

MAGNETOSTATIC FIELDS: Current density – Magnetic Flux –Magnetic Flux Density-Magnetic Field Intensity Relationship between Magnetic Field Intensity and Magnetic Flux density- Biot-Savart's Law –Determination of Magnetic Field due to Infinitely Long Straight Conductor, Circular Current Loop and Rectangular Current Loop- Ampere's Law – Determination of Magnetic Field due to a Co-axial Cable using Ampere's Law- Force and Torque in Magnetic Field- Self and Mutual Inductances-Inductance of a Solenoid and a Toroid-Practical Applications of magnetostatic fields .

Unit IV

ELECTROMAGNETIC FIELDS: Displacement current – Eddy current -Faraday's Law – Lenz's Law – Transformer and Motional EMFs, Maxwell's Equations.

Unit V

ELECTROMAGNETIC WAVES: Generation – Propagation of Waves in Dielectrics – Conductors and Transmission lines – Skin effect.-Power and the Poynting Vector – Applications of EMF waves.

Text Books

1. William H.Hayt Jr., John A.Buck, "Engineering Electro Magnetics", Tata McGraw- Hill Education India Private Limited, New Delhi, 3rd Edition, 2007.
2. Joseph. A. Edminister, "Theory and Problems of Electro Magnetics", 2nd Edition, Schaum's Outline Series, Tata Mc Graw-Hill Education India Private Limited, New Delhi, 2005.

Reference Books

1. Matthew N.O. Sadiku, "Elements of Electromagnetics', Oxford University Press, London, 3rd Edition 2005.
2. Gangadhar, K.A., "Field Theory", Khanna Publishers Limited, New Delhi, 15th Edition, 3rd Reprint, 2004.
3. Uday A.Bakshi, Ajay V.Bakshi, "Electromagnetic Fields". Technical Publications, Pune, 1st Edition, 2006.

12EE203 ELECTRON DEVICES

Credits: 3:0:0

Course Objective

- To study the operation and characteristics of different semiconductor devices.
- To know different methods of fabrication of semiconductor devices in an IC.
- To familiarize the student with the principle of operation, capabilities and limitation of various electron devices and their applications.

Course Outcome

- The concepts of semiconductor devices will be known
- Application in rectifiers, inverters, choppers etc. will be known.
- The concepts of IC fabrication will be known.

Unit I

P-N JUNCTION DIODE: Diode operation-V-I characteristics - Static and Dynamic resistance, Temperature dependence of characteristics, diffusion and transition capacitances, Diode as a circuit element, small signal and large signal models. Diode Switching times, PN junction diode ratings. Breakdown phenomenon in diodes - LED, Photodiode, Zener diodes, Schottky barrier diodes.

Unit II

BIPOLAR JUNCTION TRANSISTOR (BJT): Physical behavior of a BJT – Ebers - Moll model, large signal current gains, Modes of transistor operation - Common Base, Common Emitter and Common Collector configurations, Input and output characteristics, Early effect, regions of operation, AC and DC load lines - Need for stability of Q-Point, Bias stability – fixed bias, collector to base bias, self bias. Transistor switching times - Transistor as a switch and an amplifier, High frequency effects, BJT ratings

Unit III

JUNCTION FIELD EFFECT TRANSISTOR (JFET): JFET operation - V-I characteristics, transfer characteristics, regions of operation. DC analysis - JFET biasing. Small signal J F E T model, JFET as a switch, Voltage variable resistor and an amplifier.

Unit IV

METAL OXIDE SEMICONDUCTOR FIELD EFFECT TRANSISTOR (MOSFET): Constructional details - Operation of Enhancement and Depletion type MOSFETs, V-I Characteristics, Transfer characteristics, analytic expression for drain current, Comparison of PMOS and NMOS devices - MOSFET biasing, MOSFET as a switch, resistor and amplifier.

Unit V

INTEGRATED CIRCUIT (IC) FABRICATION: Monolithic IC technology - Planar processes, Epitaxial growth, Oxidation, Photolithography, Diffusion, Ion implantation, Metallization. BJT fabrication – need for buried layer, Junction and Dielectric isolation, Fabrication of PNP multiple emitter transistors, Monolithic diodes, Fabrication of FETs, NMOS enhancement and depletion MOSFETs, Self isolation, IC packaging.

Text Books

1. Millman J., Grabel A, "Microelectronics", Tata McGraw- Hill Education India Private Limited, New Delhi, 3rd Edition, 2000.

2. Boylestead L. R., Nashelsky L.,"Electronic Devices and Circuit Theory", Pearson Education India Series, New Delhi, 10^{th} Edition, 2009.

Reference Books

1. Thomas L. Floyd, "Electronic Devices", Pearson Education India Series, New Delhi, 7^{th} Edition, 2007.
2. David A Bell, "Electronic Devices and Circuits", Prentice Hall of India, New Delhi, 4^{th} Edition, 2000.
3. Sedha R.S., "A Text Book of Applied Electronics", S.Chand & Company Ltd, New Delhi. 3^{rd} Edition, 2000.
4. Roy Choudhury, Shail Jain, "Linear Integrated Circuits", New Age International Limited, New Delhi, 2^{nd} Edition, 2003.
5. Gupta J.B., "Electronic Devices and Circuits", S.K.Kataria & Sons, New Delhi, 3^{rd} Edition, 2010

12EE204 CIRCUITS AND DEVICES LABORATORY

Credits 0:0:2

1. Verification of Ohms Law and Kirchhoff's Law.
2. Verification of Superposition Theorem using PSPICE.
3. Verification of Thevenin and Norton Theorem using PSPICE.
4. Transient Response of a simple RL, RC and RLC circuits using PSPICE.
5. Resonance of series RLC and parallel RLC circuits using PSPICE.
6. Filters using PSPICE.
7. Characteristics of PN diode & Zener diode
8. Characteristics of JFET
9. Characteristics of UJT & SCR
10. Input Output Characteristics of Transistor under CE configuration
11. Study of Half wave & Full wave Rectifier with and without filter
12. Non-Linear wave shaping techniques-Clipper and Clamper

12EE205 ELECTRONIC CIRCUITS

Credits: 3:0:0

Course Objective

- To impart knowledge about the various methods of transistor biasing and design of simple amplifier circuits.
- To teach the methods of analysis of feedback amplifiers and analyze, design of oscillators, tuned amplifiers and multivibrators.
- To train the students to analyze, design of power supplies and wave shaping circuits.

Course Outcome

- Knowledge to identify, formulate, and solve engineering problems in the area circuits and systems will be gained.
- Ability to function on multi-disciplinary teams through the electronic circuits experiments and projects.
- Ability to design an electric system, components or process to meet desired needs within realistic constraints

Unit I

POWER SUPPLIES : Rectifiers – Half wave and Full wave rectifiers, Average and RMS value, Ripple factor, Regulation, Rectification efficiency, Transformer Utility Factor, Filters – Inductor, Capacitor, L type and π type, Ripple Factor and Regulation, Basic concept about voltage regulator, Introduction to Switched Mode Power Supplies.

Unit II

WAVE SHAPING: Response of High pass and Low pass RC circuit for sinusoidal, step, pulse, square, ramp and exponential inputs. Linear wave shaping – Integrator, Differentiator. Non-linear wave shaping–Clipping and clamping circuits, Attenuator, Introduction to pulse transformers.

Unit III

VOLTAGE AMPLIFIERS: BJT and JFET amplifiers – RC coupled amplifiers, Cascaded BJT amplifiers, BIFET amplifiers, DC amplifiers, Differential and Common mode gain, CMRR, Cascade and Darlington Amplifiers. Chopper Amplifiers

Unit IV

POWER AMPLIFIERS AND FEEDBACK AMPLIFIERS: Power amplifiers– Classification, Class A/B/C, Single ended and Push-pull Configuration, Power dissipation and output power, Conversion efficiency, Complementary symmetry power amplifiers, Class AB operation, Basic concepts of feedback amplifiers, Voltage and current feedback circuits.

Unit V

OSCILLATORS AND MULTIVIBRATORS: Oscillators – Barkhausen criteria, RC Phase Shift, Wien bridge oscillators, Hartley and Colpitt's oscillators, Frequency stability of oscillators. Crystal Oscillators, Non-sinusoidal oscillators – Multivibrators – Bistable, Monostable, Astable Multivibrators and Schmitt Trigger using BJT.

Text Books

1. Mike Tooley., "Electronic Circuits Fundamentals and Applications", Elsevier Private Limited, USA, 2011.
2. Millman J. and Taub H., Mothiki S Prakash Rao, "Pulse, Digital and Switching Waveforms", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2nd Edition, 2007.

Reference Books

1. David A. Bell., "Electronic Devices and Circuits", Oxford University Press, London, 5th Edition, 2007.
2. Boylestad R.L. and Nashelsky L., "Electronic Devices and Circuit Theory", Pearson Education India Series, New Delhi, 9th Edition 2005.
3. Floyd, "Electronic Devices", Pearson Education India Series, New Delhi, 8th Edition, 2003.
4. Bogart, "Electronic Devices & Circuits", Prentice Hall of India, New Delhi, 6th Edition, 2003.

12EE206 ELECTRONIC CIRCUITS LABORATORY

Credits 0:0:2

1. Common Emitter Amplifier
2. Common Source Amplifier
3. Differential Amplifier using BJT
4. Integrator and Differentiator using R and C
5. Series Voltage Regulator
6. Emitter Follower
7. UJT Relaxation Oscillator
8. RC Phase-Shift Oscillator
9. Colpitts Oscillator
10. Astable Multivibrator
11. Bistable Multivibrator
12. Schmitt Trigger Circuit

12EE207 DC MACHINES AND TRANSFORMERS

Credits 3:1:0

Course Objective

- To introduce the concept of rotating machines and the principle of electromechanical energy conversion in single and multiple excited systems.
- To understand the generation of D.C. voltages by using different type of generators and study their performance.
- To study the working principles of D.C. motors and their load characteristics, starting and methods of speed control.

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Course Outcome

- Knowledge of constructional details of different type of transformers, working principle and its performance will be gained.
- Skill to estimate the various losses taking place in D.C. machines and transformers.
- Skill to analyze the different testing method to arrive at its performance.

Unit I

ELECTRO-MECHANICAL ENERGY CONVERSION: Flux linkage, inductance and energy – time varying and rotational induced EMF's – losses – conservation of energy – energy and co energy – force and torque – singly and doubly excited systems – reluctance and mutual torque.

Unit II

DC GENERATORS: Laws of magnetic circuit – Principle of operation, Constructional details, Armature Windings, EMF equation, Methods of Excitation, Separate, Shunt, Series and Compound excitations - No load characteristics – Armature reaction, Commutation, Inter poles, Compensating windings, Load characteristics of various types of DC Generators.

Unit III

DC MOTORS: Principle of operation – Torque equation, Electrical and Mechanical characteristics of DC Shunt, Series and Compound motors, Starters – Speed control – Armature and Field control – Braking.- Losses and efficiency – Swinburne’s test – Separation of losses, Hopkinson’s test.

Unit IV

TRANSFORMERS: Principle of operation – Constructional features, Classification of Transformers, EMF equation, Transformation ratio, Transformer on no load and load, Phasor diagrams -Equivalent circuit - Voltage regulation, Regulation curve, Losses, Efficiency, All Day efficiency – Parallel operation.

Unit V

TESTS ON TRANSFORMER: Phasing out, Polarity and Voltage ratio tests – Open circuit and Short circuit tests,Sumpner's test, Separation of losses, Condition Monitoring of Transformers – Parallel operation, Auto transformer – Principle of operation – Saving of copper – Phasor diagram – Equivalent circuit – comparison with two winding transformer.

Text Books

1. Kothari D.P., Nagrath I.J., "Electric Machines", Tata McGraw- Hill Education India Private Limited, New Delhi, 4th Edition, 2010.
2. Arthur Eugene Fitzgerald, Charles Kingsley Jr, Stephen D. Umans , " Electric Machinery", Mc Graw – Hill Professional Series , New York, 6th Edition, 2002.

Reference Books

1. Murugesh Kumar, K., "DC Machines and Transformers", Vikas Publishing House Private Limited., New Delhi, 2nd Edition, 2004.
2. Cotton, H., "Advanced Electrical Technology", A.H Wheeler and Company Publications, London, 1990.
3. Gupta, B.R., Vandana, Singhal, "Fundamentals of Electrical Machines", New Age International Publishers Limited, 1996.
4. Sen, P.C., "Principles of Electrical Machines and Power Electronics" John Wiley &Sons, Incorporation, Singapore, 2nd Edition, 1997

12EE208 DC MACHINES AND TRANSFORMERS LABORATORY

Credits 0:0:2

1. Load characteristics of a Separately Excited DC Generator.
2. Load characteristics of DC Shunt Generator
3. Load characteristics of DC Compound Generator
4. Load test on DC Shunt Motor
5. Load test on DC Series Motor
6. Speed control of DC Shunt Motor
7. Electric Braking of DC Shunt Motor
8. Swinburne's Test
9. Load test on Single Phase Transformer
10. Open circuit and Short circuit test on Single Phase Transformer
11. Sumpner's Test on a Single Phase Transformer.
12. Three Phase Transformer Connections.

12EE209 INDUCTION AND SYNCHRONOUS MACHINES

Credits 3:1:0

Course Objective

- To learn the basic concepts about the different types of induction and synchronous machines.
- To understand the speed control and the starter operations.
- To acquire knowledge on two reaction theory.

Course Outcome

- Knowledge of selecting the suitable motor for an application and implement suitable control techniques for the selected motor.
- Ability to identify the various operation conditions of Synchronous motor and its impact.
- Ability to understand the importance of various parameter while synchronization.

Unit I

THREE-PHASE INDUCTION MOTORS: Principle of Operation – Construction and types of Rotor – Torque equation – Torque-Slip characteristics – Maximum torque – Equivalent circuit – Phasor diagram – Circle diagram - Starters – Speed control – Crawling and Cogging – Electrical Braking – Double Cage Rotors – Induction Generators.

Unit II

FRACTIONAL KILOWATT MOTORS: Principle of operation – Double revolving field theory – Equivalent circuit – Performance calculations – Methods of self starting – Types of Single Phase Induction Motor – Stepper Motor – Universal Motor – Synchronous Reluctance Motor – Hysteresis Motor.

Unit III

SYNCHRONOUS MACHINES: Types - Constructional features – 3-phase windings – Winding factors – EMF equation – Armature reaction – Voltage regulation – Predetermination of regulation by Synchronous Impedance – Ampere Turn and Potier reactance methods, Load characteristics – Power expression – Parallel operation – Synchronizing Current and Synchronizing power – Active and Reactive power sharing – Alternator on infinite Bus bar.

Unit IV

SYNCHRONOUS MACHINES: Synchronizing and synchronizing power – parallel operation – alternators on infinite busbars – two reaction theory of analyzing salient pole synchronous machines – Phasor diagrams – Voltage regulation – Power / Power angle relation – Determination of X_d and X_q.

Unit V

SYNCHRONOUS MOTORS: Principle of operation – Methods of starting – Phasor diagrams – V-curves and Inverted V-curves - Power/Power-angle relations – Synchronous Condensers – Hunting and methods of Suppression.

Text Books

1. Kothari D.P., Nagrath I.J., “Electrical Machines”, Tata McGraw- Hill Education India Private Limited, New Delhi, 3rd Edition, 2004.
2. Murugesh Kumar, K, “Induction and Synchronous Machines”, Vikas Publishing House Limited, New Delhi, 4th Reprint, 2009.

Reference Books

1. Arthur Eugene Fitzgerald, Charles Kingsley, Stephen D. Umans , “ Electric Machinery”, Mc Graw Hill Professional Series , New York, 6th Edition, 2002.
2. Alexander, S. Langsdorf., “Theory of Alternating Current Machinery”, Tata McGraw-Hill Education India Private Limited, New Delhi, 2nd Edition, 2009.
3. Gupta, B.R., Vandana, Singhal, “Fundamentals of Electric Machines”, New Age International Publishers Limited, New Delhi, 2nd Edition, 2002.

12EE210 AC MACHINES AND CONTROLS LABORATORY

Credits 0:0:2

1. Load test on Three Phase Squirrel Cage Induction Motor.
2. Load test on an Alternator.
3. No load and blocked rotor Test on Three Phase Squirrel Cage Induction Motor.
4. Speed control of Three Phase Wound Rotor Induction Motor.
5. Load test on Single Phase Induction Motor.
6. Voltage Regulation of Alternator by MMF method.
7. V and Inverted V Curves of Three-Phase Synchronous Motor.
8. Operation of Alternator on infinite bus bar.
9. Voltage regulation of three phase alternator using slip test.
10. Transfer function of Separately Excited DC Generator.
11. Transfer function & Frequency Response analysis of an Armature Controlled DC Motor.
12. Transfer function & Frequency Response analysis of a Field Controlled DC Motor.
13. Determination & Operation on Optimal Voltage for Maximum Efficiency in Induction Motor.

12EE211 ELECTRICAL MACHINE DESIGN

Credits 3:1:0

Course Objective

- Knowledge on the design aspects of Electrical Machines.
- Have a good understating on the design and application of DC and AC machine.
- Knowledge of basic design concepts and cooling arrangement of transformer.

Course Outcome

- To demonstrate the magnetic circuit and electric circuit’s aspects of any machine.
- To design the DC and AC machine for any specification given.
- To design the transformer and its cooling tubes for the speciation given.

Unit I

GENERAL ASPECTS: Major considerations – Limitations - Main dimension**-** Output equation - Choice of specific electric and magnetic loadings - Separation of D and L for rotating machines. MMF for air gap - Effects of slots, ventilating ducts and saliency - MMF for teeth –Total MMF calculation - Leakage reactance, Estimation of number of conductors / turns - Coils - Slots - Conductor dimension - Slot dimension.

Unit II

DC MACHINES: Choice of number of poles - Length of Air gap - Design of field system, Inter poles, Commutator and Brushes.

Unit III

TRANSFORMERS: Classification – output equation - Core section - Window dimensions - Yoke dimension - Overall dimension - No load current calculation – Temperature rise of Transformers- Design of tanks and cooling tubes.

Unit IV

INDUCTION MACHINES: Length of air gap - Cage rotor - End ring current - Wound rotor - Dispersion coefficient - No-load current calculation - Stator and rotor resistance - Losses and efficiency.

Unit V

SYNCHRONOUS MACHINES: Short circuit ratio – Air gap length –Salient pole machine - Design of field winding- Turbo-alternator – Damper winding.

Text Book

1. Sawhney, A.K., “A Course in Electrical Machine Design”, Dhanpat Rai & Sons Publishing Company Private Limited, New Delhi, 6th Reprint, 2006.

Reference Books

1. Bhattacharya, S.K, “Electrical Machines”, Tata McGraw- Hill Education India Private Limited, New Delhi, 2nd Edition, 1998.
2. Albert E. Clayton and Hancock,N.N, “The performance and Design of Direct Current Machines”, Oxford & IBH Publishing Private Limited., New Delhi, 1990.
3. Say, M.G., “Alternating Current Machines”, ELBS & Pitman, London, 5th Edition, 1992.
4. Rai, H.M., “Principles of Electrical Machine Design”, Sathyaprakashan Publications, New Delhi, 4th Edition, 1995.
5. Shanmugasundaram A., “Electrical Machine Design Data Book”, Wiley Eastern Ltd, 1989.

12EE212 POWER ELECTRONICS

Credits: 3:0:0

Course Objective

- Study the Static and Dynamic characteristics of Power Semiconductor Devices.
- Understand the operation of power electronic converters and its control strategies of various power converters.
- Study the design parameters for control circuitry requirement of various converters.

Course Outcome

- Usage of electronics and solid-state power devices for the control, conversion, and protection of electrical energy.
- Ability to design criteria (power, efficiency, ripple voltage and current, harmonic distortions, power factor).
- Ability to components; interpret terminal characteristics of the components for designing the circuitry for power converters.

Unit I

POWER SEMICONDUCTOR DEVICES: Introduction – Power Diodes – Power Transistors – Power MOSFETs – IGBTs –Thyristor family : SCRs, TRIACS, GTOs and IGCT – Static and Dynamic characteristics – Protection circuits – Series and parallel connections, MCT.

Unit II

AC TO DC CONVERTERS: Controlled rectifiers: Analysis of Single Phase and Three Phase Half Wave converters with R, RL Load - Estimation of average load voltage and average load current – Single Phase Half controlled and Fully Controlled Bridge Converters – Estimation of average load voltage and load current for continuous current operation – Input power factor estimation for ripple free load current – Three phase Half and Fully Controlled Converters (no analysis) – Dual Converters.

Unit III

AC TO AC AND DC TO DC CONVERTERS: AC to AC Converter: Single Phase Full Wave controller with R and RL load – Estimation of RMS load voltage, RMS load current and input power factor – Three phase AC voltage controllers (No analysis) – Single phase to Single phase Cyclo-converters – DC TO DC Converter**:** Principle of step up and step down operation – Single quadrant DC chopper with R, RL and RLE load – Time ratio control – Estimation of average load voltage and load current for Continuous current operation – Two Quadrant and Four Quadrant DC choppers.

Unit IV

DC TO AC CONVERTERS: Types – Voltage source and Current source inverters – Single phase bridge inverters – Three phase bridge inverters – Control of AC output voltage – Harmonic reduction – Single phase Series Inverters.

Unit V

CONTROL CIRCUITS & APPLICATIONS: Functional requirements of the switching control circuits – Generation of control signals for single phase AC to DC converters – Cosine wave crossing control, Ramp comparator approach. Generation of timing pulses for DC choppers – PWM techniques for DC to AC converters – Introduction to power converter control using Microprocessors, Microcontrollers and DSP – Applications: Motor drive applications: DC Motor Drives using Phase Controlled Thyristor Converters and DC Choppers – AC voltage controller and inverter fed induction motor drives – UPS –HVDC systems – Tap changing of Transformers.

Text Books

1. Rashid, M.H., "Power Electronics – Circuits, Devices and Applications", Pearson Education India Series Private Limited, New Delhi, 3rd Edition, 2003.

2. Mohan, Ned. et.al, "Power Electronics Converters, Applications and Design", Wiley India Private Limited, New Delhi, 3rd Edition 2007.

Reference Books

1. Philip T. Krein, "Elements of Power Electronics", Oxford University Press Incorporation, New York, 2008.
2. Joseph Vithayathil, "Power Electronics: Principles and Applications", McGraw Hill Education India, New Delhi, 2010.
3. Umanand L., "Power Electronics: Essentials & Applications", Wiley India Private Limited, New Delhi, 2009.
4. Jayant Baliga B., "Fundamentals of Power Semiconductor Devices", Springer-Verlag Publication, New Delhi, 1st Edition, 2008.

12EE213 POWER ELECTRONICS LABORATORY

Credits 0:0:2

1. Characteristics of MOSFET, IGBT, SCR and TRIAC
2. Single Phase Full Converter Bridge Rectifier with R & R – L Load
3. Single Phase Semi Converter Bridge Rectifier with R & R – L Load
4. Three Phase Half wave Converter with R & R – L Load
5. D.C. Chopper with Motor Load
6. Single Phase A.C. Voltage Controller with R & R – L Load
7. Single Phase Cycloconverter with R & R – L Load
8. Single Phase Series Inverter with R & R – L Load
9. Switched Mode P:ower Supply
10. Static Inverter with Three Phase Induction Motor Load
11. Simulation of Power Electronic Circuits using MATLAB/Simulink
12. Simulation of Power Electronic Circuits using PSIM

12EE214 ELECTRIC DRIVES AND CONTROL

Credits: 3:0:0

Course Objective

- Understand the classification and characteristics of Drives.
- Analyze the various types and operations of DC & AC Drives.
- Analyze the operation of Special Machine Drives.

Course Outcome

- Understand the dynamics of Electrical drive systems.
- Select suitable motor depending upon the loading.
- Select suitable converters and their controls for drive applications.

Unit I

INTRODUCTION AND DYNAMICS OF ELECTRIC DRIVES: Electric Drives – types – Parts – Choice of Electric drive – Advantages – status of DC and AC drives – fundamental torque equation – speed- torque conventions and multi quadrant operation – equivalent values of drive parameters – components of load torque – nature and classification of load torque – calculation of time and energy-loss in transient operation – steady state stability – load equalization.

Unit II

CONTROL OF ELECTRIC DRIVES AND SELECTION OF MOTOR RATING: Modes of operation – closed loop control of drives: current limit control – torque control – speed control – speed control of multi motor drives – PLL control – position control – Thermal model of motor for heating and cooling-classes of motor duty – determination of motor rating.

Unit III

DC MOTOR DRIVES: DC motors and its performance – starting – Braking – speed control – Methods of armature voltage control – controlled rectifier fed DC drives – single phase fully controlled rectifier control of DC separately excited motor – Three phase fully controlled rectifier control of DC separately excited motor – Multi quadrant operation of DC separately excited motor fed from fully controlled rectifier – chopper controlled DC drives-chopper control of separately excited DC motor – Chopper control of series motor.

Unit IV

INDUCTION MOTOR DRIVES: Induction motor and their performance – starting – braking – speed control – stator voltage control – variable frequency control from voltage sources – VSI control – CSI control – rotor resistance control – slip power recovery – variable speed constant frequency generation.

Unit V

STEPPER MOTOR, SYNCHRONOUS MOTOR(SM), SOLAR AND BATTERY POWERED DRIVES: Synchronous motor and their performance – Synchronous motor variable speed drives – variable frequency control of multiple SM – self controlled SM drive employing load commutated thyristor inverter – self controlled SM drive employing a cycloconverter – sinusoidal PMAC motor drives – Brushless DC motor Drives – Stepper motor: variable reluctance, permanent magnet, important features of stepper motor, torque Vs Stepping rate characteristics -solar powered pump drives-battery powered vehicles.

Text Books

1. Dubey, G.K., “Fundamentals of Electrical Drives”, Narosa Publishing House, 2nd Edition, New Delhi, 2006.
2. Bose, B.K., “Modern Power Electronics and AC Drives", Prentice Hall of India, Private Limited, 1st Edition, New Delhi, 2009.

Reference Books

1. Ion Boldea, Nasar S. A., “Electric Drives”, C.R.C Press, New York, 2nd Edition, 2005.
2. Krishnan R, “Electric Motor Drives: Modeling, Analysis and Control”, Prentice Hall of India Private Limited, 1st Edition, New Delhi, 2009.
3. Vedam Subramanyam, “Electric Drives: Concepts and Applications”, Tata McGraw- Hill Education India Private Limited, New Delhi, 2nd Edition, 2010.
4. Mohamed A. El-sharkawi, Mohamed A. El, “Fundamentals of Electric Drives”, Cengage Engineering (Publisher), Washington DC, 1st Edition, 2009.

12EE215 GENERATION, TRANSMISSION AND DISTRIBUTION

Credits 3:1:0

Course Objective

- Understand the concepts of various methods Electrical Energy Generation.
- Learn the usage of passive elements in various Power Transmission Systems.
- Understand the factors affecting Insulators and calculate the various parameters in Distribution System.

Course Outcome

- Ability to analyze the performance of various units involved in the power plants.
- Ability to design a power system solution based on the problem requirements and realistic Constraints.
- Ability to develop a major design experience in power a system that prepares them for engineering practice.

Unit I

POWER GENERATION: Generation, Transmission & Distribution Scenario of India - Types of generation: Conventional and Non-conventional, Thermal Power Plant, Hydro Power Plant, Gas Power Plant, Nuclear Power Plant, Non-conventional Energy Sources - Load capacity factor - Connected load factor - Load duration curve - Selection of units.

Unit II

POWER TRANSMISSION SYSTEMS: Various systems of transmission – Advantages of high transmission voltages - Comparison of conductor materials required for various overhead systems - Overhead Lines Parameters : Electrical constants - Resistance, Inductance and capacitance of Single and Three Phase lines - Effects of earth on capacitance - Skin effect - Proximity effect - Transposition - Bundled conductors - Line supports-Performance: Short and Medium transmission lines - Phasor diagrams - Nominal T and π methods - Line regulation - Efficiency. Rigorous solution for long line - ABCD constants - Ferranti effect - Tuned power lines - Surge impedance and surge impedance loading.

Unit III

LINE INSULATORS: Types – Potential distribution over a string of suspension insulators - Methods of increasing string efficiency - Corona – Factors affecting corona - Stress and Sag Calculation – Effect of wind and ice - supports at different levels – Stringing chart.

Unit IV

UNDERGROUND CABLES : Types - Capacitance and insulation resistance - Sheath effects - Grading - Stresses - Loss angle - Breakdown voltage - Optimum cable length – location of faults in cables – Comparison between Overhead lines and Underground cables.

Unit V

DISTRIBUTION SYSTEMS: Feeders, Distributors and Service mains - Radial and ring main systems - Calculation of voltage in distributors with concentrated and distributed loads, A.C. single phase and three phase distribution systems.

Text Books

1. Mehta, V.K., Rohit Mehta, “Principles of Power Systems”, S.Chand & Company Private Limited, New Delhi, 14th Edition, 2005.

2. Singh S.N, "Electric Power Generation, Transmission and Distribution", PHI Learning Private Limited, New Delhi, 2nd Edition, 2009.

References Books

1. Soni, M.L., Gupta, P.V., Bhatnagar U.S. Chakrabarthi A., "A Text Book on Power System Engineering", Dhanpat Rai & Sons Company Private Limited, New Delhi, 2008.
2. Uppal, S.L., "Electrical Power", Khanna Publishers Limited, New Delhi, 13th Edition, 2002.
3. Wadhwa, C.L., "Electrical Power Systems", New Age International Publishers Ltd., New Delhi, 6th Edition, 2010.
4. Weedy B.M., Cory B.J., "Electric Power Systems", John Wiley & Sons Limited, England, 4th Edition, 2009.

12EE216 POWER SYSTEM ANALYSIS

Credits: 3:0:0

Course Objective

- Develop understanding of the basic concepts of load flow, economic dispatch, fault analysis, and transient stability.
- Apply this knowledge to model and predict system behavior.
- Apply this knowledge to design power transmission and distribution systems to meet needs.

Course Outcome

- Demonstrate the ability to model power systems.
- Analyze the impact of short-circuit faults on the power network and make design changes to the network to control the fault currents.
- Understand the dynamic principle of power systems and generators.

Unit I

INTRODUCTION: Need for System analysis in planning and operation of power system- One line diagram- Per unit representation - Symmetrical components - Short circuits analysis for fault on machine terminals.

Unit II

SHORT CIRCUIT STUDIES: Primitive network and its representation – bus incidence matrix – Formation of Bus admittance matrix – bus impedance matrices. Types of faults - Algorithms for fault calculations - Sequence Impedance matrices - Symmetrical and Unsymmetrical fault analysis using Z_{bus}.

Unit III

LOAD FLOW STUDIES: Formulation of load flow problem - bus classification – Solution by Gauss - Seidal, Newton - Raphson and Fast decoupled methods - Comparison -. Computation of slack bus power, transmission loss and line flow.

Unit IV

ECONOMICAL OPERATION OF GENERATING STATIONS: Optimal operation of generators – Economical scheduling of thermal plant with and without transmission losses –

Loss formula derivation- Unit commitment – Elementary idea of optimal load scheduling of Hydro - Thermal plants.

Unit V

STABILITY STUDIES & POWER QUALITY ANALYSIS: Steady state and Transient stability - Swing equation and its solution by Modified Euler and Runge- Kutta methods- Equal area criterion Power Quality Analysis: Sags and swells - voltage sag - voltage swell – voltage imbalance -voltage fluctuation - power frequency variations. International standards of power quality

Text Books

1. Hadi Saadat, "Power System Analysis", Tata McGraw-Hill Education India Private Limited, New Delhi, 2002, 11th Reprint 2007.
2. Gupta, B.R., "Power System Analysis and Design", S.Chand & Company Limited, New Delhi, 2005.

Reference Books

1. Weedy B.M., Cory B.J., "Electric Power Systems", John Wiley & Sons Limited, England, 4th Edition, November 2001.
2. Wadhwa C. L., "Electrical Power Systems", New Age International Private Limited, New Delhi, 6th Edition, 2010.
3. Nagsarkar T.K., Sukhija M.S., "Power system Analysis" Oxford University Press, London, 2007.
4. Sankaran C., "Power Quality", C.R.C Press, New York, 2001.

12EE217 COMPUTER AIDED POWER SYSTEMS ANALYSIS LABORATORY

Credits 0:0:2

1. Formation of Y_{bus} Matrix using Direct Inspection Method
2. Formation of Y_{bus} Matrix using Singular Transformation Method
3. Load Flow Analysis by Newton- Raphson Method
4. Load Flow Analysis by FDLF method
5. Automatic Load Frequency Control
6. Automatic Voltage Regulator
7. Z_{bus} Formation using building algorithm
8. Analysis of Symmetrical Faults
9. Economic Load Dispatch
10. Transient Stability Analysis of Single Machine Infinite Bus Bar (SMIB)
11. Harmonic Analysis of simple electrical circuit using MATLAB-SIMULINK
12. Speed Control of DC motor using MATLAB-SIMULINK

12EE218 POWER SYSTEM PROTECTION AND SWITCHGEARS

Credits 3:0:0

Course Objective

- To discuss the causes of abnormal operating conditions (faults, lightning and switching surges) of the apparatus and system.
- To understand the characteristics and functions of relays and protection schemes.
- To understand the problems associated with circuit interruption by a circuit breaker.

Course Outcome

- Choose the appropriate relay for the application.
- Design Protective schemes for various Electrical apparatus.
- Analyze the testing of circuit breakers.

Unit I

INTRODUCTION& PROTECTIVE RELAYS: Principles and need for protective schemes – Nature and cause of faults – types of fault –per unit representation – Analysis of Symmetrical fault – Current limiting reactors. Relays – Definition – Requirement of relays – Universal torque equation – Non directional and directional over current relays – Earth fault relays – Distance relays – Impedance, Mho and Reactance relays – Differential relays – Negative sequence relays - Pilot (Translay) relay – Carrier and Microwave pilot relays – Under frequency relays - Testing of relays – relay Coordination – Introduction to static relays - Microprocessor and computer based protective relaying

Unit II

APPARATUS & LINE PROTECTION: Apparatus and Line Protection: Alternator, transformer, Busbar and motor protection using relays – Feeder Protection – radial and ring main system. Microprocessor based protective schemes.

Unit III

CIRCUIT BREAKERS: Functions of switchgear - Elementary principles of arc extinction - Arc control devices -Recovery voltage and restriking voltage - current chopping and capacitance current breaking - Bulk oil, low oil, air break, air blast, and sulphur hexafluoride and vacuum circuit breakers - HVDC breakers - Rating - Testing of circuit breakers – Testing and Commissioning of Electrical Equipments.

Unit IV

SURGE AND SURGE PROTECTION: Switching surges - Lightning phenomenon – Traveling waves on transmission lines -Over voltage due to lightning - Protections against lightning - Lightning arresters – Types - Lightning arrester selection - Surge absorbers.

Unit V

EARTHING AND INSULATION CO-ORDINATION: Solid, resistance and reactance Earthing - Arc suppression coil - Earthing transformers –Earth wires - Earthing of appliances- Insulation co-ordination: Definition – Determination of line insulation - Insulation levels of sub-station equipment - Co-ordination amongst items of substation equipment - Introduction to Indian Electricity rules.

Text Books

1. Bhuvanesh A Oza, Nirmal Kumar C Nair, Rashesh P Mehta and Vijay H Makwana., "Power System Protection and Switchgear", Tata McGraw- Hill Education India Private Limited, New Delhi. 2010.
2. Badri Ram, Vishwakarma D N., "Power System Protection and Switchgear", Tata McGraw- Hill Education India Private Limited, New Delhi, 22nd Reprint, 2007.

Reference Books

1. Paithankar Y. G., Bhide S. R., "Fundamentals of Power System Protection", Prentice Hall of India Limited, New Delhi, 2003.
2. Soni, M.L., Gupta, P.V., Bhatnagar, U.S. and Chakrabarti, A., "A Text Book on Power Systems Engineering", Dhanpat Rai & Sons Company Limited, New Delhi, 2003.
3. Sunil, S.Rao, "Switchgear Protection and Power Systems", Khanna Publishers Limited, New Delhi, 12th Edition, 2008.

12EE219 CONTROL SYSTEMS

Credits 3:1:0

Course Objective

- Understand the methods of representation of systems and getting their transfer function models.
- Impart adequate knowledge in the time response of systems and steady state error analysis.
- Impart basic knowledge about the frequency response and stability of a closed loop system.

Course Outcome

- Have a sound knowledge in the basic concepts of control theory
- Design closed loop system projects.
- Work out the practical problems by using state variable analysis.

Unit I

INTRODUCTION: Open loop and Closed loop systems – Examples, Control system components. Transfer function of physical systems– Mechanical systems, Translational and Rotational systems, Electrical network. Transfer function of DC Generator, DC servomotor, AC servomotor, Synchros, Transfer function of overall systems. Impulse Transfer function. Block diagram - reduction techniques. Signal flow graphs – Mason's gain formula.

Unit II

TIME RESPONSE ANALYSIS: Standard Test signals – Time response of zero, first and second order system, Performance criteria, Type of systems. Steady state error constants – position, velocity and acceleration error constants. Generalized error series – Feedback characteristics of control systems. Controllers – P, PI and PID control modes, tuning of PID controller-Ziegler-Nichols method.

Unit III

FREQUENCY RESPONSE ANALYSIS: Frequency domain specifications – peak resonance, resonant frequency, bandwidth and cut-off rate, correlation between time and frequency responses for second order systems. Polar plot, Bode plot – Gain Margin and Phase Margin.

Unit IV

STABILITY OF SYSTEMS: Characteristic equation – Location of roots of characteristic equation – Absolute stability and Relative stability. Routh Hurwitz criterion of stability – Necessary and sufficient conditions. Nyquist Stability- Principle of argument – Nyquist path – Nyquist stability criterion – Determination of Nyquist stability – Assessment of relative stability. Bode Plot – Assessment of stability. Root locus concept, Rules for construction of root loci, problems, stability analysis.

Unit V

STATE VARIABLE ANALYSIS: Introduction to state space analysis – Physical variable, Phase variable and Canonical variables forms - Transfer function from state space representation - controllability - observability.

Text Books

1. Gopal M., "Control Systems – Principles and Design", Tata McGraw- Hill Education India Private Limited, New Delhi, 2002.
2. Ogata K., "Modern Control Engineering", Prentice Hall of India Private Limited., New Delhi, 4^{th} Edition, 2002.

References Books

1. Nagrath I.J, & Gopal M, "Control System Engineering", New Age International Publishers Limited, New Delhi, 5^{th} Edition, 2007
2. Benjamin C. Kuo, "Automatic Control Systems", John Wiley & Sons Incorporation, New Jersey, 8^{th} Edition, 2003.
3. Norman S.Nise, "Control System Engineering", John Wiley & Sons Incorporation, New Jersey, 8th Edition, 2007.
4. Manke.B.S**,** "Linear Control Systems With Matlab Applications", Khanna Publishers Limited, New Delhi,2009

12EE220 DIGITAL ELECTRONICS

Credits 3:1:0

Course Objective

- To introduce the concepts of Boolean algebra.
- To make them familiar with the implementation of combinational logic functions.
- To make them understand about the working of counters and flip flops.

Course Outcome

- Apply Boolean Algebra & K –Map To Digital Circuits.
- Design Combinational and Sequential Circuits.
- Design the Logic Circuits to Specific Applications.

Unit I

NUMBER SYSTEMS AND BOOLEAN ALGEBRA: Review of Binary, Octal & Hexadecimal number Systems-representation of signed Numbers, floating point number representation-BCD-ASCII-EBCDIC-Excess 3 codes, gray Code-error detecting & correcting codes. Boolean algebra: Postulates & theorems of Boolean algebra –canonical forms – simplification of Logic Functions using Karnaugh map, Quine Mcclausky method.

Unit II

COMBINATIONAL LOGIC DESIGN: Logic gates –implementation of combinational logic functions – encoders & decoders –multiplexers & demultiplexers –code converters – comparator - half adder, full adder –parallel adder – binary adder – parity generator/checker – implementation of logical functions using multiplexers.

Unit III
SEQUENTIAL LOGIC DESIGN-I : RS, JK, JK Master– Slave, D&T Flip Flops – level triggering and edge triggering –excitation tables –Asynchronous & Synchronous counters – modulus counters–shift register –Johnson counter- Ring counter – timing waveforms-counter applications.

Unit IV
SEQUENTIAL LOGIC DESIGN-II: Basic models of sequential machines – concept of state table – state diagram – state reduction through partitioning & implementation of synchronous sequential circuits – Introduction to asynchronous sequential logic design.

Unit V
PROGRAMMABLE LOGIC DEVICES: Semicustom design – Introduction to PLD's – ROM – PAL – PLA – FPGA – Architecture of PLD's: PAL 22V10, PLS 100/101 – Implementation of digital functions.
LOGIC FAMILIES: RTL, DTL, TTL families, Schottky – clamped TTL, Emitter Coupled Logic (ECL), Integrated Injection Logic (IIL), MOS inverters, CMOS inverters, Comparison of performance of various logic families.

Text Books

1. Morris Mano M., "Digital Electronics", Prentice Hall PTR, New Jersey, 3rd Edition, 2001.
2. Thomas L. Floyd, "Digital Fundamentals", Prentice Hall Higher Education Series, New Delhi, 10th Edition 2007.

Reference Books

1. Tocci.R.J., "Digital Systems – Principles & Applications", Prentice Hall India, New Delhi,10th Edition , 2008.
2. Fletcher.W.I, "An Engineering Approach to Digital Design", Prentice Hall India, New Delhi, 2007.
3. Morris Mano M., "Digital Logic & Computer Design", Prentice Hall India, New Delhi, 2007

12EE221 LINEAR INTEGRATED CIRCUITS

Credits 3:0:0
Course Objective
Students will be able to

- Understand the functionality of various linear integrated circuits.
- Understand the usage of different linear ICs for different applications.
- Acquire a good knowledge in designing the circuits.

Course outcome

- Understand the linear ICs and its various modes of operation.
- Utilize and Construct various applications using the linear ICs.

- Design suitable voltage regulation with protection circuit.

Unit I

OPERATIONAL AMPLIFIER CHARACTERISTICS: Functional Block Diagram – Symbol, Characteristics of an Ideal Operational Amplifier, Circuit schematic of µA 741, Open loop gain, CMRR-input bias and offset currents, input and output offset voltages, offset compensation techniques. Frequency response characteristics – stability, limitations, frequency compensation, slew rate.

Unit II

LINEAR APPLICATIONS OF OPERATIONAL AMPLIFIERS: Inverting and Non-inverting amplifiers – Voltage follower, Summing amplifier, Differential amplifier, Instrumentation amplifier. Integrator and Differentiator – Practical considerations. Voltage to Current and Current to Voltage converters, Phase changers. Sinusoidal oscillators. Active filters – Design of Low pass, High pass, Wide band pass and Band stop Butterworth filters, Narrow band pass and Notch filters.

Unit III

NONLINEAR APPLICATIONS OF OPERATIONAL AMPLIFIERS: Comparator – Regenerative comparator, Zero crossing detector, Sample and hold circuit, Precision diode, Half and Full wave rectifiers, Active peak detector, Clipper and Clamper, Logarithmic and Exponential amplifiers, Multiplier and Divider, Square and Triangular waveform generators.

Unit IV

IC VOLTAGE REGULATORS & SPECIAL FUNCTION ICS: IC Voltage Regulators - Fixed and adjustable three terminal regulators - Block diagram of 723 General purpose voltage regulators – Circuit configurations, Current limiting schemes, Output current boosting, Switching regulators.

SPECIAL FUNCTION ICs: 555 Timer Functional block diagram and description – Monostable and Astable operation, Applications, IC566 Voltage Controlled Oscillator, Analog Multiplier, Comparator ICs,

Unit V

PLL, A-D AND D-A CONVERTERS: PLL Functional Block diagram – Principle of operation, Building blocks of PLL, Characteristics, Applications: Frequency synthesis, AM detection, DC Motor speed control.

DIGITAL TO ANALOG CONVERTERS: Binary weighted and R-2R Ladder types – Analog to digital converters: Continuous, Counter ramp, Successive approximation, Single slope, Dual slope and Parallel types – DAC/ADC performance characteristics.

Text Books

1. Sedra, Smith, "Microelectronic Circuits", Oxford University Press, London, 5th Edition, 2004.
2. Roy Choudhury, Shail Jain, "Linear Integrated Circuits", New Age International Limited, 4th Edition, 2011.

Reference Books

1. Gayakwad, A.R., "OP-Amps and Linear Integrated circuits", Pearson Education India Series, New Delhi, 4th Edition, 2004

2. Coughlin, F.R., and Driscoll, F.F., “Operational Amplifiers and Linear Integrated Circuits”, Prentice Hall of India, New Delhi, 4th Edition, 1997.
3. David A Bell, “Operational Amplifiers and Linear ICs”, Prentice Hall of India, New Delhi, 3rd Edition, 2003.

12EE222 LINEAR AND DIGITAL IC LABORATORY

Credits 0:0:2

1. Performance characteristics of Op-amp IC
2. Instrumentation amplifier using Op-amp ICs.
3. Maximally flat active filter using Op-amp IC.
4. Precision full wave and half wave rectifier, using Op-amp IC.
5. Wien’s bridge oscillator using Op-amp IC.
6. Astable multivibrator and Schmitt trigger, using Op-amp IC
7. Realization of different flip-flops, using logic gates.
8. Realization of simple switching functions, using NAND or NOR gates.
9. Half adder, Full adder, Half subtractor and Full subtractor using logic gates.
10. Shift register and Ring counter
11. Multiplexer and Demultiplexer
12. Digital to Analog converter

12EE223 MICROPROCESSORS AND MICROCONTROLLERS

Credits 3:1:0

Course Objective:
- To learn the basic 8085 Microprocessor architecture, working and programming.
- To understand the operation of 8051 Microcontroller.
- To accumulate the knowledge about PIC Microcontroller.

Course Outcome
- Knowledge about the processing of microcontroller and microprocessor.
- Able to use it for real time applications.
- Clear idea about PIC Microcontroller.

Unit I
ARCHITECTURE & PROGRAMMING OF 8085 MICROPROCESSOR: Functional Block Diagram – Registers, ALU, Bus systems – Timing and control signals- Programming of 8085: Instruction formats – Addressing modes – Instruction set – Need for Assembly language – Development of Assembly language programs – Machine cycles and Timing Diagram for Moving, Load and call Instruction.

Unit II
ARCHITECTURE OF 8051: Block diagram of Microcontroller – Comparison with Microprocessor and Microcontroller – Pin details of 8051 – ALU – Special function registers – ROM – RAM – RAM Memory Map (including registers and register banks) – Program Counter

– PSW register –Stack - I/O Ports – Timer Interrupt – Serial Port – External memory – Clock – Reset – Clock Cycle –Machine Cycle – Instruction cycle – Instruction fetching and execution.

Unit III

INSTRUCTION SET AND PROGRAMMING: Assembling and running an 8051 program – Instruction set of 8051 – Data transfer instructions – Different addressing modes – Arithmetic Instructions – Signed number concepts and arithmetic operations – Logic and Compare instructions – Rotate instruction and data serialization – BCD, ASCII – Loop and jump instructions – Call instructions – Time delay routines – Program control – Assembler directives – Sample programs.

Unit IV

I/O, TIMER, INTERRUPT AND SERIAL PROGRAMMING: Bit addresses for I/O and RAM – I/O programming – I/O bit manipulation programming – Programming 8051 Timers – Counter programming – Basics of Serial programming – 8051 connection to RS 232 – 8051 Serial Port Programming – 8051 interrupt – Programming Timer Interrupt – Programming external hardware interrupts – Programming the serial communication interrupt – Interrupt priority in 8051.

Unit V

INTERFACING EXTERNAL DEVICE WITH 8051: 8051 interfacing to external memory – 8051 interfacing with the 8255 – Sensors interfacing – Parallel ADC and Serial ADC interfacing – DAC interfacing - Keyboard interfacing – Seven segment and LCD display interfacing – Stepper Motor interfacing – DC motor interfacing and PWM .

Text Books

1. Mazidi and D.MacKinlay, "8051 Microcontroller and Embedded Systems using Assembly and C", Pearson Education Low Price Edition, New Delhi, 2006.
2. Krishna Kant," Microprocessors and Microcontrollers: Architecture, Programming and System Design 8085, 8086, 8051, 8096", PHI Learning Pvt Ltd, New Delhi, 1st Edition, 2010.

Reference Books

1. Myke Predko," Programming customizing the 8051 Microcontroller", Tata McGraw Hill Publications, New Delhi, 1st Edition 2007.
2. Crisp, "Introduction to Microprocessors and Microcontrollers", Elsevier/ Reed Elsevier India Pvt. Ltd, New Delhi, 2nd Edition, 2009.
3. Kenneth J. Ayala, "8051 Microcontroller", Cengage Learning, New Delhi, 3rd Edition, 2004.

12EE224 MICROPROCESSORS AND MICROCONTROLLERS LABORATORY

Credits: 0:0:2

1. Simple addition, Subtraction, Division and Multiplication of two 8-Bit numbers using INTEL 8085
2. Finding the maximum and minimum value in an array using INTEL 8085
3. Arranging the given data in Ascending, Descending order using INTEL 8085
4. BCD to HEX conversion and HEX to BCD conversion using INTEL 8085

5. HEX to ASCII and ASCII to Binary conversion using INTEL 8085
6. Interfacing ADC with 8085 Processor
7. Interfacing 8279 keyboard/ display controller with 8085 microprocessor
8. Simple addition and Subtraction of two 8-Bit numbers using 8051 Microcontroller
9. Multiplication and division of two 8-Bit numbers using 8051 Microcontroller
10. Stepper motor control using 8051 Microcontroller
11. DC Motor control using PIC Microcontroller
12. AC Power control using PIC Microcontroller

12EE225 DIGITAL SIGNAL PROCESSING

Credits 3:1:0

Course Objective

- To analyze signals and systems.
- To study various transformation techniques and filter design.
- To study about a programmable digital signal processor & quantization effects.

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Course Outcome

- Students will be able to select appropriate DSP processors for particular applications.
- Apply various transformation techniques for signal processing applications.
- Design filters for different real time applications.

Unit I

SIGNALS AND SYSTEMS: Classification of signals: continuous and discrete, energy and power; mathematical representation of signals; spectral density; sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect - Digital signal representation; Classification of systems: Continuous, discrete, linear, causal, stable, dynamic, recursive, time variance.

Unit II

DISCRETE TRANSFORMS: DFT properties, magnitude and phase representation - Computation of DFT using FFT algorithm – Decimation - in - time Algorithms(DIT), Decimation - in - frequency(DIF) Algorithms - Use of FFT in Linear Filtering – Introduction to wavelet transform.

Unit III

IIR FILTER DESIGN: Structures of IIR – Design of Analog filter(HPF, BPF, LPF) – Discrete time IIR filter from analog filter – IIR filter design by Impulse Invariance, Bilinear transformation, Approximation of derivatives – (HPF, BPF, BRF) filter design using frequency translation.

Unit IV

FIR FILTER DESIGN: Structures of FIR – Linear phase FIR filter – Filter design using windowing techniques, Frequency sampling techniques – Finite word length effects in digital Filters.

Unit V

APPLICATIONS: Multi-rate signal processing – Speech compression – Adaptive filter – Musical sound processing – Image enhancement - selecting digital signal processors - Introduction to Commercial Processors.

Text Books

1. Proakis J. G., and Manolakis D. G., 'Digital Signal Processing: Principles, Algorithms, and Applications', 4th Edition, Prentice-Hall, 2007.
2. Ramesh Babu P., 'Digital Signal Processing', Scitech Publications (India) Pvt. Ltd., New Delhi, 2010, 4th Edition.

Reference Books

1. Alan V. Oppenheim, Ronald W. Schafer and John R. Buck, 'Discrete – Time Signal Processing', Prentice Hall, New Delhi, 2010.
2. Mitra S.K., 'Digital Signal Processing – A Computer Based Approach', Tata McGraw - Hill Education India Private Limited, New Delhi, 4th Edition, 2011.
3. Steven W. Smith, "The Scientist and Engineer's Guide to Digital Signal Processing", California Technical Publishing San Diego, California, 2nd Edition, 2002.
4. Venkataramani B., Bhaskar M., 'Digital Signal Processors, Architecture, Programming and Applications', Tata McGraw- Hill Education India Private Limited, New Delhi, 2003.
5. Emmanuel C. Ifeachor, Barrie.W.Jervis, "Digital Signal Processing", Pearson Education / Prentice Hall, 2nd Edition, 2002.

12EE226 DIGITAL SIGNAL PROCESSING LABORATORY

Credits: 0:0:2

1. Generate basic Discrete Time Signal Waveform
2. Basic operations on signals and properties of discrete time systems
3. Convolution
4. Time and frequency response of DT system
5. Realization of transfer function
6. Compute Discrete Fourier Transform of given sequence
7. Spectrum Analysis
8. IIR filter design
9. FIR filter design
10. Signal Reconstruction
11. Perform Sampling rate conversion
12. Least Means Square algorithm

12EE227 C++ AND DATA STRUCTURES

Credits 3:0:0

Course Objective

- To study the basics of C++ programming.
- To know various programming methods in C++.
- To know the various applications using programming language.

Course Outcome

- Understand the fundamental concepts of C++ programming.
- Apply programming skills for various applications including electrical applications.
- To have analytical ability by quick programming.

Unit I

INTRODUCTION TO DATA STRUCTURES: Linked list, Single linked list, Doubly linked list, Circular Linked list, Stack, Queue.

Unit II

SORTING AND SEARCHING TECHNIQUES: Sorting-Bubble sort-Insertion Sort-Selection Sort-Quick Sort-Heap Sort-Merge Sort, Searching-Linear Search-Binary Search.

Unit III

INTRODUCTION TO C++: C++ fundamentals – data types, operators and expressions, control flow, arrays, strings, pointers and functions. A Simple class, C++ objects as physical objects, C++ Objects and Data types, Object as function argument, Constructors, as function argument, Overloaded Constructors, Copy Constructors, Returning objects from functions, structures and classes, Static class data, const and classes, Arrays and Strings.

Unit IV

OPERATOR OVERLOADING: Overloading Unary and Binary Operator, Inheritance: derived class and base class, derived class constructors, Overloading member functions, class hierarchies, public and private inheritance, level of inheritance, multiple inheritance. Pointers: address and pointers, pointers and arrays, pointer and c-type strings, pointers to pointer.

Unit V

VIRTUAL FUNCTIONS: Virtual functions, Friend functions, Static functions, this pointer. Streams and files: stream classes, stream errors, disk file I/O with streams, file pointers, error handling in file I/O. Templates and exception: function templates, class templates, exceptions.

Text Books

1. Robert Lafore, “Object Oriented Programming in C++”, BPB Publications, 3rd Edition, Pune, 2007.
2. Mark A. Weiss, “Data Structures and Algorithm Analysis in C++", Addison-Wesley, Boston, USA, 3rd Edition, 2007.

Reference Books

1. Balaguruswamy E., “Object-Oriented Programming with C++”, Tata McGraw- Hill Education India Private Limited, New Delhi, 2nd Edition, 2004.
2. Adam Drozdek, “Data Structures and Algorithms in C++”, Vikas Publishing House, New Delhi 2004.
3. Malik D.S., “Data Structures Using C++”, Cengage Learning, New Delhi, 1st Edition, 2003.

12EE228 C++ AND DATA STRUCTURES LABORATORY

Credits: 0:0:2

1. Basics of C++ Programming
2. Implementation of Classes and Objects
3. Implementation of Constructor and Destructor
4. Implementation of Overloading
5. Implementation of Inheritance
6. Illustration on Pointers
7. Implementation of Abstract Class and Virtual Functions
8. Implementation of Class Template
9. Implementation of Stack and Queue
10. Implementation of Linked List
11. Implementation of Searching Techniques
12. Implementation of Sorting Techniques

12EE229 MEASUREMENTS AND INSTRUMENTATION

Credits: 3:0:0

Course Objective

- Understand about the operation of an indicating instrument and use them for measurement of electrical quantities.
- Adequate knowledge of comparison methods of measurement.
- Exposure to various transducers and data acquisition system.

Course Outcome

- Knowledge of various measurement techniques available.
- Basic working of instruments used for measurement
- Errors in measurements and their rectifications.

Unit I

INTRODUCTION AND INDICATING INSTRUMENTS: Functional elements of an instrument – Static and dynamic characteristics – Errors in measurements. D'Arsonval Galvanometer- Moving iron: attraction and repulsion type instruments - Moving coil instruments- Permanent magnet moving coil instruments, Dynamometer type moving coil Instruments - Extension of ranges, use of shunts and Instrument Transformers.

Unit II

MEASUREMENT OF POWER AND ENERGY: Dynamometer type wattmeter. Energy meters- Calibration of energy meters- Measurement of power using Instrument Transformers- Maximum demand indicator, Power factor meter.

Unit III

MEASUREMENT OF R-L-C: Resistance measurement ,Kelvin double bridge- Wheatstone bridge- Measurement of inductance- Measurement of capacitance, Maxwell, Anderson, Hay's and Schering bridges -Measurement of Earth resistance.

Unit IV

MEASUREMENT OF NON-ELECTRICAL QUANTITIES: Measurement of displacement- Principle of operation of Resistance potentiometer- Inductive and capacitive transducers.Measurement of force and pressure-LVDT- Strain Gauge .Measurement of position- Piezo-electric transducers- Encoders. Hall Effect sensors - Measurement of Pressure- High Pressure and low pressure measurement- Measurement of Temperature- Resistance thermometers, thermistors and thermocouples – Thermography - Measurement of Speed - contact type. SMART sensors.

Unit V

DIGITAL METERS AND DISPLAY DEVICES: Electronic voltmeter- Digital voltmeters - Digital Multimeter – Watt meters – True RMS Meter – Spectrum Analyzer – Harmonic distortion analyzer – Digital CRO - LED – LCD.

Text Book

1. Sawhney, A.K., "A Course in Electrical & Electronic Measurement and Instrumentation", Dhanpat Rai & Company Private Limited, New Delhi, 18th Edition, 2007.

Reference Books

1. Helfrick A.D., "Modern Electronic Instrumentation & Measurements", Prentice Hall India Private Limited, New Delhi, 2007.
2. Doeblin,E.O., "Measurement Systems : Application And Design", Tata Mc-Graw-Hill Education India Private Limited , New Delhi, 5th Edition, 2004.
3. Golding,E.W., Widdis,F.C., "Electrical Measurements and Measuring Instruments", A H Wheeler & Company, Calcutta, 5th Edition, 2003.
4. Rangan,C.S., Sharma, G.R., Mani, V.S., "Instrumentation Devices and Systems", Tata McGraw- Hill Education India Private Company, New Delhi, 2nd Edition, 2002.

12EE230 MEASUREMENTS AND COMPUTER AIDED ELECTRICAL MACHINE DESIGN LAB

Credits 0:0:2

1. Measurement of Resistance using Wheatstone and Kelvin's bridge.
2. Measurement of Inductance using Hays and Anderson Bridge.
3. Measurement of Capacitance using Schering and Maxwell Bridge.
4. Calibration of voltmeter, Ammeter and Wattmeter.
5. Study of Resistive, Inductive and Capacitive Transducers.
6. Study of Thermo Electric Transducers
7. Design of D.C Machine armature (Open Slot) using AutoCAD
8. Drawing of field magnetic frame of a DC machine using AUTOCAD
9. Drawing of the commutator of a DC machine using AUTOCAD
10. Drawing of the stator of a three-phase motor using AUTOCAD
11. Drawing of squirrel cage rotor with fan using AUTOCAD
12. Drawing of one limb of a three phase oil cooled power transformer using AUTOCAD.

12EE231 MATERIAL SCIENCE

Credits 3:0:0

Course Objective

- To understand the concepts of Crystalls, Metals and Alloys.
- To realize the Qualitative study of various polarization.
- To impart knowledge on Advanced Materials.

Course Outcome

- Knowledge of different materials and their applications.
- Analyze and understand Qualitative study of various polarization
- Perform classification of insulating materials on temperature basis.

Unit I

CRYSTALLOGRAPHY, METALS AND ALLOYS: Crystallography: Crystal systems, Lattice parameters, Bravais lattice, packing factors of cubic and HCP crystal systems, Miller indices. Linear and planar density of atoms, Debye – Scherrer method of crystal structure. Crystal imperfections-points, line and surface defects and their role in electrical, mechanical and optical properties of materials.Metals and Alloys: Drude Lorentz theory of electrical conduction, Wiede mann Franzlaw, Band theory of solids. Applications of conductors, transmission lines, conducting materials, precision resistors

Unit II

SEMI-CONDUCTING MATERIALS: Elemental and Compound semiconductors, Intrinsic and Extrinsic semiconductors-Properties, carrier concentration in intrinsic semiconductors. Carrier concentration in n type and p type semiconductors, Material preparation – Czochralski's technique and zonerefining technique, Hall effect – Hall coefficient in extrinsic semiconductors,experimental determination of hall coefficient, Application of hall effect, Semiconductor devices –Solar cells and LCD.

Unit III

DIELECTRIC MATERIALS AND DEVICES: Qualitative study of various polarizations, Electric dipole moment determination, Effect of temperature and frequency on dielectric constant, Dielectric loss, Ferroelectric materials classification – $BaTiO_3$ and PZT-Piezoelectric materials, Applications of ferroelectric and piezoelectric materials, Breakdown mechanism.

Unit IV

MAGNETIC MATERIALS AND DEVICES: Ferro and Ferri magnetic materials – properties, Helesenberg and domain theory of ferromagnetism, Hystersis ferrite- structure and properties, Applications – floppy disks, CD ROM, Magnetic optical recording.

Unit V

ADVANCED MATERIALS: Nano phase materials - Synthesis techniques, properties, applications, Shape memory alloys-Characteristics, properties of NiTi alloy, applications in MEMs, Superconductivity, Types of superconductors – High Tc superconductors, Comparison with low Tc superconductors, Application of superconductors.

Text Books

1. William D Callister Jr., “Material Science and Engineering”, John Wiley and Son, New York 2007.
2. Bradley D. Fahlman, “Materials Chemistry”, Kindle Edition, 2008.

Reference Books

1. Jayakumar S, “Material Science”, R.K. Publishers, Coimbatore 2007
2. Palanisamy P K, “Material Science”, SCITECH Publications, Chennai 2002.
3. Srivatsava J.P, “Elements of Solid State Physics”, Prentice Hall of India, New Delhi, 2001

12EE232 ENERGY SYSTEMS

Credits: 3:0:0

Course Objective

- Impart knowledge about the various non conventional energy sources.
- Understand concept of illumination systems, heating and welding systems.
- Learn the requirements of traction systems.

Course Outcome

- Technological basis for harnessing these renewable energy sources including their possibilities and limitations.
- Determination of appropriate lighting control techniques and equipment to a sample project.
- Select the suitable drive for traction application.

Unit I

SOLAR ENERGY: Introduction to Energy Conservation – Energy conversation methods - Basic Theory of solar energy – Empirical equations for estimating solar radiation – Hourly global, Diffuse and Beam radiations on Horizontal surface under cloudless skies – solar radiation on Inclined plane surface – Solar Photovoltaic system – Theory of solar cell – Maximizing the solar PV output and Load Matching- Maximum power point tracker – Balance of system components – Solar PV systems and applications.

Unit II

WIND ENERGY: Origin & Nature of winds – Wind Turbine siting – Major applications of wind power – Wind Turbine Types and their Construction – wind turbine conversion system – Effects of wind speed and Grid condition – Wind energy storage – Environmental aspects – wind energy programme in India.

Unit III

BIOMASS, GEOTHERMAL ENERGY AND EMERGING TECHNOLOGIES: Photosynthesis process – Usable Forms of Biomass, their composition and fuel properties – Biomass Resources – Biomass conversion Technologies –Biomass energy programme in India – Geothermal energy – applications – Origin and Distribution – Types of resources – Geothermal energy in India – Fuel cell – Hydrogen Energy.

Unit IV

ILLUMINATION, ELECTRIC HEATING & WELDING: Electric lamps – gaseous discharge- construction and application – control equipment, efficiency and losses – Lighting calculations – determination of MHCP and schemes – polar curves of different types of sources –

Rousseau's construction – photometers – lighting schemes – design of lighting schemes – factory & flood lighting – resistance heating, induction heating – furnaces – high frequency dielectric heating, resistance welding arc welding.

Unit V
ELECTRIC TRACTION: Requirements of traction system – Systems of traction – Speed time curves – Tractive effort calculations – Power of traction motor – specific energy consumption – Series, parallel control of DC motor, open circuited, shunt and bridge traction – Electric braking.

Text Books

1. Khan B.H., "Non-Conventional Energy Resources", Tata McGraw- Hill Education India Private Limited, New Delhi, 2nd Edition, 2010.
2. Uppal S.L, "Electrical Power", Khanna Publishers, New Delhi,2011

Reference Books

1. Rai G.D. "Non-Conventional Energy Sources", Khanna publishers, New Delhi, Reprint 2011.
2. Rao S and Paruklekar, "Energy Technology – Non Conventional, Renewable and Conventional", Khanna Publishers, New Delhi, 3rd Edition, 2005.
3. Gupta J.B., "Utilization of Electric Power and Electric Traction", S.K.Kataria and Sons (Publishers), New Delhi, Reprint 2010.
4. Partab H., "Art and Science of Utilization of Electrical Energy", Dhanpat Rai and Company, New Delhi, 2004.

12EE233 COMMUNICATION ENGINEERING

Credits 3:0:0

Course Objective

- Learn the basic principles, concepts and types of communication systems.
- Understand the various design issues in a communication system.
- Gain knowledge about optical communication.

Course Outcome

- Analyze and design basic communication systems, particularly with application to noise-free analog and digital communications.
- Apply concepts and techniques from circuit analysis to communication systems.
- Develop the ability to compare and contrast the strengths and weaknesses of various communication methods.

Unit I
RADIO COMMUNICATION SYSTEM: Types of signals – Analogue and digital signals - Spectrum of signals – Telecommunication services – Telecommunication paths - Concept of modulation - Principle of AM and FM – AM and FM transmitters and receivers.

Unit II

PULSE AND DIGITAL COMMUNICATION SYSTEM: Pulse Amplitude Modulation, Pulse Position Modulation, Pulse Duration Modulation, Pulse Code Modulation – Differential PCM - Delta modulation – Adaptive Delta modulation - Digital modulation systems – ASK, FSK, PSK.

UNIT III
DATA COMMUNICATION SYSTEM: Data Communication codes – Bar codes – Error control – Error detection – Error correction – Data communication hardware – Data communication circuits – Data communication Modems.

UNIT IV
TRANSMISSION MEDIUM: Characteristics of cables – Cable types – Open wire, Coaxial, Strip line, optical fibers – Wave guides – Rectangular and Circular type - Concept of multiplexing – FDM and TDM - Noise - External noise, Internal noise, S/N ratio, noise figure – Noise and Bandwidth.

UNIT V
TELEVISION: Scanning process – Line scanning, Field scanning, Interlaced scanning – Television Transmitter - Monochrome and PAL Color television receiver systems – Camera – Image Orthicon – Vidicon – Picture tubes – Introduction to LCD and LED televisions.

Text Books

1. Anokh Singh, "Principles of Communication Engineering", S. Chand & Company, New Delhi, 5th Edition, 2010.
2. Wayne Tomasi, "Electronic Communication Systems: Fundamentals Through Advanced", Pearson Education, Arizona, 2001.

Reference books

1. William Schweber, "Electronic Communication Systems - A Complete Course", Prentice Hall International, New Jersey, 4th Edition, 2002.
2. Kennedy G, "Electronic Communication Systems", Tata McGraw-Hill Education India Private Limited, New Delhi, 4th Edition, 2011.
3. Simon Haykins, "Communication Systems", John Wiley & Sons, New Jersey, 5th Edition, 2009.
4. Bruce Carlson. A, "Communication Systems", Tata McGraw- Hill Education India Private Limited, New Delhi, 5th Edition, 2009.

12EE234 BIOMEDICAL INSTRUMENTATION

Credits 3:0:0

Course Objective

- Study different types of electrodes used in bio potential recording.
- Understand the characteristics of bio amplifiers and different types of recorders.
- Understand how to measure various biochemical and nonelectrical parameters of human system.

Course Outcome

- The concepts of physiological and the Electrical Components of a Biomedical System will be known.
- Knowledge of the measurement of physiological parameters.

- The concepts of Imaging System and Telemetry and the various Therapeutic Equipments used in Medicine will be known.

Unit I

ELECTROPHYSIOLOGY AND BIOPOTENTIAL RECORDERS: Neuron – Axon – Axon potential – Electro physiology of Cardiovascular system – ECG –Phonocardiography – Neurophysiology – Central nervous system – EEG – Respiratory system – Muscular system - EMG, - Eye – ERG

Unit II

MEASUREMENT AND PHYSIOLOGICAL PARAMETERS: Physiological Transducers - Measurement of Blood pressure – Blood flow – Cardiac output measurement – Heart rate – Respiration rate – Measurement of lung volume – Oximeters – Audiometer.

Unit III

THERAPEUTIC AND SURGICAL EQUIPMENTS: Electro Surgical unit – Short wave & Microwave Diathermy – Laser surgical unit –Anesthesia machine – Pacemakers – Total artificial heart (TAH) – Dialyser – Heart lung machine – Defibrillators – Ventilators – Nerve stimulators – Laparoscopy – Centralized and Bedside patient monitoring system – Nerve stimulators.

Unit IV

BIOMEDICAL EQUIPMENTS AND PATIENT SAFETY: Flame photometer – spectrophotometer – Chromatography – PH, PCO_2, analysis –Sterilizers – Physiological effects of Electric Current – Shock Hazards from Electrical Equipments – Electrical accidents and its preventions.

Unit V

IMAGING SYSTEMS AND TELEMETRY: Computerized Tomography (CT) – MRI instrumentation – Ultrasound scanner – X-ray machine – Fluoroscopic techniques – Angiography – Cardiac Catherisation lab – Echo cardiograph – Vector cardiograph – Biotelemetry.

Text Books

1. Richard Aston, "Principles of Biomedical Instrumentation and Measurement", Merrill (Mac Millan) Publishing Company, Princeton, 2004.
2. Arumugam, M., "Biomedical Instrumentation", Anuradha Agencies, Publishers, Kumbakonam, 2006.

Reference Books

1. Geddes, L.A., and Baker, L.E., "Principles of Applied Biomedical Instrumentation", John Wiley & Sons Limited, New Delhi, 2003.
2. Kandpur, R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill Education India Private Limited, New Delhi, 2nd Edition, 12th Reprint 2008.

12EE235 EMBEDDED SYSTEMS

Credits: 3: 0: 0

Course Objective

- Introduce the basic concepts of Embedded Systems.

- Introduce Interface Issues and Techniques of Embedded Systems.
- Introduce real time operating systems.

Course Outcome

- Knowledge about the architecture of embedded processors.
- Knowledge about the components of real time operating systems.
- Design of their own embedded systems.

Unit I

SYSTEM DESIGN: Definitions - Classifications and brief overview of micro-controllers microprocessors and DSPs - Embedded processor architectural definitions - Typical application scenario of embedded systems.

Unit II

INTERFACE ISSUES RELATED TO EMBEDDED SYSTEMS: A/D, D/A converters - Interfacing to External Devices – Switches – LED/LCD Displays – Relays – Dc Motor – Stepper Motor.

Unit III

TECHNIQUES FOR EMBEDDED SYSTEMS: State Machine and state Tables in embedded design – Event based, Process based and Graph based models – Petrinet Models - Simulation and Emulation of embedded systems - High level language descriptions of S/W for embedded system - Java based embedded system design.

Unit IV

REAL TIME MODELS, LANGUAGE AND OPERATING SYSTEMS: Real time languages - Real time kernel, OS tasks, task states, task scheduling, interrupt processing, clocking communication and synchronization, control blocks, memory requirements and control, kernel services

Unit V

MICRO C/OS-II REAL TIME OPERATING SYSTEM: Study of Micro C/OS-II RTOS – RTOS System Level Functions – Task Service Functions – Time Delay Functions – Memory Allocation Related Functions – Semaphore Related Functions – Mailbox Related Functions – Queue Related Functions

Text Book

1. RajKamal, "Embedded Systems Architecture, Programming and Design", Tata McGraw-Hill Education India Private Limited, New Delhi, 2nd Edition, 2008

Reference Books

1. Tim Wilhurst, "An Introduction to the Design of Small Scale Embedded Systems, Palgrave Publishers, U.K., 2004.
2. Tammy Noergaard, "Embedded Systems Architecture", Elsevier, New York, 2005.
3. Frank Vahid, Tony Givargis, "Embedded Systems Design", Wiley India, New Delhi, 2006

12EE236 SPECIAL ELECTRICAL MACHINES

Credits 3:0:0

Course Objective

- Differentiate the constructional features and principle of operation, characteristics of various special machines.
- Devise suitable control techniques for the special machine considered.
- Control of special machines with microprocessor and microcontrollers.

Course Outcome

- Selecting an energy efficient linear or rotary motor based on the characteristics of the load & application
- Incorporating the correct control technique to the machine for efficient operation
- Improving the performance of the motor by enhancing the motor suitably.

Unit I

STEPPER MOTORS: Constructional features – principle of operation – variable reluctance motor – Hybrid motor – Single and Multi stack configurations – theory of torque production – characteristics – drive circuits and circuit for Open loop control, closed loop control of stepping motor – applications.

Unit II

SWITCHED RELUCTANCE MOTORS: Constructional features - Principle of operation – Torque equation – Power Converters – Torque Speed characteristics – Voltage, Current and Single Pulse Control Techniques – Torque Control – applications.

Unit III

PERMANENT MAGNET BRUSHLESS DC MOTORS: Principle of operation – types – magnetic circuit analysis – EMF and Torque equations – Power Controllers – Motor characteristics and control.

Unit IV

PERMANENT MAGNET SYNCHRONOUS MOTORS: Principle of operation – EMF and torque equations – reactance – phasor diagram – power controllers - converter - volt-ampere requirements – torque speed characteristics - microprocessor based control.

Unit V

LINEAR MOTORS: Linear Induction Motor (LIM) Classification – Construction – Principle of operation – Concept of Current sheet – Goodness factor – DC Linear Motor (DCLM) types – Circuit equation – DCLM control applications.

Text Book

1. Venkataratnam K., “Special Electric Machines”, Taylor and Francis, London, 2008.

Reference Books

1. Miller, T.J.E. “Brushless Permanent Magnet and Reluctance Motor Drives”, Clarendon Press, Oxford, 1989.
2. Kenjo, T, “Stepping Motors and their Microprocessor control”, Clarendon Press, Oxford, 1989.

3. Naser A., Boldea I., "Linear Electric Motors: Theory, Design and Practical Application", Prentice Hall Inc., New Jersey, 1987
4. Kenjo, T, Naganori, S "Permanent Magnet and brushless DC motors", Clarendon Press, Oxford, 1989.
5. Vinoth Kumar.K, Saravana Kumar. R, "Special Electrical Machines", Dhanpat Rai & Sons Publishing Company, New Delhi, 2009

12EE237 VIRTUAL INSTRUMENTATION

Credits 3:0:0

Course Objective

- Study about the Virtual instrumentation system and LabVIEW based Virtual Instrumentation.
- Study about the hardware and software involved programming techniques in VI.
- Study about the basic of Programming Techniques.

Course Outcome

- Understand the advantages of Data flow programming
- Use VI for instrumentation and control
- Design a LabVIEW based instrumentation system

Unit I

REVIEW OF VIRTUAL INSTRUMENTATION: Historical perspective, advantages, Block diagram and Architecture of a Virtual Instrument, Data Flow Techniques, Graphical programming in data flow, comparison with Conventional programming.

Unit II

INTRODUCTION TO LabVIEW: Introduction to LabVIEW-Advantages of LabVIEW-Software Environment-Creating and Saving VI- Controls and Indicators- Data types. SubVI: Creating- Opening-Editing-Placing an SubVI in a block- Creating a Stand Alone Application

Unit III

PROGRAMMING TECHNIQUES: Loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O

Unit IV

DATA ACQUISITION BASICS: Signals Handling and Classification – Signal Conditioning - Analog Interfacing (I/O) - Counters & Timers – Digital (I/O) - DAQ Hardware – DAQ Software Architecture - DAQ Assist

Unit V

COMMON INSTRUMENT INTERFACES: GPIB-RS232-Handshaking- RS232/RS485 interfacing, VISA – IVI - PCMCIA – SCXI – VXI - Networking basics for office & Industrial applications

Textbooks

1. Gary W. Johnson, Richard Jennings, "LabVIEW Graphical Programming", McGraw-Hill Education, New York, 3rd Edition, 2001.

2. Jovitha Jerome, “Virtual Instrumentation Using LabVIEW” Prentice Hall India Learning Private Limited, New Delhi, 2010

Reference Books

1. Leonard Sokoloff, “Basic concepts of Labview 4”, Prentice Hall of India, New Jersey, 1998.
2. LabVIEW: Basics I & II Manual, National Instruments, 2005.
3. Sanjay Gupta and Joseph John, “ Virtual Instrumentation using LabVIEW”, Tata Mc Graw – Hill Education India Private Limited, New Delhi, 1st Edition, 2005.

12EE238 ILLUMINATION ENGINEERING

Credits: 3:0:0

Course Objective

- To design a electrical system including cost estimate and energy efficient lighting systems in residential, commercial and industrial establishments.
- To be familiar with the current guidelines in the design, construction, and management of safe and energy-efficient road lighting systems through actual completed projects.
- To understand the concept of lighting system maintenance, basic lighting energy audit and economic analysis of lighting.

Course Outcome

- Perform indoor & outdoor lighting design calculations.
- Determine appropriate lighting control techniques and equipment to a sample project.
- Perform basic lighting energy audit to a sample project.

Unit I

LANGUAGE OF LIGHT & LIGHTING: Eye & vision – Light & Lighting – Light & Vision –, Light & Color – Basic Concepts and Units – Photometry – Measurement and Quality of Lighting.

Unit II

LIGHTING ACCESSORIES: Light sources: Daylight, Incandescent – Electric Discharge – Fluorescent – Arc lamps – Lasers – Neon signs – LED-LCD displays – Luminaries – Wiring.

Unit III

CALCULATION AND MEASUREMENT: Polar curves – Effect of voltage variation on efficiency and life of lamps – Lighting calculations– Illumination from point, line and surface sources – Photometry and Spectro-photometry – photocells.

Unit IV

INTERIOR LIGHTING: Lighting design procedure for Industrial – Residential – Office – Departmental stores – Indoor stadium – Theatres – Hospitals.

Unit V

EXTERIOR LIGHTING: Environment and glare – Lighting Design procedure for Flood – Street – Aviation and Transport lighting – Lighting for Displays and Signaling.

Text Books

1. Leon Gaster, John Stewart Dow, "Modern Illuminants And Illuminating Engineering", Nabu Press, Washington DC, 1st Edition, 2010.
2. Jack L. Lindsey, "Applied Illumination Engineering", Prentice Hall of India, 3rd Sub Edition, New Delhi, 2008.

Reference Books

1. Cady, "Illuminating Engineering", General Books, USA, 2010.
2. Kamlesh Roy, "Illuminating Engineering", Laxmi Publications, 2nd Edition, 2006
3. William Edward Barrows, "Electrical Illuminating Engineering", Bibliolife Publishers, USA, 2010.
4. IES Lighting Handbook, 10th Edition, 2011.

12EE239 AUTOMOTIVE ELECTRONICS

Credits 3:0:0

Course Objective

- Study the concepts of sensors, actuators, drives.
- Study Electronics Fuel Injection System and Lighting system and accessories.
- Study the digital control of starting and braking methods in the automobile system.

Course Outcome

- Understanding the significance of automation in automobile.
- Understanding the Digital engine control system.
- Understanding the significance of automotive electronics in leveraging the passenger safety.

Unit I

SENSORS AND ACTUATORS: Introduction, Basic sensor arrangement, types of sensors such as - oxygen sensors, Crank angle position sensors - Fuel metering / vehicle speed sensor and detonation sensor - Altitude sensor, flow sensor. Throttle position sensors, Solenoids, Stepper motors, Relays.

Unit II

STARTING SYSTEM: Condition at Starting, Behavior of starter during starting. Series motor and its Characteristics. Principle & construction of starter motor. Working of different starter drive units, care & maintenance of starter motor. Starter switches.

Unit III

DIGITAL ENGINE CONTROL SYSTEM: Introduction – Control model for fuel control – Open loop and closed loop control systems – Engine cranking and warm up control - Acceleration enrichment - Deceleration leaning and idle speed control – Electronic Ignition Control: Distributor less ignition- Closed Loop Ignition Timing - Electronic spark timing control – Spark Advanced Correction Schemes - integrated engine control system - Types of solid state ignition systems and their principle of operation - Advantages of electronic ignition systems

Unit IV

LIGHTING SYSTEM & ACCESSORIES: Insulated & earth return systems, Positive & negative earth systems. Details of Head light & Side light. Head light dazzling & preventive methods. Electrical Fuel Pump, Speedometer, Fuel, Oil & Temperature gauges, Horn, Wiper system, Trafficator.

Unit V

VEHICLE MOTION CONTROL: Typical Cruise Control- Digital Cruise Control-Throttle Actuator-Antilock Braking Systems-Electronics Suspension Systems-Electronic Steering Control-Collision Avoidance Radar Warning Systems – Low Tire Pressure Warning Systems-Navigation- Advanced Driver Information Systems – Automatic Driving Control

Text Book

1. William B.Ribbens, "Understanding Automotive Electronics", Butterworth, Heinemann Woburn, New York, 6^{th} Edition, 2003.

Reference Books

1. James D. Halderman and Chase D. Mitchell, "Diagnosis and Troubleshooting of Automotive Electric, Electronic, and Computer Systems", Prentice Hall, New Jersey, 4^{th} Edition, 2006.
2. James D. Halderman and Chase D. Mitchell, "Automotive Electricity and Electronics", Prentice Hall of India, New Delhi, 2004.
3. P L Kohli, "Automotive Electrical Equipment", Tata McGraw- Hill Education India Private Limited, New Delhi, 2008

12EE240 RENEWABLE ENERGY SOURCES

Credits: 3:0:0

Course Objective

- To explain concept of various forms of renewable energy
- To outline division aspects and utilization of renewable energy sources for both domestics and industrial applications
- To analyze the environmental and cost economics of using renewable energy sources compared to fossil fuels.

Course Outcome

- Have knowledge about various renewable energy sources.
- Be able to choose the appropriate renewable energy as an alternate for conventional power in any application.
- Be able to analyze the cost effect of renewable energy sources.

Unit I

SOLAR ENERGY: Solar radiation its measurements and prediction - solar thermal flat plate collectors, concentrating collectors – applications - heating, cooling, desalination, power generation, drying, cooking etc - principle of photovoltaic conversion of solar energy, types of solar cells and fabrication. Photovoltaic applications: battery charger, domestic lighting, street lighting, and water pumping, power generation schemes.

Unit II

WIND ENERGY: Atmospheric circulations – classification - factors influencing wind - wind shear – turbulence - wind speed monitoring - Betz limit - Aerodynamics of wind turbine rotor-site selection – wind resource assessment - wind energy conversion devices - classification, characteristics, and applications. Hybrid systems - safety and environmental aspects.

Unit III

BIO-ENERGY: Biomass resources and their classification - chemical constituents and physicochemical characteristics of biomass - Biomass conversion processes - Thermo chemical conversion: direct combustion, gasification, Pyrolysis and liquefaction - biochemical conversion: anaerobic digestion, alcohol production from biomass - chemical conversion process: hydrolysis and hydrogenation. Biogas - generation - types of Biogas Plants- applications

Unit IV

HYDROGEN AND FUEL CELLS: Thermodynamics and electrochemical principles - basic design, types, and applications - production methods - Biophotolysis: Hydrogen generation from algae biological pathways - Storage gaseous, cryogenic and metal hydride and transportation. Fuel cell – principle of working- various types – construction and applications.

Unit V

OTHER TYPES OF ENERGY: Ocean energy resources - principles of ocean thermal energy conversion systems - ocean thermal power plants - principles of ocean wave energy conversion and tidal energy conversion – hydropower – site selection, construction, environmental issues - geothermal energy - types of geothermal energy sites, site selection and geothermal power plants.

Text Book

1. Rai G. D., "Non conventional Energy Sources", Khanna Publishers, New Delhi, 2007.

Reference Books:

1. Sukhatme, S.P., "Solar Energy", Tata McGraw - Hill Education India Private Limited, New Delhi, 2006.
2. John Twidell, Tony Wier, "Renewable Energy Sources", Taylor & Francis Publishers, New York, 2005.
3. Thomas .b. Johansson, Henry Kelly, Amulya K.N .Reddy, Robert .H. Williams, "Renewable Energy Sources for Fuels and Electricity", Island Press, Washington DC, 2009.
4. Anthony San Pietro, "Biochemical and Photosynthetic aspects of Energy Production", Academic Press, 1980**.**
5. Khandelwal K.C, Mahdi S.S., Biogas Technology - A Practical Handbook, Tata Mc Graw Hill, 1986.

12EE241 DIGITAL SYSTEM DESIGN

Credits 3:0:0

Course Objective

- To review the concepts of Digital logic circuits
- To understand PLDs and FPGA Programming techniques
- To have a appreciable knowledge on the programmable logic devices and its programming abilities.

Course Outcome

- Understand the sequential logic circuits and the other symmetric functions.
- Get knowledge on the programmable logic devices and its programming abilities.
- Have an understanding on the FPGA and its programming using VHDL.

Unit I
COMBINATIONAL & SEQUENTIAL LOGIC CIRCUITS: Review of combinational circuit minimization and design- Adder, MUX, DEMUX,- Review of sequential design fundamentals – flip flops-Mealy machine - Moore machine - State diagrams - State table minimization – Incompletely specified sequential machines - State assignments - Design of synchronous and asynchronous sequential logic circuits working in the fundamental mode.

Unit II
PROGRAMMABLE LOGIC DEVICES: Basic concepts - Programming techniques - Programmable Logic Element (PLE) -Programmable Logic Array (PLA) - Programmable Array Logic (PAL)-Designing an up-down counter using PLA - Structure of Standard PLD's - Design of combination and sequential circuits using PLD's.

Unit III
FIELD PROGRAMMABLE GATE ARRAYS: Introduction to FPGA- Type of FPGA – Architecture of Xilinx XC3000 Series – Logic Cell Array (LCA) – Configurable Logic Blocks (CLB) Input/Output Blocks (I/OB) – Programmable Interconnects - CPLD-AlteraMax 7000 Series – Introduction to Actel Act-1 Logic Module – Xilinx XC4000 Series.

Unit IV
INTRODUCTION TO VHDL: Entity - Architecture – Data objects-Data Types, Data operators-Variables – Signals – Constants – Arrays – Operators- IF statement- CASE statement- Loop Statement – PROCESS statement-NEXT statement- EXIT statement-WAIT statement- ASSERT statement,

Unit V
ADVANCED PROGRAMING CONCEPTS IN VHDL: Functions – Procedures – Packages – Libraries – Attributes – Operator Overloading –Generics – Modeling Delays - Modeling Synchronous Logic and State Machine Modeling. VHDL description of combinational logic circuits: MUX, De-MUX, encoder, decoders and Adders, circuits– VHDL description of sequential logic circuits: Up-Down Counter, Traffic Light Control Application.

Text Book
1. Charles H. Roth, Jr., "Digital System Design using VHDL", PWS Publishing Co., Boston, Massachusetts USA, 2009.

Reference Books
1. Godse A.P., Godse D.A., "Digital Systems", Technical Publications, Pune, 5th Edition, 2005.
2. Bhaskar J., "A VHDL Synthesis Primer", BS Publications, Hyderabad, 3rd Edition, 2004

12EE242 POWER SYSTEM STABILITY

Credits 3:0:0

Course Objective

- Impart knowledge about the concept of stability in a Power System.
- Make the students understand the importance of stability under different conditions like transient and steady state in the power system.
- Learn the methods of improving the stability & use of computations for the analysis of this stability.

Course Outcome

- Realize the situation happening in the power system under various load conditions.
- Have a thorough knowledge about maintaining and improving the stability of a system.
- Get knowledge on methods to analyze transient and steady state stability of a power system.

Unit I

INTRODUCTION TO STABILITY: Concept of Power system stability - Importance of Stability studies - Steady state and Transient state – Modeling of Synchronous machines for stability studies.

Unit II

STEADY STATE STABILITY: Models used – power flow equations – steady state stability including composite loads – two machine system and Clarke diagram – multi machine system and stability criteria – factors influencing stability limit.

Unit III

TRANSIENT STABILITY: Single and two machine systems – Swing equation – Solution of swing equation by Modified Euler and Runge-kutta method – Equal area criterion and its application – Graphical integration – state space representation – phase plane method – stability of multi-machine system.

Unit IV

IMPROVING TRANSIENT STABILITY: Factor affecting transient stability – Methods of improving stability – Lyapunov method – effect of excitation and speed governing system on transient stability – effect of inertia and damping.

Unit V

COMPUTER APPLICATIONS: Application of computers for stability studies – Digital simulation methods for transient stability studies.

Text Book

1. Kundur P., "Power System Stability and Control", EPRI Power System Engineering Series, McGraw-Hill Education Series, New York, 1st Edition, 2006.

Reference Books

1. Padiyar K.R., "Power System Dynamics, Stability and Control", BS Publications, Hyderabad, 2nd Edition, 2008.
2. Peter W., Saucer, Pai M.A., "Power System Dynamics and Stability, Pearson Education (Singapore), 9th Edition, 2007.

3. Kothari D.P., "Modern Power System Analysis", Tata McGraw-Hill Education India Private Limited, New Delhi, 3rd Edition, 2004.
4. Elgerd O.I., "Electric Energy System Theory: An Introduction", Tata McGraw-Hill Education India Private Limited, New Delhi, 23rd Reprint, 2004.
5. Arrillaga J, Watson N.R., "Computer Modeling of Electrical Power Systems", John Wiley & Sons Limited, New Jersey, 2003.

12EE243 POWER SYSTEM CONTROL

Credits 3:0:0

Course Objective

- Understand & model power-frequency dynamics and to design power-frequency controller.
- Understand & model reactive power-voltage interaction.
- Understand different methods of control for maintaining voltage profile against varying system load.

Course Outcome

- Realize the importance of maintaining the frequency and voltage within the safe range.
- Have a thorough knowledge about modeling of systems under varying conditions
- Get knowledge on SCADA system, its function and state estimation concepts

Unit I

INTRODUCTION: Need for voltage and frequency regulation in power system - System load characteristics - Basic P-F and Q-V control loops -Real power and Reactive Power improvement methods.

Unit II

REAL POWER AND FREQUENCY CONTROL: Fundamentals of Speed governing mechanisms and Modeling – Speed – Load characteristics - Control areas – LFC control of a single area – Static and dynamic analysis of uncontrolled and controlled cases - Multi-area systems – Two area system modeling - Static analysis -uncontrolled case - tie line with frequency bias control of two area and multi-area system – Steady state instabilities.

Unit III

REACTIVE POWER AND VOLTAGE CONTROL: Typical excitation system – Modeling – Static and Dynamic analysis – Stability Compensation - Effect of Generator loading - Static Shunt Capacitor/reactor VAR compensator, Synchronous Condenser, Tap-changing transformer - Static VAR system - Modeling – System level voltage control

Unit IV

COMPUTER CONTROL OF POWER SYSTEM: Energy control center functions – System hardware configuration SCADA system – Functional aspects – Security monitoring and control – System states and their transition - Various controls for secure operation – Online monitoring of Systems.

Unit V

STATE ESTIMATION: Introduction-Least square estimation-static state estimation of power systems-tracking state estimation of power systems- some computational considerations-External system equivalency- treatment of bad data-network observability and pseudo measurements-Application of power system state estimation

Text Books

1. Olle I.Elgerd, "Electric Energy System Theory - An Introduction", Tata Mc Graw-Hill Education India Private Limited, New Delhi, 1983.
2. Kundur P., "Power System Stability and Control", EPRI Power System Engineering Series, Mc Graw- Hill Education India Private Limited, New York, 1st Edition, 2006.

Reference Books

1. Kirchmayer .L.K. "Economic Operation of Power System", John Wiley & Sons Inc., New Jersey, 1953.
2. Allen J.Wood, Bruce F.Woolenbarg, "Power Generation, Operation and Control", John Wiley & Sons Inc., New Jersey, 2nd Edition, 1996.
3. Mahalanbis, A.K., Kothari, D.P and Ahson, S.I., "Computer Aided Power System Analysis and Control", Tata Mc Graw-Hill Education India Private Limited, New Delhi, 1990.
4. Jizhong Zhu, "Optimization of Power System Operation" John Wiley & Sons Inc., New Jersey, 2009.
5. Kothari. D.P., Nagrath. I.J., "Modern Power system analysis" Tata Mc Graw-Hill Education India Private Limited, New Delhi, 4th Edition, 2011

12EE244 NEURAL NETWORKS AND FUZZY SYSTEMS

Credits 3:0:0

Course Objective

- Expose the students to the concepts of Single layer and Multi layer feed forward Neural Networks.
- Provide adequate knowledge about feedback neural networks.
- Provide comprehensive knowledge about the applications of Neural Networks and Fuzzy Systems in Electrical Engineering.

Course Outcome

- Apply the concept of neural network for optimization of any system performance.
- Use an appropriate network for to data in Real Time Applications.
- Apply the concepts of neural networks for Process Identification and Power Plants.

Unit I

INTRODUCTION TO NEURAL NETWORKS: Organization of human brain – Comparison between computer & human brain – Comparison between Artificial and Biological Neural Network - Artificial Neuron Model & Mcculloch Pitts Neuron Model – Characteristics of Neural Networks – Applications – Advantages of Neural Networks – Types of Activation function – Neural Networks Architectures – Leaning Strategy – Types of learning Rules.

Unit II

SINGLE LAYER FEEDFORWARD NEURAL NETWORKS: Single layer Perceptron – Discriminant functions – Non-Parametric Training concept – Training and Classification using Discrete Perceptron: Algorithm – Perceptron Convergence Theorem – Single layer continuous Perceptron Networks for Linearly Separable Classifications – Summary and Comparison between SDPTA & SCPTA – Multicategory Single Layer Perceptron Networks.

Unit III
MULTI LAYER FEEDFORWARD AND FEEDBACK NEURAL NETWORKS: Introduction – Credit Assignment Problem – Generalized Delta Learning rule - Back propagation – training algorithm – applications – Kolmogorov's Theorem - Hopfield nets – Introduction – Discrete and Continuous Hopfield nets – Architecture – Training Algorithm – Application Algorithm – Energy function.

Unit IV
INTRODUCTION TO FUZZY SYSTEMS: Fuzzy and Classical Sets – Classical and Fuzzy Sets – Cartesian Product of Relation – Cardinality – Operations – Properties – Composition – Tolerance and Equivalence Relation – Membership Functions – Features – Classification of fuzzy sets – Fuzzification – Membership Value Assignments – Defuzzification – Methods – Fuzzy rule based system – Fuzzy Inference system.

Unit V
APPLICATIONS OF NEURAL NETWORKS AND FUZZY SYSTEMS: Applications of Neural Networks – Process Identification – Inverted Pendulum Forecasting – Applications of Fuzzy Logic in Power Plants – Image processing – Biomedicine – Blood Pressure during Anesthesia – Automotive Applications.

Text Books
1. Jacek M Zurada, "Introduction to Artificial Neural Systems", Jaico Publishing House, New Delhi, 2006.
2. Timothy.J.Ross, "Fuzzy Logic with Engineering Applications", Wiley India Private Limited, New Delhi, 2011.

Reference Books
1. Vinoth Kumar.K., Saravanakumar.R., "Neural Networks and Fuzzy Logic", S.K.Kataria & Sons Publisher, New Delhi, 2010.
2. Sivanandam S.N., Deepa S.N., "Principles of Soft Computing", Wiley India Private Limited, New Delhi, 2011.
3. Sivanandam S.N., Sumathi. S and Deepa S.N., "Introduction to Neural Networks using MATLAB 6.0", Tata Mc Graw-Hill Education India Private Limited, New Delhi. 2006.
4. Sivanandam S.N., Sumathi. S and Deepa S.N., "Introduction to Fuzzy Logic using MATLAB", Springer Verlag Berlin Heidelberg Publisher, New York, 2007.
5. Laurene Fausett, "Fundamentals of Neural Networks: Architectures, Algorithms and Applications", Pearson Education India, New Delhi, 2009.

12EE245 MICRO ELECTRO MECHANICAL SYSTEMS

Credits: 3:0:0

Course Objective

- Introduce the concept of Micro Electro Mechanical Systems
- Outline different methods of micromachining, microstructures, micro sensors, and micro actuators
- Study the various applications of MEMS

Course Outcome

- Have knowledge about various Micro Electro Mechanical Systems.
- Understand Material Processing and Device Fabrication using which can do Microsystems Design for various applications.
- Understand the Applications of MEMS in various fields.

Unit I

INTRODUCTION TO MEMS: Historical background of Micro Electro Mechanical Systems, role of MEMS in improved efficiency, Smart materials and structures, materials-processing, synthesis, Multifunctional Polymers.

Unit II

MATERIAL PROCESSING AND DEVICE FABRICATION: Lithography, Ion Implantation, Etching, Wafer bonding, integrated processes, Bulk silicon micromachining, surface micro machining, CVD oxide process.

Unit III

MICRO SENSORS AND MICRO ACTUATORS: Micromechanical components – springs, bearings, gears and connectors, High temperature sensors, Capacitive pressure sensor, bulk micro-machined accelerometer, Surface micro machined micro spectrometer.

Unit IV

MICROSYSTEMS DESIGN AND PACKAGING: Design considerations, Mechanical Design, Process design, Realization of MEMS components using Intellisuite. Micro system packaging, Packing Technologies, Assembly of Microsystems, Reliability in MEMS**.**

Unit V

APPLICATIONS OF MEMS: Blood Pressure Monitoring Transducers, Disposable Blood Pressure Monitoring Transducers. MEMS devices – Infusion pumps, Kidney dialysis, Respirators, Active noise and vibration control, Intelligent structures, micro –robots, Buildings and Manufacturing systems.

Text book

1. Tai-Ran Hsu, "MEMS & Microsystems, Design and Manufacture", McGraw-Hill Education India Private Limited, New York, 2006.

Reference Books

1. Maluf, Nadim, "An introduction to Micro Electro Mechanical Systems Engineering", AR Tech House, Boston, 2000.
2. Julian W.Gardner,Vijay K.Varadan,Osama O.Awadel Karim, "Microsensors, MEMS and Smart Devices", John Wiley & Sons Limited, New York, 2001.

3. Fatikow S., Rembold U., “Microsystems Technology and Micro Robotics”, Springer-Verlag Berlin Heidelberg, 1997.
4. Mohamed Gad-el-Hak, “The MEMS Hand book”, CRC Press 2002.
5. Lawrence.J.Kamm, “Understanding Electro-Mechanical Engineering”, Prentice Hall India Limited, New Delhi, 2000.

12EE246 COMPUTER ARCHITECTURE

Credits 3:0:0

Course Objective

- Familiarize students about hardware design and behavior of the various functional modules of the computer.
- Understand and evaluate constraints and tradeoffs in microprocessor design.
- Highlight the important issues in computer architecture, organization, its performance, design and relation to the system software.

Course Outcome

- Recognize different types of architectures and the difference between computer architecture and organization.
- Know how to design a computer system.
- Bridge the software, hardware, and firmware gaps.

Unit I

INTRODUCTION: Register transfer language-register, bus and memory transfers–Arithmetic logic and shift micro operations.

BASIC COMPUTER ORGANISATION: Instruction codes – Instructions – Timing and Control – Instruction Cycle – Fetch and Decode – Execution – Typical register and memory sequence instructions – Input, Output and Interrupt – Design stages.

Unit II

CENTRAL PROCESSOR ORGANIZATION: General register organization – Stack organization – Instruction formats – Addressing modes – Data transfer and manipulation – Program control – Control memory – Address sequencer – Data path structure - CISC characteristics, RISC Characteristics, RISC pipeline.

Unit III

ARITHMETIC PROCESSING: Introduction – Addition, Subtraction, Multiplication and Division algorithms – Floating point Arithmetic operations.

Unit IV

MEMORY AND INPUT/OUTPUT ORGANIZATION: Basic concepts – Memory Hierarchy – Main memory – Auxiliary memory – Associative memory – Cache and Virtual memory concepts – Input – Output interface – Asynchronous Data transfer – Modes of transfer – Direct memory access – I/O processor.

Unit V

INTRODUCTION TO PARALLEL PROCESSING: Parallelism in Uni-processor systems – Taxonomy of architectures – SISD, SIMD, MISD, MIMD modes of Memory access - shared memory, distributed memory – typical applications.

Textbooks

1. Morris Mano, M., "Computer System Architecture", Prentice Hall of India, New Delhi, 3rd Edition, 2000.
2. Hwang K., and .Briggs F.A., "Computer Architecture and Parallel Processing", McGraw–Hill Education India Private Limited, New Delhi, 1989.
3. Stallings W., "Computer Organization and Architecture", Pearson Education, New Delhi, 7th Edition, 2006.

Reference Books

1. Carl Hamacher, V., Vranesic, Z.G., and Zaky, S.G., "Computer Organisation", Mc Graw-Hill International Edition, New York, 5th Edition, 2002.
2. Kai Hwang., and Briggs, F.A., "Computer Architecture and Parallel Processing", McGraw-Hill International Edition, New York, 1985.

12EE247 OPERATING SYSTEMS

Credits 3:0:0

Course Objective

- Study the evolution of Operating Systems.
- Analyze the concepts of memory management and process management systems.
- Understand the procedure of each and every management system and do case study.

Course Outcome

- Understand the concepts of operating systems.
- Gain understanding of memory and process management.
- To have a better knowledge on different windows versions and its development.

Unit I

INTRODUCTION: Operating system – Function – Evolutions of Operating System- Serial processing- Batch Processing- Multiprocessing-Time sharing, Advanced Operating Systems – Need for advanced OS-Distributed OS – Multiprocessor OS – Database operating system – Real Time OS.

Unit II

MEMORY MANAGEMENT: Single contiguous allocation – Partitioned allocation – Paging – Virtual memory concepts – Swapping – Demand paging – Page replacement algorithms – Segmentation – Segmentation with paging.

Unit III

PROCESS MANAGEMENT: Introduction to processes –Scheduling objectives- Scheduling Criteria- Types of scheduling algorithms – Performance comparison – Inter process communications- Synchronization – Semaphores – Deadlock-Prevention, Recovery, Detection – Avoidance.

Unit IV

DEVICE AND FILE MANAGEMENT: Principles of I/O hardware – I/O software – Disks – Disk Scheduling Algorithms–File Systems – Files-Directories- File system implementation – Allocation methods –Security – Protection mechanisms.

Unit V

CASE STUDIES: LINUX – History – Design Principles – Kernel modules – Process Management – Scheduling – Memory Management – File Systems – Input and Output – Inter process Communication – Network Structure – Security. WINDOWS 2000 **–** History – Design Principles – System Components – Environmental Subsystems – File System – Networking – Programmer Interface.

Text Books

1. Silberschatz A, Galvin. P, G.Gagne, "Operating Systems Concepts", John Wiley &Sons, Singapore, 6th Edition, 2004.
2. Achyut Godbole, "Operating Systems", Tata Mc Graw-Hill Education India Private Limited, New Delhi, 15th Reprint, 2003.

Reference Books

1. Andrew S Tanenbaum, Albert S. Woodhull, "The MINIX book Operating Systems: Design and Implementation", Pearson Education India Private Limited, New Delhi, 3rd Edition, 2006.
2. Deitel H M., "An Introduction to Operating Systems", Pearson Education Private Limited, New Delhi, 2nd Edition, 2005.
3. Mukesh Singhal and Niranjan G.Shivaratis, "Advanced Concepts in Operating Systems", Mc Graw- Hill Incorporation Limited, New York, 2004.

12EE248 COMPUTER COMMUNICATION

Credits 3:0:0

Course Objective

- Study the communication networks in computer
- Know various data communication techniques.
- Know the various applications using network protocols.

Course Outcome

- Understand the concepts of Computer Communication
- Understand the peripheral connections in a computer.
- It also gives broad idea on networking which are available for daily use.

Unit I

INTRODUCTION: Computer Networks – A perspective – Goals – Applications – Switching techniques – Circuit switching –Message switching – Packet switching – Network components existing network – ARPANET – Concepts of network protocol – OSI reference model – Basics of Queuing theory – Queuing models – Poisson Statistics – M/M/1 queue.

Unit II

LOCAL AREA NETWORKS: Topologies – Star – Ring, Bus – Ethernet – Transmission media – LAN Access Techniques – Polling Contention – ALOHA – CSMA – CSMA/CD - Token Bus and Token Ring protocols – Delay throughput Characteristics – Token Ring and CSMA/CD Bus – performance.

Unit III
DATA COMMUNICATION TECHNIQUES: Asynchronous and synchronous communication – BISYNC, SDLC, HDLC – X.2.5 protocols – Error control coding.

Unit IV
INTER – NETWORKING: Routing Algorithms – Congestion Control Algorithms – Internetworking – TCP/IP – IP Protocol – IP Address.

Unit V
BROADBAND NETWORKS: ISDN – User Access – Transmission structure - ISDN Protocol – Limitations – B – ISDN – ATM concepts and principles – Introduction to VSAT networks.

Text Books

1. Andrew Tannenbaum., "Computer Networks", Prentice Hall of India, New Delhi, 4th Edition, 2003
2. Forouzan, "Introduction to Data Communication and Networking", Tata McGraw - Hill Education India Private Limited, New Delhi, 4th Edition, 2004.

References Books

1. William, Stallings, "Data and Computer Communication", Prentice Hall of India, New Delhi, 7th Edition, 2003.
2. Keiser, G.E., "Local Area Networks", Galgotia Publications, Pune, 2nd Edition, 2002.
3. Uyless, Black., "Computer Networks, Protocols, Standards and Interfaces", Prentice Hall International Edition, 2nd Edition, 2002

12EE249 GRID COMPUTING

Credits 3:0:0

Course Objective

- Introduce about the grid computing techniques.
- Explain and describe the structure of Grid Computing in Business.
- Make a complete case study of enterprise grid, engine and grid cyper-infrastructure.

Course Outcome

- Acquire knowledge about open grid service architecture.
- Understand about the grid taxonomy, grid infrastructure provider.
- Know about the security in grid computing.

Unit I
INTRODUCTION: A vision of the grid and its promises-Scientific Roots- Business Perspective-WS-Resource Frame Format and its meaning-Virtual Organizations and its security-Open Grid Service Architecture(OGSA) and its overview-Grid Versus Distributed Computing-Grid Versus Web Services-Grid Versus Peer to Peer(P2P).

Unit II

GRID COMPUTING IN BUSINESS: Grid Taxonomy- Departmental Grids – Enterprise Grids- Open Grids and the Grid Joining the Grid- Strategies for Participation- Building an Enterprise Grid- example-Software Release Engineering on the Grid-Grid Enabling a Solution-Grid Infrastructure Provider-Service Provider on the Grid-example-Grid for Equipment Health Monitoring.

Unit III

TECHNICAL ISSUES: High Level System Design-Analogies-The Web –Peer to Peer – Technology Areas-Data Management And Databases-Storage Management- Resource Management – Super Computers- Clusters And Farms-On – Demand CPU Resources-Workflow Management-Security-Internal
Versus External Security

Unit IV

MANAGEMENT ISSUES: Building And Selling Grid Business Case-Change And Transition Period Management-Role Of Consultants risk Mitigation: Risk Identification-Risk Quantification-Risk Response Development-Risk Response Control-Fighting White Space Risk-White Space In The Grid Sector-Agile Development: Pair Programming-Test-Driven Programming-The Globus Campaign System.

Unit V

CASE STUDIES: The MCNC enterprise grid-SUN N1 grid engine-LSF suite-the NEES grid cyper-infrastructure the globus toolkit 4 service container.

Text Book

1. Plazczak P., Wellner R., “Grid Computing: The Savvy Managers Guide”, Elsevier, New Delhi, 2006.

Reference Book

1. Joshy Joseph and Craig Fellenstein, “Grid Computing”, Pearson Education, New Delhi, 2007.

12EE250 NANO COMPUTING

Credits 3:0:0

Course Objective

- To make the students know about the introduction to nanoelectronics.
- To be aware of the different architecture.
- To be aware of the different Nanosystems.

Course Outcome

- Have good knowledge in the basis of Nanotechnology.
- Be aware of the development of Nanoelectronics.
- Have an dea about the nanosystems that could be used in information systems.

Unit I

INTRODUCTION TO NANO ELECTRONICS: The development of microelectronics – The region of Nanoelectronics – The complexity problem–The challenge initiated by Nanoelectronics. Basics of Nanoelectronics:Electromagnetic Fields and Photons – Quantization of Action, Charge, and Flux – Electrons behaving as waves – Electrons in potential wells – Diffusion process

Unit II

QUANTUM ELECTRON DEVICES: Classical to quantum physics: upcoming electronic devices – electrons in mesoscopic structure – short channel MOS transistor – split gate transistor – electron wave transistor – electron spin transistor – quantum cellular automate – quantum dot array – Principles of Single Electron Transistor (SET) – SET circuit design – comparison between FET and SET circuit design

Unit III

PARALLEL ARCHITECTURES FOR NANOSYSTEMS: Mono and Multiprocessor Systems – Some considerations to parallel processing – Influence of Delay Time – Power Dissipation – Architecture for processing in Nanosystems: Classic systolic Arrays – Processor with large memory –Processor with large memory – Processor array with SIMD and PIP architecture – Reconfigurable computers – The Teramac Concept as a Prototype.

Unit IV

MEMORY DEVICES AND SENSORS: Nano ferroelectrics – Ferroelectric random access memory – Fe-RAM circuit design – ferroelectric thin film properties and integration – calorimetric sensors – electrochemical cells – surface and bulk acoustic devices – gas sensitive FETs – resistive semiconductor gas sensors –electronic noses – identification of hazardous solvents and gases – semiconductor sensor array.

Unit V

NANOSYSTEMS AS INFORMATION PROCESSING MACHINES: Nanosystems as functional machines-information processing as information modification system design and its interfaces-requirements of nanosystems. Uncertainties: Removal of Uncertainties by nano machines- Uncertainties in nano systems – Uncertainties in the development of nano electronics.

Text Books

1. Karl goser et.al, "Nanoelectronics and Nanosystems: From Transistors to Molecular and Quantum devices", Springer Link, New Delhi, 2005.
2. Rainer Waser, "Nanoelectronics and Information Technology", John Wiley& Sons, Germany, 2005

Reference Books

1. Rainer Waser, "Nano electronics and information technology: Advanced electronic materials and novel devices", Wiley-VCH Verlag Publishers, Weiheim, 2nd Edition, 2005.
2. K.Goser, Glosekotter P., Dienstuhl J., "Nanoelectonis and Nanosystems-From Transistors to Molecular Quantum Devices", Springer-Verlag Publishers, Germany, 2004.
3. Jack Uldrich, Deb Newberry, "The Next Big Thing Is Really Small: How Nanotechnology Will Change the Future of Your Business", Crown Business Publishers, New York, 1st Edition, 2003.
4. Douglas Mulhall, "Our Molecular Future: How Nanotechnology, Robotics, Genetics and Artificial Intelligence Will Transform Our World", Prometheus Books Publishers, Amherst, New York, 2002.

12EE251 BASICS OF MEDICAL ELECTRONICS

Credits 3:0:0

Course Objective

- Have knowledge about the various devices used in medical field.
- Have an awareness of the safety aspects of medical instruments.
- Understand the basics of how the signals are obtained from the body that is to be measured by various machines.

Course Outcome

- Have knowledge about various devices used in medical field
- Have the basic understanding of how the signals are obtained from the body
- Be aware of the safety aspects in this field.

Unit I

ANATOMY AND PHYSIOLOGY: Elementary ideas of cell structure- Cell potential- Heart and circulatory system- Central nervous system-Muscle action-Respiratory system-Body temperature and reproduction system

Unit II

BIO MEDICAL RECORDERS AND ELECTRODES: Bio electrodes-Electrode tissue interface-Types of Electrodes-Electrodes used for ECG , EEG, EMG - Block diagram description and application of ECG Machine-EEG Machine-EMG Machine.

Unit III

TRANSDUCERS: Classification and characteristics of Transducer, pressure transducer – LVDT pressure transducer, Strain gauge pressure transducer, temperature transducer- Thermocouple, Electrical Resistance Thermometer, Thermistor, photoelectric transducer – photovoltaic, Photo emissive.

Unit IV

PATIENT MONITORING SYSTEMS: Heart rate measurement-Pulse rate measurement-Respiration rate measurement-Blood pressure measurement- Use of Microprocessor in patient monitoring.

Unit V

SAFETY ASPECTS OF MEDICAL INSTRUMENTS: Gross current shock- Micro current shock - Leakage current and types of leakage current- Safety standards.

Text Books

1. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill Education India Private Limited, New Delhi, 2007.
2. Leslie Cromwell, "Biomedical Instrumentation and measurement", Prentice hall of India, New Delhi, 2007
.

Reference Books

1. John G. Webster, “Medical Instrumentation Application and Design”, John Wiley and sons, New York, 2009
2. Arumugam.M. “Biomedical Instrumentation", Anuradha Agencies Publishers, Kumbakonam, 2006

12EE252 BASICS OF ELECTRIC AND HYBRID VEHICLE

Credits: 3:0:0

Course Objective

- To understand the concepts of electric and hybrid vehicle
- To know the necessity of alternative and novel energy sources.
- To study the various machines and controller used in electric and hybrid vehicle.

Course Outcome

- Develop a hybrid vehicle with existing renewable system.
- Design a new controller for hybrid electric vehicle.
- Apply control techniques to store the energy.

Unit I

INTRODUCTION: Electrical Vehicle History- Battery electric vehicles- Hybrid vehicle-Fuelled electric vehicles- Solar powered vehicles-Electric vehicles which use flywheels or super capacitors.

Unit II

BATTERIES: Introduction- Battery Parameter-Self-discharge rates-Battery temperature, heating and cooling needs -Battery life- Introduction to Lead Acid Batteries, Nickel-based Batteries, and Lithium Batteries, use of batteries in Hybrid Vehicles.

Unit III

ALTERNATIVE ENERGY SOURCES AND STORAGE DEVICES: Introduction -Solar Photovoltaic -Wind Power- Flywheels- Super Capacitors-Supply Rails, Hydrogen Fuel Cells: Basic Principles-Hydrogen storage methods.

Unit IV

ELECTRIC MACHINES FOR HYBRID VEHICLE: Operation of the DC motor- Induction motor – Brushless DC Motor – Switched Reluctance Motors – converters for BLDC and SRM.

Unit V

DESIGN OF ANCILLARY SYSTEMS: Introduction- Heating and Cooling Systems -Design of the Controls -Power Steering -Choice of Tires-Wing Mirrors, Aerials and Luggage Racks -Electric Vehicle Recharging and Refueling.

Text Books

1. Iqbal Husain, “Electric and Hybrid Vehicles Design Fundamentals”, CRC Press, New York, USA. 2nd Edition, 2010.
2. Mehrdad Ehsani ,Yimin Gao, Sebastien E. Gay, Ali Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design”, CRC press, Newyork, USA, 2008.

Reference Books

1. Seth Leitman, Bob Brant, “Build Your Own Electric Vehicle”, Professional Edition:Ebook , McGraw-Hill, New York, 2nd Edition, 2008.
2. James Larminie, John Lowry, “Electric Vehicle Technology Explained”, Wiley publications, India, 3rd Edition 2007.
3. Austin Hughes, “Electric Motors and Drives: Fundamentals, Types and Applications”, McGraw-Hill, New York, USA, 3rd Edition, 2006.
4. Carl Vogel, “Build Your Own Electric Motorcycle”, McGraw-Hill, New York, USA, 2nd Edition 2009.
5. David Linden, Thomas B. Reddy, “Handbook of Batteries”, McGraw-Hill, New York, USA, 2nd Edition, 2008.

12EE253 BUILDING AUTOMATION

Credits: 3:0:0

Course Objective

- Understand about the building automation and its management system.
- Study about the security and safety systems in smart building.
- Suggest suitable possibilities to integrate system and its managements for intelligent building.

Course Outcome

- Construct and design structured building system by enabling integrated system connections.
- Apply the building automation system and telecommunication facilities in modern intelligent buildings; and apply networking technologies in building automation.
- Evaluate the comprehensive specifications of an importance of energy conservation components for a modern commercial building.

Unit I

INTRODUCTION TO BUILDING AUTOMATION SYSTEM: Introduction – Features, Characteristics, and Drawbacks of Building Automation system – Building Management System: Introduction, HVAC, Sensors & Transducers – Temperature, Pressure, Level and Flow – Meaning of Analog & Digital Signals, Valves and Actuators – Concept of Controller IOs – Cable Selection – Earthing.

Unit II

ENERGY MANAGEMENT SYSTEM: Energy Meters Types – Meter Networking – Monitoring Energy Parameters, Analysis of Power Quality – Instantaneous Power, Active Power, Reactive Power, Power Factor, Voltage, Current – Effect of Power Quality on Energy Consumption – Energy Conservation, Importance of Energy Saving.

Unit III

SAFETY SYSTEMS: Introduction – Fire Development Stages – Fire Sensors & Detectors – Detector Placement – Fire Extinguishing Principles & Its Classification – Fire Alarm System – Pre-alarm, Alarm – Cable Selection – Installation Guidelines – Best Installation Practices.

Unit IV

SECURITY SYSTEMS & VIDEO MANAGEMENT: Introduction, Access Control – Concept Generic Model – Card Technologies – Concept of Antipass back – Biometrics – Video Door phone – Intrusion Detection System – Sensors – **Video Management:** Introduction, CCTV Camera Basics – Digital Video Recording, Features – Digital Vs Analog Recording – Digital Video Management System – TCP/IP Networking.

Unit V
INTEGRATED SYSTEMS: Introduction – Energy Management System – Safety System – Security Systems – Video Management – Benefits of Integrated Systems, Challenges – Future Prospects of Integrated Systems.

Text Books
1. Shengwei Wang, "Intelligent Buildings and Building Automation", Spons Architecture Price Book, New York, 1st Edition, 2009.
2. Jong-jin Kim, "Intelligent Buildings", Butterworth-Heinemann, Illustrated Edition, London, 2006.

Reference Books
1. Derek Clements - Croome, "Intelligent Buildings: Design Management and Operation", Thomas Telford Ltd., UK, Illustrated Edition, 2004.
2. Reinhold A. Carlson Robert A. Di Giandomenico, 'Understanding Building Automation Systems: Direct Digital Control, Energy Management, Life Safety, Security Access Control, Lighting, and Building", Means, R. S. Company, Incorporated (Publisher), New Delhi, 1st Edition, 1991.
3. In Partnership with Nijatc, "Building Automation: Control Devices and Applications", Amer Technical Publishers, New York, 1st Edition, 2008.

12EE254 FUNDAMENTALS OF ELECTRICAL SAFETY

Credits: 3:0:0

Course Objective
- Exhibit knowledge of safety rules and regulations, and demonstrate awareness of hazards in the workplace.
- Explain the use of personal protective equipment.
- Understand the various reasons for electrical accidents

Course Outcome
- Demonstrate proper safety procedures.
- Demonstrate proper use of hand and power tools.
- Identify various trades used in the construction industry.

Unit I
INTRODUCTION TO ELECTRICAL SAFETY: Basic Definitions and Nomenclature-Fundamentals of Electrical Safety- Mathematical Principles of Electrical Safety-The Earth-Effects of Electric currents passing through the human body and Safety Requirements – Electricity Acts, Statutory requirements and Laws.

Unit II

STUDY OF ELECTRICAL SAFETY COMPONENTS: Introduction to conductors and insulators- Wire Characteristics- Ampacity, Insulation Type, Wire Size, Cables & Cords – Electrical Standards- Safety against over voltages- Safety against Static Electricity.

Unit III
INDOOR AND OUTDOOR SAFETY PRECAUTIONS: Indoor safety-Check Equipment, Wet/Damp Areas, Metal Objects, Electrical Emergencies. Outdoor safety-Overhead Power Lines, Underground Power Lines, Outdoor Equipment, Antennas/Ladders, Recreational Safety, Job Site Hazards, Electrical Emergencies.

Unit IV
ELECTRICAL HAZARDS: Main Factors in Electrical Accidents-Electrical Shock- Definition-Arc Flash-Arc Flash Burn Injuries -Arc Blast Pressure - Inhalation Injuries- Determining Safe Approach Distance Determining Arc Hazard Category.

Unit V
CALCULATING ELECTRIC BILLS: Ohms Law-Watt's Law- Fuel cost-calculating Energy use and cost-Estimating, Meter-disc revolution, check meter- study of kWh meter. Estimation of usage of power. Estimated rate- Actual rate- Rates classes and rate schedule – Electrical Bill component- Fuel cost adjustment demand rate-power factor penalty, Smart Meters, architecture of Smart Meter, Smart metering schemes and Power Quality Measurements using Smart meters.

Text Books

1. Massimo A. G. Mitolo**,** "Electrical Safety of Low-Voltage Systems", McGraw-Hill, USA, 2nd Edition, 2008.
2. John Cadick, Mary Capelli-Schellpfeffer, Dennis K. Neitzel, 'Electrical Safety Hand book, McGraw-Hill, New York, USA, 3rd Edition, 2005.
3. David J. Marne, "National Electrical Safety Code (NESC) Handbook", McGraw-Hill, New York, 2nd Edition, 2007.

Reference Books

1. Kenneth G. Mastrullo, Ray A. Jones,"The Electrical Safety Program Book", Jones and Bartlett Publishers, London, 1st Edition, 2003.
2. Wayne C. Turner, Steve Doty," Energy Management hand book", 6th Edition, The Fair Mont press, Georgia, 2006.
3. Albert Thumann, William J.Younger, Terry Niehus, "Handbook of Energy Audits", CRC Press Newyork, 8th Edition, 2009.
4. Palmer Hickman, "Electrical Safety-Related Work Practices", Jones & Bartlett Publishers, London, 2nd Edition, 2009.

12EE255 ARTIFICIAL ORGANS & REHABILITATION ENGINEERING

Credits: 3:0:0

Course Objective

- Provide knowledge about various types of assist devices.
- Give a basic idea of the artificial organs that can aid a human to live a normal life.

- Provide the awareness of how a help can be rendered to a differently abled person

Course Outcome

- Students will have knowledge about various types of assist devices.
- Students will have the ability to choose which type of assist device is suitable for various disorders and legal aspects related to rehabilitation.
- Students will have the urge to develop new devices based on the basic knowledge gained in different assisting devices.

Unit I

INTRODUCTION TO ARTIFICIAL ORGANS: Biomaterials used in artificial organs and prostheses, Outlook for Organ replacement – Design considerations – Evaluation Process.

Unit II

ARTIFICIAL KIDNEY: Brief of kidney filtration, Haemodialysis: flat plate type, coil type and hollow fiber. Haemodialysis Machine, Portable kidney machine.

Unit III

ARTIFICIAL HEART-LUNG MACHINE: Brief of lungs gaseous exchange / transport, artificial heart-lung devices. Oxygenators: bubble, film oxygenators and membrane oxygenators. Gas flow rate and area for membrane oxygenators.

Unit IV

AUDIOMETER: Anatomy & Physiology of EAR-air conduction, bone conduction, masking, functional diagram of an audiometer. Hearing aids: different types, receiver amplifiers.

Unit V

VISUAL AIDS: Ultra sonic and laser canes, Intra ocular lens, Braille Reader, Tactile devices for visually challenged, Text voice converter

Text Books

1. Joseph D. Bronzino, "The Biomedical Engineering HandBook", CRC Press, Connecticut, 2nd Edition, 2000.
2. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, New Delhi, 2007.

Reference Books

1. Arumugam.M., "Biomedical Instrumentation", Anuradha Agencies Publishers, Kumbakonam, 2006

12EE256 ADVANCED CONTROL SYSTEMS

Credits: 3:0:0

Course Objective

- Insight a wide knowledge on the description and stability of non-linear system.
- Understand the analysis of digital control system using state-space formulation.
- Look at the formulation and analysis of multi input multi output (MIMO) system.

Course Outcome

- Gain knowledge in analysis of non-linear system and digital control of linear system.
- Implement the concept of MIMO system.
- Find non-linear system stability using the trajectory methods.

Unit I

STATE SPACE ANALYSIS OF CONTINUOUS TIME SYSTEMS: State variable representation – Conversion of state variable form to transfer function and vice versa – Eigen values and Eigenvectors – Solution of State Equation – Controllability and observability – Pole placement design – Design of State observer.

Unit II

Z TRANSFORM AND SAMPLED DATA SYSTEMS: Sampled data theory – Sampling process – Sampling theorem – Signal reconstruction – Sample and hold circuits – z Transform – Theorems on z Transforms – Inverse z Transforms – Discrete systems and solution of difference equation using z transform – Pulse transfer function – Response of sampled data system to step and ramp Inputs – Stability studies – Jury's test and bilinear transformation.

Unit III

STATE SPACE ANALYSIS OF DISCRETE TIME SYSTEMS: State variables – Canonical forms – Digitization – Solution of state equations – Controllability and Observability – Effect of sampling time on controllability – Pole placement by state feedback – Linear observer design – First order and second order problems.

Unit IV

NON-LINEAR SYSTEMS: Types of non linearity – Typical examples – Phase plane analysis – Singular points – limit cycles – Construction of phase trajectories – Describing function method – Basic concepts – Dead Zone – Saturation – Relay – Backlash – Lyapunov stability analysis – Stability in the sense of Lyapunov – Definiteness of scalar functions – Quadratic forms – Second method of Lyapunov – Lyapunov stability analysis of linear time invariant systems and nonlinear system.

Unit V

MIMO Systems: Models of MIMO system – Matrix representation – Transfer function representation – Poles and Zeros – Decoupling – Introduction to multivariable Nyquist plot and singular values analysis – Model predictive control.

Text Book

1. Nagrath I.J., Gopal M., 'Control Systems Engineering', New Age International Publishers, 5th Edition, New Delhi 2003.

Reference Books

1. Raymond T. Stefani, Bahram Shahian, Clement J. Savant and Gene Hostetter , 'Design of feedback Control systems', Oxford University Press, New York,4th Edition, 2002.

2. Katsuhiko Ogata, "Discrete-Time Control Systems", New Age International, New Delhi, 4th Edition, 2007.
3. Gopal M, "Digital Control and State Variable Methods", Tata McGraw- Hill, New Delhi, 3rd Edition. 2008.
4. Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", Pearson Education, New Delhi, 8th Edition, 2004.

12EE257 HIGH VOLTAGE ENGINEERING

Credits 3:0:0

Course Objective

- To understand the various types of over voltages in power system and protection methods.
- To impart knowledge of breakdown mechanism in solid, liquid and gaseous dielectrics.
- Generation and measurement of over voltages.

Course Outcome

- Understand the causes of over voltages and Insulation Coordination, Choice of Insulation Design.
- Generation and Measurement of High Voltages and Currents.
- Testing of Electrical Power Apparatus

Unit I

TRANSIENTS IN POWER SYSTEMS AND INSULATION COORDINATION: Introduction - Transients in Simple Circuits - Travelling Waves on Transmission Lines - Lightning Phenomenon- Line Design Based on Lightning - Switching Surge Test Voltage Characteristics- Insulation Co-ordination and Overvoltage Protection - Ground Wires - Surge Protection of Rotating Machine.

Unit II

ELECTRIC BREAKDOWN OF GASES, LIQUID AND SOLID MATERIALS: Introduction - Mechanism of Breakdown of Gases - Breakdown in Electronegative Gases - Breakdown in Liquid Dielectrics - Breakdown in Solid Dielectrics - Breakdown in Vacuum.

Unit III

GENERATION OF HIGH D.C., A.C. AND IMPULSE VOLTAGES: Half-wave Rectifier Circuit - Cockroft-Walton Voltage Multiplier Circuit - Electrostatic Generator --Generation of High A.C. Voltages - Series Resonant Circuit -Definitions: Impulse Voltage - Impulse Generator Circuits - Multistage Impulse Generator Circuit - Construction of Impulse Generator Impulse Current Generation

Unit IV

MEASUREMENT OF HIGH VOLTAGES AND CURRENTS : Introduction - Sphere Gap - Uniform Field Spark Gap - Rod Gap - Electrostatic Voltmeter - Generating Voltmeter - The Chubb-Fortescue Method - Impulse Voltage Measurements Using Voltage Dividers - Measurement of High D.C. and Impulse Currents.

Unit V

HIGH VOLTAGE TESTING OF ELECTRICAL EQUIPMENT: Testing of Overhead Line Insulators - Testing of Cables - Testing of Bushings - Testing of Power Capacitors - Testing of Power Transformers - Testing of Circuit Breakers - Test Voltage.

Text Book

1. Wadhwa C.L., High Voltage Engineering, New Age International (P) Limited, 2nd Edition, New Delhi, 2007

Reference Books

1. Naidu M.S., Kamaraju V., 'High Voltage Engineering', Tata McGraw- Hill, 3rd Edition, 2004.
2. Kuffel E., Zaengl W.S., 'High Voltage Engineering Fundamentals', Pergamon press, Oxford, London, 2nd Edition, 2000.

12EE258 ELECTRICAL AND ELECTRONICS WORKSHOP PRACTICE

Credits 0:0:2

1. Study of Lighting Schemes
2. Study of accessories used in wiring and types of wiring.
3. Exercises in house wiring and power wiring
4. Study of Earthing and Measurement of Earth resistance using Megger.
5. Experiment on the various types of Electrical Machines.
6. Study of domestic appliances.
7. Study of Power Supplies.
8. Study of CRO
9. PCB Fabrication.
10. Measurement of RLC.
11. Characteristics of PN junction diode and Zener diode.
12. Transducers.

12EE259 DESIGN LABORATORY

Credits: 0:0:2

1. Design and Fabrication of Power Supply Circuit.
2. Design and Assembling of a Single Phase Transformer.
3. Design and Fabrication of Instrumentation Amplifier.
4. Design and Fabrication of PID Controller.
5. PWM Generation using IC555 for DC Motor Control.
6. Design of 3 Bit ADC using OP-AMP.
7. Trouble shooting of Induction Motor.
8. Electric braking of DC Motor.
9. Design of light control using thyristor.
10. UJT firing scheme.
11. Water level controller using Microprocessor.
12. Stepper motor controller using Microprocessor.

12EE260 POWER ENGINEERING SIMULATION LABORATORY

Credits: 0:0:2

1. Simulation of Half Wave Controlled Rectifier using MATLAB/SIMULINK.
2. Simulation of Single Phase AC Voltage Controllers using MATLAB/SIMULINK.
3. Automatic Load Frequency Control using MATLAB/SIMULINK.
4. Automatic Voltage Regulator (AVR) using MATLAB/SIMULINK.
5. Simulation of Single Phase Full Bridge Sinusoidal PWM Inverter using MATLAB/SIMULINK.
6. Simulation of Multilevel Inverter using MATLAB/SIMULINK.
7. Simulation of Single Phase Fully Controlled Rectifier using PSIM.
8. Simulation of Buck – Boost Converter using PSIM.
9. Simulation of Three Phase Sinusoidal PWM Inverter using PSIM.
10. Simulation of One Quadrant Chopper Circuit with current Feedback using MATLAB/SIMULINK & PSIM Co-simulation.
11. Simulation of Single Phase AC Voltage Controllers using PSIM.
12. Simulation of ZCS and ZVS Resonant Converter using PSIM.

12EE261 CONTROL SYSTEMS LABORATORY

Credits: 0:0:2

1. Determination of transfer function parameters of a DC servo motor.
2. Determination of transfer function parameters of AC servo motor.
3. Analog simulation of type-0 and type-1 system.
4. Digital simulation of linear systems.
5. Digital simulation of non-linear systems.
6. Design and implementation of compensators.
7. Design of P, PI and PID controllers.
8. Stability analysis of linear systems.
9. Closed loop control system.
10. Study of synchros.
11. Design of Lag Compensator.
12. Design of Lead Compensator.

12EE262 HVDC TRANSMISSION

Credits: 3:0:0

Course Objective

- The course aims at use of high voltages as the key to efficient transmission and distribution of electrical power.
- To have an overview about different forms of insulation and their behavior, over voltage conditions and protection of equipments.
- To analyze the malfunctioning of converters and protection.

Course Outcome

- facilitate a basic understanding about high voltage insulators, cables, bushings, occurrence of over voltages and protection of HV equipments from failure due to over voltage
- Outline the benefits of using DC transmission , terminal converters its operation and control.
- Analyze the Challenges and its solutions available in High voltage DC transmission.

Unit I

DC POWER TRANSMISSION TECHNOLOGY: Historical development – HVAC and HVDC links – Comparison – Economic Technical Performance – Reliability – Limitations.

Unit II
ANALYSIS OF HVDC CONVERTERS: Single and three phase converters – Analysis with gate control but no overlaps – With overlaps less than 60º – With overlap greater than 60º – Complete characteristics of rectifier and Operation of Inverter.

Unit III
CONVERTER AND HVDC SYSTEM CONTROL: Basic means of Control – Gate Control – Power reversal – Constant Current Vs Constant Voltage – Control characteristics – Stability of Control – Frequency control – Multi terminal lines.

Unit IV
MISOPERATION OF CONVERTERS & PROTECTION: Converter disturbance – By pass action in bridge – Short circuit on a rectifier – Commutation failure Protection: Basics of protection – DC reactors – Voltage and current oscillations – Clearing line faults and re-energizing – Circuit breakers – Over voltage protection.

Unit V
HARMONICS AND FILTERS: Characteristics and uncharacteristic harmonics – Troubles due to harmonics – Means of reducing harmonics – Harmonic filters – Telephone interface.

Text Books

1. Padiyar. K.R, "HVDC Power Transmission System", New Age International Private Limited, New Delhi, 2nd Edition, 2010.
2. Rao S., "EHV-AC, HVDC Transmission and Distribution Engineering (Theory, Practice and Solved Problems)", Khanna Publishers, New Delhi, 3rd Edition, 2001.

Reference Books

1. Erich Uhimann, "Power Transmission by Direct Current", Springer / BS Publication, New Delhi, 1st Edition, 2004.
2. Jos Arrillaga, Neville R. Watson, Y. H. Liu Arrilaga J., "Flexible Power Transmission – The HVDC Options", John Wiley & Sons, New Delhi, 2007.
3. Chan-Ki Kim, Vijay K. Sood, Gil-Soo Jang, Seong-Joo Lim, Seok-Jin Lee, "HVDC Transmission: Power Conversion Applications in Power Systems", Wiley-IEEE Press, New Delhi, Illustrated Edition, 2009.

12EE263 HVDC AND FACTS

Credits: 3:0:0

Course Objective

- To study the various types of Modern transmission systems
- To impart knowledge on HVDC and FACTS
- To study the effect of FACTS controllers on AC transmission system

Course Outcome

- Understand the various components of HVDC and FACTS.
- Analyze the different control schemes of HVDC and FACTS systems.

- Derive the optimal operating condition for HVDC and FACTS systems.

Unit I
HIGH VOLTAGE DIRECT CURRENT (HVDC): HVDC system Introduction -Principle of operation, Standard transmission voltages, Power handling capacity and line losses.

Unit II
DC POWER TRANSMISSION TECHNOLOGY: comparison of AC and DC transmission, application of DC transmission – Description of DC transmission system planning for HVDC transmission-modern trends in DC transmission.

Unit III
FACTS: Basic concepts of static VAR Compensator (SVC) – Thyristor Switched Series capacitor (TCSC) – Unified power flow controller (UPFC).

Unit IV
TYPES OF FACTS & APPLICATIONS: Operation of SVC-Voltage control by SVC-influence of SVC on system voltage- Operation of the TCSC – Different modes of operation-Applications of SVC and TCSC.

Unit V
EMERGING FACTS CONTROLLERS Static Synchronous Compensator (STATCOM) – Principle of operation – V-I Characteristics – Unified Power Flow Controller (UPFC) – Principle of operation – Modes of Operation

Text Book
1. K.R.Padiyar, "HVDC Power Transmission System", New Age International Publishers, 2nd Edition, 2010.
2. Narain G. Hingorani, "Understanding FACTS -Concepts and Technology of Flexible AC Transmission Systems", Standard Publishers Distributors, Delhi, 2001.

Reference Book
1. Wadhwa C.L., "Electrical Power Systems", New Age International Publishers, 4th Edition, 2005.
2. Mohan Mathur.R., Rajiv. K.Varma, "Thyristor – Based Facts Controllers for Electrical Transmission Systems", IEEE press and John Wiley & Sons, Inc 2000.
3. Mafen Abdel – Salam, Hussein Anis, Ahdab E-Moshedy, Roshdy Padwan "High Voltage Engineering – Theory & Practice", Marcel Dekker Incorporation, 2000.

12EE301 POWER SEMICONDUCTOR DEVICES

Credits: 4:0:0

Course Objective
- To understand various static and dynamic performances of static switches.
- To familiarize the student on switching and steady state characteristics power electronic devices.
- To analyze the control circuits and switching losses in power devices.

Course Outcome

- Design switching using power semiconductor devices.
- Specify design criteria (power, efficiency, ripple voltage and current, harmonic distortions, power factor).
- Select the components, interpret terminal characteristics of the components, model components, design circuit, and understanding operation of power electronics circuits.

Unit I

INTRODUCTION: Status of Development of power semiconductor Devices - Types of static switches – Controlled and uncontrolled - Ideal and real switches - Static and dynamic performance - Use of heat sinks - Switching losses. Power Diodes: Types - Electrical rating - Switching and steady state characteristics - switching aid circuits - Series and parallel operation - Schottky diodes – Fast recovery diodes.

Unit II

THYRISTORS: Physics of device operation - Electrical rating - Switching and steady state characteristics – Gate circuit requirements - Protection - Series and parallel operation - Driver circuit - Types of Thyristors: Asymmetrical Thyristor - Reverse conducting Thyristor - Light fired Thyristor - switching losses.

Unit III

SPECIAL TYPES OF THYRISTORS: TRIACs, GTOs and MCTs: Electrical rating - Switching and steady state characteristics - protection - Gate circuit requirements-Turn ON and Turn OFF methods – Series, Parallel operation of GTO Thyristors.

Unit IV

POWER TRANSISTORS & POWER MOSFETS: Power Transistors: Types - Ratings - Static and switching characteristics - Driver circuit - Switching aid circuit - Power Darlington. Power MOSFETS: Types - Comparison with BJTs - Structure - Principle of operation - Switching losses - Driver circuit - Switching aid circuit.

Unit V

IGBTS & EMERGING DEVICES: Comparison with power BJT and MOSFET - Structure, Principle of working – Switching characteristics - Gate drive requirements. Emerging Devices: SITs-characteristics – Power Integrated circuit - Characteristics - Field Controlled Thyristors - New semiconductor materials for devices - Intelligent power modules.

Text Book

1. Muhammad H. Rashid, "Power Electronics - Circuits, Devices and Applications", Pearson Education, New Delhi, 2011.

Reference Books

1. Ned Mohan, et.al, "Power Electronics converters, Applications and Design", Wiley India, New Delhi, 3rd Edition 2007.
2. B. Jayant Baliga, "Fundamentals Of Power Semiconductor Devices", Springer-Verlag Publications, New Delhi, 1st Edition, 2008
3. Robert Perret, "Power Electronics Semiconductor Devices", Wiley-ISTE Publications, New Delhi, New Edition, 2009.

4. Dr. P.S. Bhimbra, “Power Electronics”, Khanna Publishers Ltd., New Delhi, 2011.

12EE302 POWER CONVERTER ANALYSIS – I

Credits: 3:1:0

Course Objective

- To give in depth knowledge of the various power electronics circuits
- To analyze the behavior of the Power Electronic circuits along with the design.
- To understand the control methods of various power converters.

Course Outcome

- Analyze the circuits and select them for the suitable applications.
- Trouble shooting the power electronic circuits
- Design various firing circuits for the converters

Unit I

SINGLE PHASE AC-DC CONVERTER: half controlled and fully controlled converters with R-L, R-L-E loads and freewheeling diodes – continuous and discontinuous modes of operation - inverter operation –performance parameters- Dual converter – Effect of source impedance – Single Phase Series Converter operation

Unit II

THREE PHASE AC – DC CONVERTER: Semi and fully controlled converter with R, R-L loads and freewheeling diodes – inverter operation– dual converter– performance parameters – effect of source impedance and over lap – 12 pulse converter.

Unit III

DC – DC CONVERTERS: Principles of step-down and step-up converters – Analysis of buck, boost, buck-boost and Cuk Regulators – Four quadrant chopper.

Unit IV

AC VOLTAGE CONTROLLERS: Principle of phase control: single phase and three phase controllers – analysis with R and R-L loads – PWM Control – Matrix Converter

Unit V

CYCLOCONVERTERS: Principle of operation – Single phase and three phase cycloconverters – Load Commutated cycloconverters

Text Book

1. Muhammad H. Rashid, “Power Electronics - Circuits, Devices and Applications”, Pearson Education, New Delhi, 2011.

Reference Books:

1. Ned Mohan, et.al, “Power Electronics converters, Applications and Design”, Wiley India, New Delhi, 3rd Edition 2007.
2. Joseph Vithayathil, “Power Electronics: Principles and Applications”, Tata McGraw-Hill Education India Private Limited, New Delhi, 2010.
3. Vedam Subrahmanyam, “Power Electronics”, New Age International (P) Limited, New Delhi, Revised 2nd Edition, 2011.

4. Muhammad H. Rashid, “Power Electronics Handbook: Devices, Circuits, and Applications”, Butterworth-Heinemann, 2010.
5. Bhimbra P.S., “Power Electronics”, Khanna Publishers Ltd., New Delhi, 2011.

12EE303 POWER CONVERTER ANALYSIS – II

Credits: 3:1:0

Course Objective:
- To give in depth knowledge of the inverters and its configurations
- To Analyze the behavior of the Power Electronic circuits along with their design
- To understand the control methods of various power converters

Course Outcome:
- Analyze the circuits and select them for the suitable applications
- Construct PE system for specific applications
- Design various firing circuits for the converters

Unit I
SINGLE PHASE INVERTERS: Principle of operation of half and full bridge inverters – Performance parameters – Voltage control of single phase inverters using various PWM techniques – various harmonic elimination techniques

Unit II
THREE PHASE VOLTAGE SOURCE INVERTERS: 180 degree and 120 degree conduction mode inverters with star and delta connected loads – voltage control of three phase inverters: sinusoidal PWM, space vector modulation techniques.

Unit III
CURRENT SOURCE INVERTERS: Single phase CSI with ideal switches – Capacitor commutated inverters with R Load – Auto sequential commutated inverter (ASCI) –comparison of current source inverter and voltage source inverters

Unit IV
MULTILEVEL INVERTERS: Multilevel concept – diode clamped – flying capacitor – cascade type multilevel inverters - Comparison of multilevel inverters - application of multilevel inverters

Unit V
RESONANT INVERTERS: Series and parallel resonant inverters - voltage control of resonant inverters – Class E resonant inverter – resonant DC – link inverters.

Text Book

1. Muhammad H. Rashid, “Power Electronics - Circuits, Devices and Applications”, Pearson Education, New Delhi, 2011.

Reference Books

1. Ned Mohan, et.al, “Power Electronics converters, Applications and Design”, Wiley India, New Delhi, 3rd Edition 2007.
2. Joseph Vithayathil, “Power Electronics: Principles and Applications”, Tata McGraw-Hill Education India Private Limited, New Delhi, 2010.
3. Vedam Subrahmanyam, “Power Electronics”, New Age International (P) Limited, New Delhi, Revised 2nd Edition, 2011.
4. Muhammad H. Rashid, “Power Electronics Handbook: Devices, Circuits, and Applications”, Butterworth-Heinemann, 2010.
5. P.S. Bhimbra, “Power Electronics”, Khanna Publishers Ltd., New Delhi, 2011.

12EE304 SOLID STATE DC DRIVES

Credits: 3:1:0

Course Objective

- To understand the fundamentals of various electromechanical systems.
- To understand the basic concept of DC Drives.
- To understand the various control techniques involved with DC Drives.

Course Outcome:

- Design and Analyze different control techniques of DC Drives.
- Select suitable DC Drive for different requirements
- Apply appropriate control method for the application.

Unit I

DC MOTORS FUNDAMENTALS AND MECHANICAL SYSTEMS: DC motor- Types, induced emf, speed-torque relations; Speed control – Armature and field speed control; Ward Leonard control – Constant torque and constant horse power operation - Introduction to high speed drives and modern drives. Characteristics of electrical system – dynamic equations, components of torque – Types of load requirements of drives characteristics – Multi-quadrant operation; Drive elements, types of motor duty and selection of motor rating.

Unit II

CONVERTER CONTROL: Principle of phase control – Fundamental relations; Analysis of series and separately excited DC motor with single-phase and three-phase converters – waveforms, performance parameters, performance characteristics – Continuous and discontinuous armature current operations; Current ripple and its effect on performance; Operation with freewheeling diode; Implementation of braking schemes; Drive employing dual converter.

Unit III

CHOPPER CONTROL: Introduction to time ratio control and frequency modulation- Class A, B, C, D and E chopper controlled DC motor – performance analysis, multi-quadrant control - Chopper based implementation of braking schemes-Multi-phase chopper- Related problems.

Unit IV

CLOSED LOOP CONTROL: Modeling of drive elements – Equivalent circuit, transfer function of self, separately excited DC motors; Linear Transfer function model of power converters; Sensing and feeds back elements - Closed loop speed control – current and speed loops, P, PI and PID controllers – response comparison. Simulation of converter and chopper fed DC drive.

Unit V
DIGITAL CONTROL OF D.C DRIVE: Phase Locked Loop and micro-computer control of DC drives – Program flow chart for constant horse power and load disturbed operations; Speed detection and gate firing.

Text Book

1. Gopal K Dubey, "Fundamentals of Electric Drives", Narosa Publishing House, 2^{nd} Edition, New Delhi, 2006.

Reference Books

1. Pillai S.K., "Analysis of Thyristor Power Conditioned Motors", University Press, 2005.
2. Krishnan. R, "Electric Motor Drives: Modeling, Analysis and Control", Prentice Hall of India Private Limited, New Delhi, 2009.
3. Sen P.C., "Thyristor DC Drives", John Wiley, New York, 1981.
4. Vedam Subrahanyam, "Electric Drives: Concepts & Applications", McGraw-Hill Education, New Delhi, 2010.
5. Singh M.D., K Khanchandani, "Power Electronics", McGraw-Hill Education Private Limited, New Delhi, 2006.

12EE305 SOLID STATE AC DRIVES

Credits: 3:1:0

Course Objective

- To understand the fundamentals of various electromechanical systems
- To understand the basic concept of AC Drives
- To understand the various control techniques involved with AC Drives

Course Outcome

- Design and Analyze different control techniques of AC Drives
- Select suitable AC Drive for different requirements
- Apply appropriate control method for the application

Unit I
INTRODUCTION TO INDUCTION MOTORS: Steady state performance equations – Rotating magnetic field – torque production, Equivalent circuit– Variable voltage, constant frequency operation – Variable frequency operation, constant Volt/Hz operation. Drive operating regions, variable stator current operation, different braking methods.

Unit II
VSI AND CSI FED INDUCTION MOTOR CONTROL: AC voltage controller circuit – six step inverter voltage control – closed loop variable frequency PWM inverter with dynamic

braking – CSI fed IM variable frequency drives – comparison – Impact of Harmonics on the drive performance.

Unit III

ROTOR CONTROLLED INDUCTION MOTOR DRIVES: Static rotor resistance control - injection of voltage in the rotor circuit – Static scherbius drives - Power factor considerations – Modified Kramer drives

Unit IV

VECTOR CONTROL: Field oriented control of induction machines – Theory – DC drive analogy – Direct and Indirect methods – Flux vector estimation - Direct torque control of Induction Machines – Torque expression with stator and rotor fluxes, DTC control strategy.

Unit V

SYNCHRONOUS MOTOR DRIVES: Wound field cylindrical rotor motor – Equivalent circuits – performance equations of operation from a voltage source – Power factor control and V curves – starting and braking, self control – Load commutated Synchronous motor drives - Brush and Brushless excitation.

Text Book

1. Gopal K Dubey, "Fundamentals of Electric Drives", Narosa Publishing House, 2nd Edition, New Delhi, 2006.

Reference Books

1. Bose Bimal K., "Modern Power Electronics And AC Drives", Prentice Hall of India Pvt. Ltd., New Delhi, 2009.
2. Pillai S.K., "Analysis of Thyristor Power Conditioned Motors", University Press, 2005.
3. Peter Vas, "Vector Control of AC Machines", Oxford University Press, 1990.
4. Krishnan. R, "Electric Motor Drives: Modeling, Analysis and Control", Prentice Hall of India Pvt. Ltd., New Delhi, 2009.
5. Vedam Subrahanyam, "Electric Drives: Concepts & Applications", Tata McGraw-Hill Education India Private Limited, New Delhi, 2010.

12EE306 GENERALISED THEORY OF ELECTRICAL MACHINES

Credits: 3:1:0

Course Objective

- To impart knowledge on the generalized representation and steady state analysis of Synchronous Machines.
- To impart knowledge on the analysis of harmonics in Induction machine using Matlab/Simulink.
- To impart knowledge on the generalized representation of Synchronous Machine using Matlab/Simulink.

Course Outcome

- Describe the Generalized Representation of machines and their analysis.
- Describe the steady state analysis and transient analysis of various machines.

- Describe the performance of Induction and Synchronous machines and their representation.

Unit I

GENERALIZED THEORY: Conversions - Basic two pole machines - Transformer with movable secondary –Transformer voltage and speed voltage - Kron's Primitive Machine - Analysis of Electrical Machines.

Unit II

BASICS OF ELECTRICAL MACHINES AND TRANSFORMATIONS: Electrical radians and Synchronous speed – Flux per pole and Induced voltage – Spatial mmf distribution of a winding – winding inductances – Developed torque of a Uniform airgap machine – Invariance of Power – Three phase transformations – Clarke’s Transformation – Park’s Transformation – dq0 Transformation applied to line elements – Transformation between abc and Stationary dq0 – Transformation between abc and Rotating dq0 – Case studies – Simulation of various transformations using MATLAB/SIMULINK.

Unit III

DC MACHINES: Generalized Representation - Generator and motor operation - Operation with displaced brushes - Steady state and transient analysis - Sudden short circuit - Sudden application of inertia load - Electric braking of DC motors – Case Studies – Simulation on MATLAB/SIMULINK - Methods of braking – Startup and Loading of a shunt dc Generator and Resistance starting of a DC Shunt Motor.

Unit IV

INDUCTION MACHINES: Introduction – Construction of Three-Phase Induction Machine – Rotating Magnetic field and slip – Circuit Model of a Three-phase Induction Machine – Machine Model in Arbitrary dq0 Reference frame – dq0 stationary and Synchronous Reference frames – Steady state model – Transient Model – Linearized Model – Case Studies – Simulation of Induction Machine in the Stationary Reference frame using MATLAB/SIMULINK.

Unit V

SYNCHRONOUS MACHINES: Introduction – Mathematical Model – Transformation to the Rotor’s dq0 Reference frame – Flux Linkages in terms of Winding Currents – Referring rotor Quantities to the stator – Voltage Equations in the rotor’s qd0 Reference frame – Electromagnetic Torque – Steady State Operation – Transient Operation – Calculating Machine Parameters – Higher Order Models – Case Studies - Simulation on MATLAB/SIMULINK - Six Phase Synchronous Machines - Three phase Synchronous Machine - Synchronous Machine Model with Unequal Stator and Rotor Mutual and Coupling of Rotor Circuits.

Text Books

1. Bimbhra P.S., “Generalized Theory of Electrical Machines”, Khanna Publishers Limited, New Delhi, 5th Edition, 2011.
2. Paul C.Krause, Oleg Wasynczuk and Scott D.Sudhoff., “Analysis of Electric Machinery and Drive Systems”, Wiley India Pvt Ltd, New Delhi, 2nd Edition, 2010.

Reference Books

1. Chee-Mun Ong., “Dynamic Simulation of Electric Machinery using Matlab/Simulink”, Prentice Hall PTR, Upper Saddle River, NJ, 1998.

2. Bandyopadhyay M. N., "Electrical Machines: Theory and Practice" PHI Learning, New Delhi, 2007.
3. Gupta J B." Theory & Performance Of Electrical Machines", S. K. Kataria & Sons, New Delhi, 2011.

12EE307 SPECIAL MACHINES AND CONTROLLERS

Credits: 4:0:0

Course Objective:

- To impart knowledge on the construction, principle of operation and the control techniques of stepper motor and Switched Reluctance Motors.
- To study the characteristics of permanent magnet brushless DC motor
- To understand the control methods, applications of PMSM and linear motors

Course Outcome:

- Differentiate the working of different drives and performance
- Select a suitable special machine drive based on the application
- Incorporate an appropriate control scheme for the application specified

Unit I

STEPPER MOTORS: Constructional features – Principle of operation – Modes of excitation – torque production in Variable reluctance (VR) stepping motor – dynamic characteristics – Drive systems and circuit for Open loop control – closed loop control of stepping motor – applications.

Unit II

SWITCHED RELUCTANCE MOTORS: Constructional features - Principle of operation – Torque equation – Power Converters – Torque Speed characteristics – Voltage, Current and Single Pulse Control Techniques – Torque Control - Sensorless control – applications.

Unit III

PERMANENT MAGNET BRUSHLESS DC MOTORS: Commutation in DC motors – Electronic commutators – Position Sensors – Multiphase Brushless motor - Square wave permanent magnet brushless motor drives – Torque and Emf equation – Torque-speed characteristics – Sensorless control – applications.

Unit IV

PERMANENT MAGNET SYNCHRONOUS MOTORS: Principle of operation – EMF – power input and torque expressions – Phasor diagram – Power controllers – Torque speed characteristics – Self control – Vector control – Current control schemes – applications.

Unit V

LINEAR MOTORS: Linear Motors: Linear Induction Motor (LIM) classification – Construction – Principle of operation – Concept of Current sheet –Goodness factor – DC Linear Motor (DCLM) types – Circuit equation – DCLM control applications – Linear Synchronous Motor – Principle of operation – circuit equation – application.

Text Book

1. Venkataratnam K., "Special Electric Machines", CRC Press, Boca Raton, U.S.A., 2008.

Reference Books

1. Krishnan Ramu, R. Krishnan, "Switched Reluctance Motor Drives", CRC Press, Boca Raton, U.S.A., 2001
2. Kenjo, T, "Stepping Motors and Their Microprocessor Control", Clarendon Press, Oxford, 1989.
3. Naser A, Boldea I, "Linear Electric Motors: Theory, Design And Practical Application", Prentice Hall Inc., New Jersey, 1987
4. Kenjo, T, Naganori, S "Permanent Magnet And Brushless DC Motors", Clarendon Press, Oxford, 1989.

12EE308 ADVANCED DIGITAL SIGNAL PROCESSING

Credits :4:0:0

Course Objective

- To have an overview of signals and systems and DFT & FFT Transforms.
- To study the design of IIR & FIR filters.
- To study the applications of DSP techniques in processors.

Course Outcome

- Understand types of digital signals and Transforms and its application to signals and systems.
- Design of IIR & FIR filters.
- Understand different DSP processors and basic programming skills.

Unit I

REVIEW OF DISCRETE TIME SYSTEMS: Discrete time Signals-Sequences –Stability and Causality –Frequency domain Representation of Discrete time Systems and Signals –Two-dimensional Sequences and Systems –Z-Transform –Z- Transform Theorems and Properties –Two-dimensional Z Transform. Structures for discrete time system – Direct, cascade and parallel forms –Lattice structure.

Unit II

DISCRETE FOURIER TRANSFORM: Representation of Periodic Sequences-the Discrete Fourier Series –Properties of the Discrete Fourier Series –Sampling, Z-Transform –Discrete Fourier Transform –properties of discrete Fourier Transform –Linear Convolution –Decimation in Time and Decimation in Frequency –FFT Algorithms.

Unit III

DIGITAL FILTER DESIGN TECHNIQUES: Introduction – Design of IIR Digital Filters from Analog Filters –Analog –Digital Transformation –Properties of FIR Digital Filters –Design of FIR Filters Using Windows –Comparison of IIR and FIR Digital Filters.

Unit IV

FINITE REGISTER LENGTH EFFECTS: Introduction - Effects of coefficient on Quantization –Quantization in Sampling -Analog Signals - Finite Register Length effects in realizations of Digital Filters – Discrete Fourier Transform computations.

Unit V

ADVANCED DSP PROCESSORS: Commercial DSP devices – TMS C240 processor, TMS320C, ADSP 2181 processor – Architecture – Addressing modes – Program control – Instruction and programming –Simple programs.

Text Books

1. Emmanuel C. Ifeachor, Barrie W. Jervis, "Digital Signal Processing: A Practical Approach", Pearson Education India Series, New Delhi, 2^{nd} Edition, 2004
2. Sanjit K Mitra, "Digital Signals Processing: A Computer Based Approach", Tata McGraw- Hill Education India Private Limited, New Delhi 2^{nd} Edition, 2004.

Reference Books

1. Alan Oppenheim. V., Ronald W.Schafer, "Digital Signal Processing", Prentice Hall of India Private Limited. New Delhi, 2^{nd} Edition 1989.
2. John G. Proakis, Manolakis. D.G, "Digital Signal Processing: Principles Algorithms and Applications," Prentice Hall of India, New Delhi, 2004.
3. Avatar Singh, Srinivasan. S., "Digital Signal Processing: Implementation using DSP Microprocessors with Examples from TMS 320C54XX, Thompson Brooks/Cole, Florence, USA 2004.

12EE309 DSP BASED CONTROL OF ELECTRIC DRIVES

Credits: 4:0:0

Course OBJECTIVE

- Basics of motion control Digital Signal Processor and generation of PWM Signals
- Concept of Event Handling, Interrupts and Interface Conversion
- Control of Motor using a DSP

Course OUTCOME

- Select a suitable Digital Signal Processor for the control of the machine.
- Implement the DSP based Control for the machine.
- Use real time DSP system for online control

Unit I

DSP CONTROLLERS AND INSTRUCTION SET: TMS 320 family overview – 320 C24X Series of DSP controllers – Architecture overview – C24X CPU internal bus structure – Memory – Central processing unit – Memory and I/O spaces - Overview of Memory and I/O spaces – Program control – Addressing modes – System configuration and interrupts – Clocks and low power modes – Digital input/output (I/O). Instruction set: Assembly language instructions – Instruction set summary – Instruction description – Accumulator, arithmetic and logic instructions – Auxiliary register and data page pointer instructions – TREG, PREG, and multiply instructions – Branch instructions – Control instructions – I/O and memory instructions.

Unit II

GPIO, INTERRUPTS, EVENT MANAGERS AND ANALOG TO DIGITAL CONVERTER: General Purpose I/O Overview – Multiplexing and General Purpose I/O Control Registers – Using the General Purpose I/O ports – Introduction to Interrupts – Interrupt hierarchy – Interrupt Control Registers – Initializing and servicing interrupts in Software - Overview of the Event Manager – Event Manager Interrupts – General Purpose Interrupts – General Purpose Timers –

Compare units – Capture units and Quadrature Encoded Pulse (QEP) circuitry – Operation of Analog to Digital Converter – Analog to Digital Converter usage.

Unit III

CLARKE'S & PARK'S TRANSFORMATION AND SPACE VECTOR MODULATION: Introduction – Clarke's Transformation – Park's Transformation – Transformations between reference frames – Field Oriented Control (FOC) transformations – implementing Clarke's and Park's transformation using DSP – Principle of Constant V/F control for Induction Motors – Space Vector PWM Technique – DSP Implementation.

Unit IV

DSP BASED VECTOR CONTROL OF INDUCTION MOTORS: Introduction – Reference frame theory – Induction motor model in the arbitrary q-d-0 reference frame – Field Oriented Control – Direct and Indirect approaches – Induction motor speed control system – Implementation of Field Oriented Speed Control of Induction Motor.

Unit V

DSP BASED CONTROL OF SPECIAL MACHINES: Principle of Stepper Motor – Stepper motor drive system – Implementation of DSP based Stepper Motor – Fundamentals of BLDC motor – BLDC Motor Control System – Implementation of DSP based BLDC Motor Control – Fundamental of Switched Reluctance Motor – Closed loop control strategy – Implementation of DSP based Switched Reluctance Motor drive.

Text Book

1. Hamid A. Toliyat, Steven G.Campbell, "DSP based Electromechanical Motion Control", CRC Press 2004.

Reference Books

1. Bimal K. Bose, "Power Electronics and Variable Frequency Drives – Technology and Applications", IEEE Press, 1997.
2. Peter Vas, "Vector Control of AC Machines", Oxford University Press, 1990.
3. Ned Mohan, "Advanced Electric Drives: Analysis, Control and Modeling using SIMULINK", John Wiley & Sons Ltd., 2001.

12EE310 ADVANCED TOPICS IN POWER ELECTRONICS

Credits: 4:0:0

Course Objective

- To impart the knowledge of latest advances in the field of power electronics
- To understand the basics of modeling of power converters
- To introduce the phenomena of non-linearity in power converters

Course Outcome

- To understand the effect of power electronic converter in a system using their models and transfer functions
- Ability to design filters for converters
- To understand the impact of non-linear phenomena in power electronic circuits

Unit I

AC EQUIVALENT CIRCUIT MODELING: Basic AC modeling approach – State-space averaging – Circuit averaging and averaged switch modeling – Canonical circuit model – Modeling the pulse-width modulator – Problems.

Unit II
CONVERTER TRANSFER FUNCTIONS: Analysis of converter transfer functions – Graphical construction of impedances and transfer functions – Graphical construction of converter transfer functions – Measurement of AC transfer functions and impedances – Problems.

Unit III
INPUT FILTER DESIGN: Introduction – Effect of an input filter on converter transfer functions – Buck converter example – Design of a damped input filter – Problems

Unit IV
NON-LINEAR PHENOMENA IN DC-DC CONVERTERS: Basics of bifurcation and chaos theory - Border collision bifurcations in the current mode controlled boost converter - Bifurcations and chaos in the latched voltage controlled buck converter - Routes to chaos in the voltage controlled buck converter without latch - Saddle-node and Neimark bifurcations in PWM dc-dc converters - Nonlinear analysis of the operation in discontinuous conduction mode - Nonlinear phenomena in the Cuk converter

Unit V
NON-LINEAR PHENOMENA IN OTHER POWER ELECTRONICS CIRCUITS AND SYSTEMS: Modeling nonlinear inductor circuits - Inverters under tolerance band control - Nonlinear noise interactions in converters/inverters - Nonlinear phenomena in the current control of induction motors - Analysis of stability and bifurcation in power electronic induction motor drive systems

Text Books

1. Erickson R.W., Maksimovic D., "Fundamentals of Power Electronics", 2nd Edition, Kluwer Academic Publishers, USA, 2004.
2. Banerjee S., Varghese G. C., "Non-linear phenomena in Power Electronics: Attractors, Bifurcations, Chaos and Non-linear control", IEEE press, New York, 2001.

Reference Books

1. Chi Kong Tse, "Complex Behaviour of Switching Power Converters", CRC Press, New York, 2004.
2. Ned Mohan, T. M. Undeland, W. P. Robbins, "Power Electronics: Converters, Applications and Design", John Wiley & Sons, USA, 3rd Edition, 2003.
3. Hua Bai, Chris Mi, "Transients of Modern Power Electronics", John Wiley & Sons, UK, 2011.

12EE311 POWER ELECTRONICS LABORATORY

Credits: 0:0:2

1. Characteristics of Power Semiconductor Devices – Thyristor, MOSFET, IGBT

2. Design, Testing of Single Phase Full Bridge Converter Bridge on R & R – L Load
3. Design, Testing of Single Phase Semi Converter Bridge on R & R – L Load
4. Design, Testing of Three Phase Half wave Converter with R & R – L Load
5. Design, Testing of MOSFET based DC Chopper on R & R – L Load
6. Design, Testing of Single Phase AC Voltage Controller with R & R – L Load
7. Design, Testing of Single Phase Series Inverter with R & R – L Load
8. Design, Testing of Single Phase Cyclo-converter with R & R – L Load
9. Design of triggering circuits using microcontrollers
10. Switched Mode Power Supply (SMPS)
11. Simulation of Semi & Full Bridge Converter using PSIM
12. Simulation of AC Voltage Controller using MATLAB

12EE312 ELECTRIC DRIVES AND CONTROL LABORATORY

Credits: 0:0:2

1. IGBT Based Inverter Fed Induction Motor Drive
2. Chopper Fed DC Motor Drive
3. Multilevel Inverter Fed Induction Motor Drive
4. DSP (TMS320F2812) Based Switched Reluctance Motor Drive
5. Space Vector PWM Control of Induction Motor.
6. Three Phase Rectifier Fed DC Motor Drive
7. Three Phase AC Voltage Controller Fed Induction Motor Drive
8. Matrix Converter Fed Induction Motor Drive
9. DSP (TMS320F2407) Based Permanent Magnet Synchronous Motor Drive
10. Control of DC Motor using dSPACE ACE 1103 Control Kit
11. DSP (TMS320F2812) BLDC Motor Drive
12. FPGA Based Motor Control
13. Measurement and recording of quality of Power Source.

12EE313 PHOTOVOLTAIC SYSTEMS

Credits: 4:0:0

Course Objective

- To provide necessary knowledge about the modeling, design and analysis of various PV systems
- To show that PV is an economically viable, environmentally sustainable alternative to the world's energy supplies
- To understand the power conditioning of PV system’s power output

Course Outcome:

- Model, analyze and design various photovoltaic systems
- Know the feasibility of PV systems as an alternative to the fossil fuels
- Design efficient stand alone and grid connected PV power systems

Unit I

INTRODUCTION TO PHOTOVOLTAIC (PV) SYSTEMS: Historical development of PV systems- Overview of PV usage in the world-Overview of PV usage in India- Solar Map-Solar energy potential for PV- irradiance, solar radiation and spectrum of sun- geometric and atmospheric effects of sunlight-Photovoltaic effect-conversion of solar energy into electrical energy.

Unit II
SOLAR CELLS AND ARRAYS: Behavior of solar cells-basic structure and characteristics: types - equivalent circuit-modeling of solar cells including the effects of temperature, irradiation and series/shunt resistances on the open-circuit voltage and short-circuit current-Solar cell arrays- PV modules-PV generators- shadow effects and bypass diodes- hot spot problem in a PV module and safe operating area- Terrestrial PV module modeling- Interfacing PV modules with different loads.

Unit III
ENERGY STORAGE ALTERNATIVES FOR PV SYSTEMS: Methods of Energy storage – Pumped Energy Storage – Compressed Energy Storage – Storage batteries- lead-acid- nickel-cadmium- nickel-metal-hydride and lithium type batteries. Small storage systems employing ultra capacitors- properties- modeling of batteries.

Unit IV
INVERTERS FOR PV SYSTEMS: Inverter control topologies for standalone and grid-connected operation-Analysis of inverter at fundamental frequency and at switching frequency-Feasible operating region of inverter at different power factor values for grid connected systems and stand-alone PV systems. Consumer applications-residential systems-PV water pumping-PV powered lighting-rural electrification.

Unit V
POWER CONDITIONING OF PV SYSTEMS: Power conditioning and maximum power point tracking (MPPT) -Maximum power point tracking (MPPT) algorithms-Grid-connected PV systems-Active power filtering with real power injection-Modeling and simulation of complete stand-alone and grid-connected PV systems.

Text Books

1. Goetzberger, Hoffmann V. U., “Photovoltaic Solar Energy Generation”, Springer-Verlag, Berlin, 2005.
2. Castaner L., Silvestre S., “Modeling Photovoltaic Systems Using PSpice”, John Wiley & Sons, England, 2002.

Reference Books

1. Komp R.J., “Practical Photovoltaics: Electricity from solar cells”, Aatec Publications, Michigan, 3rd Edition, 2001.
2. Patel M. R., “Wind and Solar Power Systems Design, Analysis, and Operation”, CRC Press, New York, 2nd Edition, 2005.
3. Jenny Nelson, “The physics of solar cells”, Imperial College Press, London, 2004.

12EE314 POWER ELECTRONIC CIRCUITS

Credits: 3:1:0

Course Objective

- To impart the knowledge of various conversion techniques of electrical energy using power electronic components.
- To establish the link between efficient usage of power and conservation of energy resources of the world.
- To provide the design details of various power electronic converters.

Course Outcome

- Understand the significance of the characteristics of various power semiconductor switches
- Design of power electronic conversion systems
- Understand various modulation (control) techniques such as pulse width modulation and selective harmonic elimination.

Unit I

POWER SEMICONDUCTOR SWITCHES: Classification of power converters-Ideal switch and rectifier-Semiconductor power switching devices used in power electronic circuits: Diode, bipolar junction transistor (BJT), silicon controlled rectifier (thyristor), Gate turn-off thyristor (GTO), MOSFET, insulated gate bipolar transistor (IGBT), integrated gate commutated thyristor (IGCT)- I-V characteristics, operation principles, maximum voltage and current ratings. Gating circuits for controlled semiconductor switches- Series and parallel commutation circuits for turning-off of thyristors.

Unit II

AC TO DC CONVERTERS: Single phase and three phase bridge rectifiers, half controlled and fully controlled converters with RL, RLE loads, Freewheeling diode, Dual Converter. Evaluation of performance parameter, Input harmonics and output ripple, smoothing inductance, power factor, effect of source impedance, overlap, Design of converter circuits – Snubber circuit design – Control circuit strategies.

Unit III

DC TO DC CONVERTERS: DC Choppers: Step down dc chopper with R, RL and RLE loads – Control strategies – Continuous and discontinuous current operations – Two quadrant and four quadrant DC chopper– Multiphase DC chopper – Switching mode regulators: Buck, Boost, Buck-Boost and CUK regulators – Chopper circuit design – Control circuit strategies.

Unit IV

INVERTERS & RESONANT CONVERTERS: Single phase and Three phase bridge inverters – Evaluation of performance parameters – Voltage control and Waveform improvement Techniques – Current source inverters – Inverter circuit design-Introduction – Classification – Resonant Switch – Quasi-Resonant Converters – Multi resonant Converters.

Unit V

AC PHASE CONVERTER: Principle of phase control, single-phase bidirectional controllers with R, L and R-L loads, Three-phase bidirectional Controllers, different Configurations, Analysis with pure R and L loads. Principle of operation – single phase and three phase cyclo-converters – Control circuit strategies.

Text Book

1. Rashid M.H., “Power Electronics Circuits, Devices and Applications”, Prentice Hall India, New Delhi, 2003.

Reference Books

1. Sen P.C., “Modern Power Electronics”, Tata McGraw-Hill Education India Private Limited, New Delhi, 2004.
2. Ned Mohan, Tore M. Undeland, William P Robbins, “Power Electronics: Converters, Applications, and Design”, John Wiley and Sons Inc., New York, 2003.
3. Joseph Vithayathil, “Power Electronics”, New Age International (P) Limited, New Delhi, 2010.
4. Singh M.D., Khanchandani K B, “Power Electronics”, Tata McGraw-Hill Education India Private Limited, New Delhi, 2nd Edition, 2006.

12EE315 SOLAR THERMAL ENERGY CONVERSION

Credits: 4:0:0

Course Objective

- To provide a comprehensive engineering basics for solar thermal system and its design
- Know about the different technologies of solar thermal systems.
- Know about the different types of solar heating & cooling.

Course Outcome

- Calculate the Solar Radiation on Horizontal and Tilted Surfaces
- Analyze the performance of Different Solar Collectors
- Choose the right type of solar collector for an application and design Solar heating and cooling systems.

Unit I

RADIATIVE PROPERTIES AND CHARACTERISTICS OF MATERIALS: Reflection from ideal specular, ideal diffuse and real surfaces, Selective Surfaces: Ideal coating characteristics; Types and applications; Anti-reflective coating; Preparation and characterization. Reflecting Surfaces and transparent materials.

Unit II

FLAT-PLATE COLLECTORS: Energy balance for Flat Plate Collectors; Thermal analysis; Heat capacity effect; Testing methods; Types of Flat Plate Collectors: Liquid Flat Plate Collectors, Air flat-plate Collectors- Thermal analysis; Evacuated tubular collectors.

Unit III

SOLAR THERMAL ENERGY STORAGE: Types: Sensible storage; Latent heat storage; Thermo-chemical storage. Design of storage system.

Unit IV

CONCENTRATING COLLECTOR: Classification, design and performance parameters; Tracking systems; Compound parabolic concentrators; Parabolic trough concentrators; Concentrators with point focus; Heliostats; Comparison of various designs: Central receiver systems, parabolic trough systems; Solar power plant; Solar furnaces.

Unit V

SOLAR HEATING & COOLING SYSTEM: Solar water heating systems, Liquid based systems for buildings, solar air heating systems, Methods of modeling and design of solar heating system, Cooling requirements of buildings, Vapour absorption refrigeration cycle; Water, ammonia & lithium bromide-water absorption refrigeration systems; solar desiccant cooling.

Text Books

1. Duffie J.A., Beckman W.A., Solar Engineering of Thermal Processes, Wiley-Interscience, New York, 2006.
2. Kalogirou S. A., "Solar thermal collectors and applications," Progress in Energy and Combustion Science, Elsevier Journal, Vol. 30, pp. 231–295, 2004.

Reference Books

1. Yogi Goswami D., Frank Kreith, "Energy Conversion", CRC Press, New York, 2008.
2. "ASHRAE Handbook Authors and Revisers Guide", ASHRAE Inc., Atlanta, 2007.
3. Yogi Goswami D., Frank Kreith, "Principles of Solar Energy", Taylor and Francis, Phildelphia, 2000.

12EE316 ADVANCED CONTROL TECHNIQUES FOR INDUCTION GENERATORS

Credits: 3:1:0

Course Objective

- To understand the transient and steady state modeling of induction generators.
- To give an in-depth knowledge about the different control techniques of induction generators.
- To enhance the students' perspective on optimized control of induction generators which are widely used in renewable energy systems.

Course Outcome:

- Understand the complex control concepts
- Ensuring energy economy and efficiency.
- Apply the optimization techniques for maximum performance

Unit I

MODELING OF INDUCTION GENERATORS: Steady State Model of Induction Generator: Classical Steady State Representation – Generated Power – Induced Torque – Representation of Induction Generator Losses -Transient Model of Induction Generator: Induction Machine in Transient State – State Space Modeling – Partition of the SEIG State Matrix with an RLC load.

Unit II

OPERATION OF INDUCTION GENERATORS: Self Excited Induction Generator: Performance, Voltage Regulation – Magnetizing Curves and Self Excitation – Mathematical Expression. Wound Rotor Induction Generator Systems: Features - Sub and Super synchronous modes - Operation

Unit III
SCALAR CONTROL OF INDUCTION GENERATORS: Scalar Control background – Scalar Control Schemes –Open control schemes – closed loop control schemes– Problems.

Unit IV
VECTOR CONTROL OF INDUCTION GENERATORS: Vector Control – Axis Transformation – Space Vector Notation – Field Oriented Control – direct vector control- indirect vector control- Problems

Unit V
OPTIMIZED CONTROL OF INDUCTION GENERATORS: Optimization Principles – Application of Hill Climbing Control (HCC) for Induction Generators- HCC based Maximum Power Search – Fuzzy Logic Controller based Maximum Power Search - Problems

Text Books

1. Godoy Simões M., Farret F. A., "Renewable Energy Systems: Design and Analysis with Induction Generators," CRC Press, Boca Raton, 2007.
2. Vladislav Akhmatov, "Induction Generators for Wind Power", Multi-Science Publishing Company, UK, 2007.

Reference Books

1. Gilbert M. Masters, "Renewable and Efficient Electric Power Systems", John Wiley & Sons Inc., New Jersey, 2004.
2. Frede Blaabjerg, Zhe Chen, "Power Electronics for Modern Wind Turbines" Morgan & Claypool Publishers, USA, 2006.
3. Loi Lei Lai, Tze Fun Chan, "Distributed Generation: Induction and Permanent Magnet Generators", John Wiley & Sons, England, 2007.

12EE317 ENERGY ENGINEERING

Credits: 4:0:0

Course Objective

- To create environment-friendly and energy-efficient buildings
- To deal with actively harnessing renewable natural resources like solar energy and utilizing materials that cause the least possible damage to the global commons – water, soil, forests and air.
- To deal with global and Indian energy scenario.

Course Outcome

- Effectively manage the energy requirements
- Work out for the new available sources and its utilization
- Manage the environmental issues regarding the energy sources

Unit I

INTRODUCTION TO ENERGY: Definition and Units of energy, power, Forms of energy, Conservation of energy, Energy flow diagram to the earth. Conventional and nonconventional energy sources- Origin of fossil fuels, time scale of fossil fuels, Renewable Energy Resources, Role of energy in economic development and social transformation. Commercial and non-commercial forms of energy, energy consumption pattern and its variation as a function of time,

Unit II

NATIONAL AND GLOBAL ENERGY SCENARIO: Energy resources available in India, urban and rural energy consumption, nuclear energy - promise and future, energy as a factor limiting growth, need for use of new and renewable energy sources. Energy consumption in various sectors, projected energy consumption for the future, exponential increase in energy consumption, energy resources, coal, oil, natural gas, nuclear power and hydroelectricity, impact of exponential rise in energy consumption on global economy, future energy options.

Unit III

VARIOUS RENEWABLE ENERGY SYSTEMS: Introduction and overview of solar, wind, bio-mass, geothermal, oceanic energy systems. Hydrogen and Fuel cells – types-scope, stand-alone power generations- Issues related to grid-connections- Global and National Policies, Funding Agencies.

Unit IV

ENVIRONMENTAL IMPACT: Kyoto protocol- Environmental degradation due to energy production and utilization, Primary and secondary pollution, air, thermal and water pollution, depletion of ozone layer, global warming, biological damage due to environmental degradation. Pollution due to thermal power station and their control. Pollution due to nuclear power generation, radioactive waste and its disposal. Effect of hydroelectric power stations on ecology and environment.

Unit V

SMART GRIDS: Electric grid operation - evolution of Smart Grids, electric system design and operation, technical and tariff changes - integration between utilities and Regional Transmission Organizations. Smart Grid components- metering, demand response, virtual power plants, dynamic pricing, grid enhancement funding, demand analysis, promotion of “green” resources, governmental regulation, network standards, network integration, loan guarantees, consumer privacy -Risks to the Smart Grid - protective measures – Wireless Sensor Networks and its applications – Introduction to Deregulation.

Text Books

1. Vaclav Smil, Energy: A Beginner's Guide, One world Publications, Oxford, 2006.
2. Stuart Borlase, “Smart Grids: Infrastructure, Technology, and Solutions” Taylor and Francis, Boca Raton, 2010

Reference Books

1. Narendra Jadhav, Rajiv Ranjan, Sujan Hajra, “Re-Emerging India - A Global Perceptive”, The ICFAI University Press, Hyderabad, 2005.
2. Eric Jeffs, “Green energy: sustainable electricity supply with low environmental impact” CRC Press, USA, 2010.
3. Kishore V. V .N., “Renewable Energy Engineering And Technology Principles and Practice”, Earthscan Publications Ltd, UK, 2009.

4. Steve Doty, Wayne C. Turner, “Energy Management Handbook” Fairmont Press, Lilburn, 2009.

12EE318 WIND ENERGY

Credits: 3:1:0

Course Objective:

- To develop a detailed understanding of the issues associated with the development of wind energy for electrical energy supply.
- To know the current state of wind energy development domestically and internationally
- To understand the issues of location and grid connection of wind energy power plants

Course Outcome:

- Understand the role which wind energy plays and can play in the electricity supply system and its role in meeting the country’s obligations in terms of greenhouse gas abatement
- Gain knowledge regarding wind energy resources and the ability to assess those resources
- Gain knowledge of construction, characteristics, control and performance of wind turbines

Unit I

ROLE OF WIND ENERGY: World’s energy requirements – Role of wind energy in Electricity production – Renewable energy policy, National and International; The role of wind energy in greenhouse gas abatement – Economics of Wind Energy – Commercial and regulatory issues – Energy trading, green credits and carbon taxes – Economic assessment of wind energy systems – Funding of wind energy projects

Unit II

WIND ENERGY RESOURCES: Characteristics of wind energy resources – Wind energy data collection and analysis – Wind measurement and instrumentation – Wind turbine representation and wind energy assessment – Overview of wind data in India – On-shore and off-shore installations – Site selection – Environmental impacts of wind energy systems – Avian, Visual, Noise, Electromagnetic, Land use.

Unit III

ANALYSIS AND DESIGN OF WIND TURBINES – MECHANICAL ASPECTS: Classification of wind turbine types – Elements of a wind turbine system – Modeling of the ideal turbine rotor – Airfoil and aerodynamics– Blade shape–performance–Loads on wind turbines– Wind turbine topologies – Mechanical design and control – Shafts, gearing, brakes, etc – Rotor and blade design – Power curve of turbine – Requirements of control systems for wind turbines.

Unit IV

ELECTRICAL ASPECTS OF WIND TURBINES: Electrical machines as applied to wind turbines – Synchronous, induction and double-fed generators – Fixed speed and variable speed operation– Stand-alone configurations – Trans mission and distribution network interfaces – Power converters – On-shore and off-shore wind farms – Ancillary electrical equipment Cables, protection, circuit breakers, capacitors

Unit V

SITING OF WIND TURBINES AND INTEGRATION WITH SUPPLY NETWORKS: Wind turbine site selection – Operational issues of wind turbines – Embedded generation and wind turbines – Impacts of wind turbines on electrical supply networks – Network issues frequency control, voltage control, fault levels – Quality of supply issues associated with wind turbines – Control of network interface – Supervisory control – Backup supply – Energy storage – Integration with other energy sources – Hybrid systems

Text Book

1. Manwell, J.F., McGowan, J.G. and Rogers A.L., "Wind Energy Explained – Theory, design and application", John Wiley & Sons, UK, 2009.

Reference Books

1. Heier, S., "Grid Integration of Wind Energy Conversion Systems" 2nd ed., John Wiley & Sons, Chichester, 2006.
2. Burton, T., Sharpe, D., Jenkins N. and Bossanyi, E., "Wind Energy Handbook", John Wiley & Sons, Chichester, 2001.
3. Ackermann, T., "Wind power in power systems", John Wiley& Sons, Chichester 2006.
4. Olimpo Anaya-Lara, Nick Jenkins , Janaka Ekanayake , Phill Cartwright, Michael Hughes, "Wind Energy Generation: Modelling and Control, John Wiley& Sons, Chichester 2009.

12EE319 HYDROGEN AND FUEL CELLS

Credits: 4:0:0

Course Objective:

- To understand hydrogen energy technology
- To understand fuel cell technology
- To enlighten the student community on various technological advancements, benefits and prospects of utilizing hydrogen/fuel cell for meeting the future energy requirements.

Course Outcome:

- Know detail on the hydrogen production methodologies, possible applications and various storage options.
- Know the working of a typical fuel cell, its types and to elaborate on its thermodynamics and kinetics
- Analyze the cost effectiveness and eco-friendliness of Hydrogen and Fuel Cells.

Unit I

HYDROGEN – BASICS AND PRODUCTION TECHNIQUES: Hydrogen – physical and chemical properties, salient characteristics – Production of hydrogen – steam reforming – water electrolysis – gasification and woody biomass conversion – biological hydrogen production – photo dissociation – direct thermal or catalytic splitting of water.

Unit II

HYDROGEN STORAGE AND APPLICATIONS: Hydrogen storage options – compressed gas – liquid hydrogen – Hydride – chemical Storage – comparisons – Hydrogen transmission systems – Applications of Hydrogen.

Unit III
FUEL CELLS: History – principle – working – thermodynamics and kinetics of fuel cell process – performance evaluation of fuel cell – comparison on battery vs fuel cell

Unit IV
FUEL CELL – TYPES: Types of fuel cells – AFC, PAFC, SOFC, MCFC, DMFC, PEMFC – relative merits and demerits

Unit V
APPLICATION OF FUEL CELL AND ECONOMICS: Fuel cell usage for domestic power systems – large scale power generation – Automobile, Space. Economic and environmental analysis on usage of Hydrogen and Fuel cell – Future trends in fuel cells.

Text Book

1. Rebecca L., Busby, "Hydrogen and Fuel Cells: A Comprehensive Guide", Penn Well Corporation, USA,2005

Reference Books

1. Bent Sorensen, "Hydrogen and Fuel Cells: Emerging Technologies and Applications", Elsevier Science Technology, United Kingdom, 2005
2. Jeremy Rifkin, "The Hydrogen Economy", Penguin Group, New York, 2002
3. Viswanathan B., Aulice Scibioh M, "Fuel Cells – Principles and Applications", Universities Press, India, 2006.
4. Thomas B.Johansson, Henry Kelly, Amulya K.N.Reddy, Robert.H.Williams, "Renewable Energy Sources for Fuels and Electricity", Island Press, Washington DC, 2009.

12EE320 ENERGY MANAGEMENT AND AUDIT

Credits: 3:1:0

Course Objective

- To understand various energy management techniques
- To understand energy auditing techniques
- To understand the importance of energy conservation

Course Outcome

- Become efficient energy managers
- Know different energy auditing methods and the implementation procedures
- Plan for the energy requirement

Unit I
ENERGY MANAGEMENT: Energy management: concepts, energy demand and supply, economic analysis, duties and responsibilities of energy managers. Energy conservation: concepts, energy conservation in – household, transportation, agricultural, service and industrial sectors, lighting, HVAC systems. Energy Conservation act. Energy policy act of 1992- State

codes –model energy codes, Labeling system- Star Labeling for Electrical appliances. Role of BEE in star labeling.

Unit II

ENERGY AUDIT: Definition – needs–types-approaches; energy costs, bench marking, energy performance, matching energy supply to requirement, fuel and energy substitution, energy audit instruments, duties and responsibilities of energy auditors

Unit III

ENERGY ACTION PLANNING: Key elements, force field analysis, energy policy- purpose, perspective, contents, formulation, ratification; location of energy management, top management support, managerial function, energy manager-accountability, motivation- information system-strategies- marketing and communicating- training and planning.

Unit IV

MONITORING AND TARGETING: Defining – elements, data and information analysis; techniques, energy consumption, production, cumulative sum of differences, energy service companies, energy management information systems, SCADA

Unit V

ELECTRICAL ENERGY MANAGEMENT: Supply side: Methods to minimize supply-demand gap, renovation and modernization of power plants, reactive power management, HVDC and FACTS; Demand Side: conservation in motors, pumps and fan systems, energy efficient motors, lighting.

Text Book

1. Steve Doty, Wayne C. Turner, "Energy Management Handbook" Fairmont Press, Lilburn, 2009.

References

1. Barney L. Capehart, Wayne C. Turner, William J. Kennedy, "Guide to Energy Management", Fairmont Press, Lilburn, 2008.
2. Clive Beggs, "Energy: Management, Supply and Conservation " Butterworth-Heinemann Publications, Oxford, 2009
3. Albert Thumann, William J. Younger, Terry Niehus, "Handbook of Energy Audits" Fairmont Press, Lilburn, 2010.
4. Moncef Krarti, "Energy Audit of Building Systems: An Engineering Approach" Taylor & Francis, Boca Raton, 2010.
5. World on transition-Towards sustainable Energy systems, German Advisory council on global change Handbook, Earthscan publication, 2004
6. http://www.beeindia.in/

12EE321 BIO-MASS ENERGY

Credits: 4:0:0

Course Objective:

- To deal about the thermal biomass conversion and biological pathways.
- To provide an introduction about the power generation techniques.

- To deal with the Design, Selection, Construction and Operation of Biogas Plants.

Course Outcome:

- Understand the thermal biomass conversion.
- Understand about the Pyrolysis, Gasification and Liquefaction and fermentation process
- Communicate effectively about issues in environmental aspects for bio energy conversion and also to design the biogas plants by the students.

Unit I

INTRODUCTION: Biomass resources and their classification - chemical constituents and physicochemical characteristics of biomass - Biomass conversion processes - Thermo chemical conversion: direct combustion, gasification, Pyrolysis and liquefaction - biochemical conversion: anaerobic digestion, alcohol production from biomass - chemical conversion process: hydrolysis and hydrogenation. Biogas- generation - types of Biogas Plants.

Unit II

THERMAL BIOMASS CONVERSION: Combustion, Pyrolysis, Gasification and Liquefaction - Biological Conversion - Methanol, Ethanol Production - Fermentation - Anaerobic Digestion Biodegradation and Biodegradability of Substrate - Hydrogen Generation from Algae – Biological Pathways.

Unit III

POWER GENERATION TECHNIQUES: Through Fermentation and Gasification - Biomass Production from different Organic Wastes - Effect of Additives on Biogas Yield - Biogas production from Dry Dung Cakes - Industrial Application - Viability of Energy Production - Wood Gasifier System, Operation of Spark Ignition and Compression Ignition with Wood Gas - Operation and Maintenance

Unit IV

ECONOMICS AND ENVIRONMENTAL ASPECTS: Energy Effectiveness and Cost Effectiveness - History of Energy Consumption and Cost - Environmental Aspects of Bio energy Conversion- Economic analysis of bio energy options.

Unit V

DESIGN, SELECTION, CONSTRUCTION AND OPERATION OF BIOGAS PLANTS:
Design of the digester – design based on end user requirements – scaling of biogas plants – digester sizing – optimal design – design of fixed dome digester – Electricity Production from biomass.

Text Books

1. Mital K.M, “Biogas Systems: Policies, Progress and Prospects”, first Edition, New Age International Pvt Ltd, New Delhi, 2006.
2. N.H.Ravindranath, Hall D.O., “Biomass, Energy and Environment”, Reprinted Edition, Oxford University Press, Oxford, 2002.

References Books

1. Chawla O.P., “Advances in biogas technology”, Publications and Information Division, Indian Council of Agricultural Research, New Delhi, 2009.

2. Nijaguna, B.T, “Biogas Technology”, First Edition, New Age International Pvt Ltd, New Delhi , 2009.
3. Mital, K.M, “Biogas Systems: Principles and Applications”, First Edition, New Age International Pvt Ltd, New Delhi, 2009.

12EE322 ENERGY MODELLING, ECONOMICS AND PROJECT MANAGEMENT

Credits: 3:1:0

Course Objective

- To impart greater understanding of energy modeling in renewable energy technology.
- To throw light on the economic aspects involved in renewable energy technology.
- To enlighten the students on the various techniques involved in project management.

Course Outcome

- Gain clear perspective on energy economy.
- Forecast the energy demand and plan wisely.
- Become excellent managers of the energy resources.

Unit I

MODELS AND MODELING APPROACHES: Macroeconomic Concepts - Measurement of National Output - Investment Planning and Pricing - Economics of Energy Sources - Reserves and Cost Estimation.

Unit II

INPUT-OUTPUT ANALYSIS: Multiplier Analysis - Energy and Environmental Input / Output Analysis - Energy Aggregation –Econometric Energy Demand Modeling - Overview of Econometric Methods.

Unit III

ENERGY DEMAND ANALYSIS AND FORECASTING: Methodology of Energy Demand Analysis - Methodology for Energy Technology Forecasting -Methodology for Energy Forecasting - Sectoral Energy Demand Forecasting.

Unit IV

ECONOMICS OF STAND-ALONE POWER SYSTEMS: Solar Energy - Biomass Energy - Wind Energy and other Renewable Sources of Energy -Economics of Waste Heat Recovery and Cogeneration - Energy Conservation Economics.

Unit V

PROJECT MANAGEMENT – FINANCIAL ACCOUNTING: Cost Analysis - Budgetary Control - Financial Management - Techniques for Project Evaluation.

Text Books

1. Munasinghe M., Meier P., “Energy Policy Analysis and Modeling”, Cambridge University Press, New York, 2008.
2. Spyros Makridakis, Steven C. Wheelwright, Rob J. Hyndman, “Forecasting Methods and Applications”, Wiley, Singapore, 2008.

Reference Books

1. James Stock, Mark Watson, “Introduction to Econometrics”, 2nd ed., Pearson Education, New Delhi, 2006.
2. Kurt Campbell, Jonathon Price, “The Global Politics of Energy”, The Aspen University, Washington, 2008.
3. Bob Shivley, John Ferrare, “Understanding Today's Electricity Business”, Enerdynamics, Laporte, 2010

12EE323 SOLAR ENERGY LAB

Credits: 0:0:2

1. Solar energy measurement
2. Solar energy forecasting
3. Solar Panel Modeling and Simulation
4. Characteristics of PV Panel
5. Perturb and Observe MPPT Technique
6. Fuzzy Logic based DC-DC Converter for PV System
7. Neural Network based DC-DC Converter for PV System
8. Simulation of Stand-alone PV systems using Matlab -Simulink.
9. Simulation of grid connected PV systems using Matlab -Simulink.
10. Study of the Effects of Partial Shading on PV Array Characteristics
11. Thermal Modeling and Simulation of a Building
12. Modeling and Simulation of Solar Water Heater

12EE324 WIND ENERGY LAB

Credits: 0:0:2

1. Wind Turbine Modeling and Simulation
2. Permanent-magnet Synchronous Generator Modeling and Simulation
3. Fuzzy Logic based Wind Energy Forecasting
4. ANN based Wind Energy Forecasting
5. Wind Power Curve Estimation
6. Maximum power tracking of a wind energy system
7. Fuzzy logic control based maximum power tracking of a wind energy system
8. Modeling and Simulation of wind turbine grid connection.
9. Simulation of a phasor model of a squirrel-cage induction generator driven by a variable pitch wind turbine
10. Simulation of a phasor model of a variable speed doubly-fed induction generator driven by a wind turbine
11. Simulation of model of a variable pitch wind turbine
12. Reactive power control in wind power plants

12EE325 SIMULATION OF POWER ELECTRONIC SYSTEMS

Credits: 3:1:0

Course Objective

- To study the basics of static and dynamic models of power electronic switches
- To learn the usage of the software tools like MATLAB, PSIM and PSPICE
- To understand the operation of different types of power electronic converters using the above mentioned tools

Course Outcome

- do the mathematical modeling of power devices under steady state and dynamic conditions
- use the various functional blocks available in the simulation packages for the problems specified
- design and simulate any power electronic circuits and compare the performance with other simulation tools

Unit I

INTRODUCTION: Need for simulation - Challenges in simulation - Classification of simulation programs - Overview of MATLAB and SIMULINK , PSIM, and PSpice, Mathematical modeling of power electronic systems: Static and dynamic models of power electronic switches - Static and dynamic equations and state space representation of power electronic systems.

Unit II

MATLAB PROGRAMMING: MATLAB – Introduction- Variables – Matrix representation and operation, Trigonometric functions, Logical relations, Exponential Complex Numbers – m file – Function – For loop – While – If else. Graphics – 2D Plots. MATLAB Programming to analyze Diode rectifiers - controlled rectifiers - AC voltage controllers- PWM generation.

Unit III

MATLAB SIMULINK: SIMULINK: Introduction – Basic Block – Sources and Sinks model analysis using SIMULINK – Simpower systems- Overview of Electrical Sources Library , Elements Library, Phasor Elements Library, Power Electronics Library, Machines Library, and Measurements Library- Simulating Induction Motor Drive- Performing Harmonic Analysis Using the FFT Tool.

Unit IV

PSIM: General information – Power circuit components – Control circuit & other components – Analysis specification – Circuit schematic design – Waveform processing – Error and warning Messages- Simulation of PWM inverters- Simulation of BLDC and SRM

Unit V

PSPICE: File formats - Description of circuit elements - Circuit description - Output variables – Dot commands - SPICE models of Diode, Thyristors, Triac, BJT, Power MOSFET, IGBT. Simulation of voltage source and current source inverters - Resonant pulse inverters - Zero current switching and zero voltage switching inverters.

Text Books

1. Shailendra Jain, "Modelling & Simulation using MATLAB & Simulink",Wiley-India,2011
2. SimPowersystems User Guide, 2011.

3. PSIM User's Guide", Powersim Inc., 2011.
4. Rashid .M.H., "SPICE for Power Electronics and Electric Power", CRC Press, New Delhi, 2nd Edition, 2005.

Reference Book

1. Rashid, M.H., "Power Electronics Handbook", Academic Press, USA, 2011

12EE326 POWER ELECTRONICS APPLICATIONS TO POWER SYSTEMS

Credits: 3:1:0

Course Objective

- To understand the safe and secure operation of simple power system.
- To suggest suitable possibilities to extend power system operation.
- To understand the recent advancements in power systems using the power electronic systems.

Course Outcome

- Find the solutions for eliminating harmonics and EMI present in the output due to fast switching devices.
- Apply power system fundamentals to the design of a system that meet specific needs.
- Design necessary filter circuit require to the distributed network.

Unit I

INTRODUCTION: High power devices for power system controllers - Characteristics - Converters configurations for large power control-Single and three phase converters: Properties - Current and voltage harmonics - Effects of source and load impedance - Choice of best circuit for power systems.

Unit II

CONVERTER CONTROL: Gate control - Basic means of control - Control characteristics - Stability of control - Reactive power control - Power flow analysis: Component models - Converter model - analysis of converter - Transient and dynamic stability analysis – protection.

Unit III

WIND ENERGY CONVERSION SYSTEM: sic components - Generator control - Harmonics - Power factor improvement. PV Conversion Systems: Different schemes - DC and AC power conditioners - Synchronized operation with grid supply.

Unit IV

HVDC SYSTEMS : Application of converters in HVDC systems - Static VAR control - Sources of reactive power - Harmonics and filters

Unit V: FACTS: Concept of Flexible AC Transmission System (FACT) - Static VAR compensators - Thyristor Controlled Reactor - Thyristor Switched Capacitor - Static Condenser - Controllable Series Compensation.

Text Book

1. Padiyar. K.R., "HVDC Power Transmission System", New Age International Private Limited, New Delhi, Reprint 2010.

Reference Books

1. Erich Uhlmann, "Power Transmission by Direct Current", Springer International Edition, New Delhi, 1st Indian Reprint 2004.
2. Rai, G.D., "Solar Energy Utilization", Khanna Publishers Limited, New Delhi, 2000.
3. Kimbark, E.X., "Direct Current Transmission", Wiley Interscience, New York, 1971.
4. Rao S., "EHV-AC, HVDC Transmission and Distribution Engineering (Theory, Practice and Solved Problems)", Khanna Publishers, New Delhi, 2006.

12EE327 NEURO-FUZZY CONTROLLERS FOR ELECTRIC DRIVES

Credits : 4:0:0

Course Objective

- To impart the knowledge on the fundamental concept of neurons and their artificial models
- To understand the Structure of fuzzy logic controller and its application to electric drives
- To provide comprehensive knowledge of fuzzy logic and neuro controllers

Course Outcome

- Explain the various learning algorithms derived from the biological neurons
- Apply the concept of neural network for optimization of any system problem
- Use appropriate network for fault diagnosis and pattern recognition

Unit I

INTRODUCTION TO NEURAL NETWORK: Introduction - Biological neurons and their artificial models - Learning, adaptation and neural network's learning rules - Types of neural networks- Single layer, multiple layer- Feed forward, feedback networks; Back propagation - Learning and training –Hopfield network.

Unit II

NEURO CONTROLLER: Neural network. for non-linear systems -Schemes of Neuro control-System identification forward model and inverse model- Indirect learning neural network control applications.

Unit III

INTRODUCTION TO FUZZY LOGIC: Fuzzy sets- Fuzzy operation -Fuzzy arithmetic - Fuzzy relations- Fuzzy relational equations -Fuzzy measure -Fuzzy functions -Approximate reasoning -Fuzzy propositions - Fuzzy quantifiers - if-then rules.

Unit IV

FUZZY CONTROLLER: Structure of fuzzy logic controller -Fuzzification models- Data base -Rule base –inference engine defuzzification module - Non-linear fuzzy control-PID like FLC-sliding mode FLC -Sugeno FLC -adaptive fuzzy control - Fuzzy control applications.

Unit V

APPLICATIONS TO ELECTRIC DRIVES: Neuro controllers for AC Drives - Fuzzy Controllers for AC Drives – Hybrid Neuro- Fuzzy Controllers for BLDC motors – Adaptive Neuro – Fuzzy Controllers for Switched Reluctance Motor Drives.

Text Books

1. Timothy Ross, "Fuzzy Logic with Engineering Applications", Wiley India Pvt Ltd, New Delhi, 2011.
2. Jacek M Zurada, "Introduction to Artificial Neural Systems", Jaico Publishing House, New Delhi, 2001.

Reference Books

1. Jang Jyh-shing Roger, Sun Chuen-tsai, Mizutani Eiji," Neuro-Fuzzy And Soft Computing: A Computational Approach To Learning And Machine Intelligence" PHI Learning Pvt limited,2009
2. Vinoth Kumar.K., Saravanakumar.R., "Neural Networks and Fuzzy Logic", S.K.Kataria & Sons Publisher, New Delhi, 2010.
3. Laurene Fausett, "Fundamentals of Neural Networks: Architectures, Algorithms and Applications", Pearson Education India, New Delhi, 2009.
4. Driankov, Hellendroon, "Introduction to Fuzzy Control", Narosa Publishers Limited, New Delhi.
5. Sivanandam S.N., Sumathi. S and Deepa S.N., "Introduction to Neural Networks using MATLAB 6.0", Tata Mc Graw-Hill Education India Private Limited, New Delhi, 2006.
6. Sivanandam S.N., Sumathi. S and Deepa S.N., "Introduction to Fuzzy Logic using MATLAB", Springer Verlag Berlin Heidelberg Publisher, New York, 2007.

12EE328 POWER ELECTRONICS IN WIND AND SOLAR POWER CONVERSION

Credits: 4:0:0

Course Objective

- To study the basics of various photovoltaic energy conversion
- To analyze the performance of self-excited and grid related problems
- To learn the Wind energy system and stand alone power supply systems

Course Outcome

- Understand various factors which affect the wind energy conversion system.
- Design isolated power generators used in wind energy conversion system.
- Design PV cells to meet the requirement of battery operated vehicle and other related applications

Unit I

INTRODUCTION: Trends in energy consumption - World energy scenario - Energy sources and their availability - Conventional and renewable sources - need to develop new energy technologies.

Unit II

PHOTOVOLTAIC ENERGY CONVERSION: Photovoltaic Energy Conversion: Solar radiation and measurement - solar cells and their characteristics - influence of insulation and temperature - PV arrays - Electrical storage with batteries - solar energy availability in India -

Switching devices for solar energy conversion - Maximum power point tracking. DC Power conditioning converters - maximum power point tracking algorithms - AC power conditioners - Line commutated inverters – synchronized operation with grid supply - Harmonic problem – Applications.

Unit III
WIND ENERGY CONVERSION (WEC): Basic Principle of wind energy conversion - nature of wind - wind survey in India - Power in the wind - components of a wind energy - conversion system - Performance of induction generators for WECS - classification of WECS.

Unit IV
SELF-EXCITED & GRID CONNECTED WECS : Self excited induction generator for isolated power generators - Theory of self-excitation - Capacitance requirements - Power conditioning schemes - Controllable DC Power from Self excited induction generators (SEIGs) - system performance. Grid Connected WECS: Grid connectors concepts - wind farm and its accessories - Grid related problems - Generator control- Performance improvements - Different schemes - AC voltage controllers - Harmonics and PF improvement .

Unit V
STAND ALONE POWER SUPPLY SYSTEMS: Wind/solar PV integrated systems - Optimization of system components - storage – Reliability evolution.

Text Book

1. Rai, G.D., "Non-conventional Energy Sources", Khanna Publishers Limited, New Delhi, 1st Edition, 2004.

Reference Books

1. Rai, G.D., "Solar Energy Utilization", Khanna Publishers Limited, New Delhi, 2000.
2. Mukund R Patel, "Wind and Solar Power Systems", Taylor & Francis Group, 2nd Edition, United Kingdom, 2005.
3. Thomas Markvart and Luis Castaser, "Practical Handbook of Photo Voltaics", Elsevier Science & Technology, New Delhi, 2003.
4. Hermann-josef Wagner, Jyotirmay Mathur, "Introduction To Wind Energy Systems: Basics, Technology and Operation", Springer International, United Kingdom, 2009.

12EE329 HVDC TRANSMISSION

Credits: 4:0:0
Course Objective

- To have an overview about HVDC system, different forms of converters and various means of control
- To analyze the various malfunctioning of the HVDC system
- To study the basics of harmonics and their reduction mechanism

Course Outcome

- Outline the benefits of using dc transmission and its operation & control
- Use the various power electronics resources for the betterment of hvdc system
- Analyze the challenges and its solutions available in high voltage engineering

Unit I
DC POWER TRANSMISSION TECHNOLOGY: Historical development – Types of HVDC Systems – Equipments for HVDC – Comparison: Economics of Power Transmission, Technical Performance, and Reliability – Limitations of HVDC.

Unit II
ANALYSIS OF HVDC CONVERTERS: Line commutated converter: Graetz bridge without overlap – Voltage source converter: basic two level converter – Converter analysis: two and three valve mode – three and four valve mode – Capacitor commutated converter.

Unit III
CONVERTER AND HVDC SYSTEM CONTROL: Principles of DC link control – Converter control characteristics – Control hierarchy – Firing angle control – Power control – Higher level controllers.

Unit IV
CONVERTERS FAULTS & PROTECTION: Converter faults: Commutation failure, Arc through, Misfire, Current extinction and Short circuit in a bridge – Protection against over currents – Over voltages in a converter station – Protection against over voltages – Functions of smoothing reactor.

Unit V
HARMONICS AND FILTERS: Problems due to harmonics – Characteristic harmonics – Non characteristic harmonics – Filters: Design criteria of ac filters – Types of ac filters – DC filters - Active filter – Carrier frequency and RI noise.

Text Books

1. Padiyar. K. R, "HVDC Power Transmission Systems", New Age International Publishers Pvt. Ltd., New Delhi, 2012.
2. Kamakshaiah. S, Kamaraju. V, "HVDC Transmission", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2011.

Reference Books

1. Erich Uhlmann, "Power Transmission by Direct Current", Springer International Edition, 2004.
2. Neville R. Watson, Y. H. Liu, J. ArrillagaArrilaga J., "Flexible Power Transmission: The HVDC Options", John Wiley & Sons, 2007.
3. Chan-ki Kim, Vijay K. Sood, Gil-soo Jang, Seong-joo Lim, Seok-jin Lee, "HVDC Transmission: Power Conversion Applications In Power Systems", John Wiley (IEEE Press), 2009.

12EE330 PLC AND AUTOMATION

Credits: 4:0:0

Course Objective

- To learn the basics of PLC.
- To study the programming of PLC and HMI systems.

- To study about the DCS and understand the concept of Automation.

Course Outcome

- Understand the concepts of PLC and basics of Programming
- Programming using PLC for various industrial applications
- Design of controllers for industrial automation systems

Unit I

PROGRAMMABLE LOGIC CONTROLLERS: Need for process control-process variables - basic control actions - characteristics of ON OFF, proportional, integral and derivative control modes - PI, PD and PID control modes Electronic PID Controllers- Basics of PLC - Architecture of PLC - Advantages - Types of PLC - Introduction to PLC Networking- Networking standards. - Protocols - Field bus - Process bus and Ethernet IEEE Standard.

Unit II

PROGRAMMING OF PLC & HMI SYSTEMS: Types of Programming - Simple process control programs using Relay Ladder Logic and Boolean logic methods - PLC arithmetic functions - HMI systems - Necessity and Role in Industrial Automation, Text display - operator panels -Touch panels - Panel PCs - Integrated displays (PLC & HMI)

Unit III

ADVANCED LADDER LOGIC FUNCTIONS: Latches-Timers-Counters-Data Handling: Move function- Mathematical function-conversions-Array data functions. Logical Functions: Comparison of values-Boolean functions. List Functions: Shift- stack-sequencer. Program Control: Branching and Looping- Fault handling – Interrupts. Input and Output functions

Unit IV

DISTRIBUTED CONTROL SYSTEMS (DCS): Difference between SCADA PLC and DCS – architecture – local control unit – programming language – communication facilities – operator interface – engineering interfaces.

Unit V

AUTOMATION: Factory Automation- Flexible Manufacturing Systems concept – Automatic feeding lines, ASRS, transfer lines, automatic inspection – Computer Integrated Manufacture – CNC, intelligent automation, Industrial networking, bus standards, HMI Systems, DCS and SCADA, Wireless controls. Case studies of Machine automation, Process automation.

Text Books

1. Frank D Petruzella Programmable logic controllers McGraw-Hill Companies, 4th ed New York, 2011
2. John.W.Webb & Ronald A. Reis, “Programmable logic controllers: Principles and Applications”, Prentice Hall of India, 2003.

Reference Books

1. Michael P. Lukas, “Distributed Control systems”, “Van Nostrand Reinfold Company, 2007.
2. Gary Dunning, “Introduction to Programmable Logic Controllers”, Thomson Press, 3rd Edition, USA, 2005.

3. Bolton. W, “Programmable Logic Controllers”, Elsevier India Private Limited, 4th Edition, New Delhi, 2008.
4. Mikell P. Groover, “Automation Production systems and Computer Integrated Manufacturing”, Prentice Hall of India, New Delhi, 2007
5. Practical Distributed Control Systems (DCS) for Engineers and Technicians

12EE331 ELECTRIC AND HYBRID VEHICLES

Credits: 3:1:0

Course Objective
- To understand the concept of Electric Vehicle Technology.
- To understand various architectures of Hybrid Electric Vehicle (HEV) technology.
- To know about various Energy storage devices.

Course Outcome
- The students will be able to understand the need of Hybrid Vehicles and Electric vehicles.
- The students will be able to design different types of Architectures in Electric & Hybrid Vehicles.
- The student will be capable to generate Electrical Power through renewable energy sources.

Unit I
ELECTRIC VEHICLES: Layout of an Electric Vehicle, performance of electric vehicles – traction motor characteristics, tractive effort, transmission requirements, vehicle performance, energy consumption, advantage and limitations, specifications, system components, electronic control system.

Unit II
HYBRID VEHICLES: Concepts of hybrid electric drive train, architecture of series and parallel hybrid electric drive train, merits and demerits, series and parallel hybrid electric drive train design.

Unit III
FUEL CELLS & SOLAR CARS: Photovoltaic cells – tracking – efficiency - solar cars - Fuel Cell – Construction, Working, Equations, possible fuel sources - fuel reformer – design -cost comparison.

Unit IV
ELECTRIC PROPULSION SYSTEM AND MOTOR CONTROL SYSTEM: DC Motors, AC Motors Permanent Magnet Motors, Brushless DC and Reluctance Motors: Characteristics - Regenerative Braking - Control System Principles - speed and torque control.

Unit V
ENERGY STORAGES & GENERATORS: Electromechanical batteries – types of batteries – lead acid batteries - nickel based batteries - lithium based batteries - electrochemical reactions -

thermodynamic voltage - specific energy - specific power - energy efficiency - ultra capacitors – DC Generators, AC Generators: Voltage and Frequency regulations.

Text Book

1. Mehrdad Ehsani, Yimin Gao, Sebatien Gay and Ali Emadi, " Modern Electric, Hybrid Electric and Fuel cell vehicles: Fundamentals, Theory and Design", CRC press, 2004.

Reference Books

1. James Larminie and John Loury, " Electric Vehicle Technology – Explained", John Wiley & Sons Ltd, 2003.
2. Sandeep Dhameja, "Electric Vehicle Battery Systems", Butterworth – Heinemann, 2002.
3. Ronald K Jurgen, "Electric and Hybrid – Electric Vehicles", SAE, 2002.
4. Ron Hodkinson and John Fenton, "Light Weight Electric/Hybrid Vehicle Design", Butterworth – Heinemann, 2001.

12EE332 ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY

Credits: 4:0:0

Course Objective

- To understand different Electro Magnetic Interference problems and various mitigation Techniques
- To understand EMI Sources, EMI problems and their solution methods in PCB level Subsystem and system level design
- To understand EMC Design and Standards

Course Outcome

- Design a compatible system with less interference.
- Provide solution methods in PCB level / Subsystem and system level design.

Unit I

EMI ENVIRONMENT: Sources of EMI conducted and radiated EMI, Transient EMI, EMI-EMC Definitions and units of parameters.

Unit II

EMI COUPLING PRINCIPLES & EMI SPECIFICATION / STANDARDS / LIMITS: Conducted, Radiated and Transient Coupling - Common Impedance Ground Coupling - Radiated Common Mode and Ground Loop Coupling - Radiated Differential Mode Coupling - Near Field Cable to Cable Coupling - Power Mains and Power Supply Coupling - Units of specifications, Civilian standards Military standards.

Unit III

EMI MEASUREMENTS: EMI Test Instruments /Systems - EMI Test - EMI Shielded Chamber - Open Area Test Site- TEM Cell Antennas - Conductors Sensors/Injectors/Couplers - Military Test Method and Procedures - Calibration Procedures.

Unit IV

EMI CONTROL TECHNIQUES: Shielding, Filtering, Grounding, Bonding, Isolation Transformer, Transient Suppressors, Cable Routing, Signal Control, Component Selection and Mounting.

Unit V

EMC DESIGN OF PCBS: PCB Traces Cross Talk, Impedance Control, Power Distribution Decoupling, Zoning, otherboard Designs and Propagation Delay Performance Models.

Text Book

1. Clayton R. Paul, “Introduction to Electromagnetic Compatibility”, John Wiley & Sons, New York, 2006.

Reference Books

1. William D. Kimmel and Daryl D. Gerke, “ EMI Suppression Handbook” , Seven Mountains Scientific Inc., 2001.
2. Bernhard Keiser, "Principles of Electromagnetic Compatibility", Artech house, 1998.
3. Kodali V.P., “Engineering EMC Principles, Measurements and Technologies", IEEE Press, 2001.

12EE333 OPTIMIZATION TECHINIQUES

Credits: 3:1:0

Course Objective

- To insist the importance of optimization problems and their applications
- To instruct the steps for formulating optimization problems
- To impart the knowledge of traditional and modern optimization techniques

Course Outcome

- Students will be able to state the different types of optimization problems, their formulation and solution techniques.
- Students will be able to understand the mechanisms of various traditional and modern optimization techniques
- Students will be able to apply the optimization techniques for practical applications

Unit I

INTRODUCTION TO OPTIMIZATION: Statement of an optimization problem – Classification of optimization problems- Formulation of optimization problems-Examples- Classical optimization techniques – Single variable and multi variable optimization – Method of direct substitution - Constraint variation – Lagrange multipliers- Multivariable optimization with inequality constraints- Kuhn Tucker conditions.

Unit II

LINEAR PROGRAMMING: Linear programming definition – Pivotal reduction of general system of equations – Simplex algorithms – Two phases of the simplex method- Karmarkar’s Method.

Unit III

NONLINEAR PROGRAMMING: Unconstrained optimization techniques- One dimensional problems-Dichotomous search, Fibonacci method– Multidimensional problems-Steepest descent method – Quasi Newton methods. Constrained optimization techniques – Sequential Quadratic Programming – Augmented LaGrange multiplier method.

Unit IV

SPECIAL OPTIMIZATION PROBLEMS: Integer Programming-Branch and Bound method-Stochastic nonlinear programming – Multi-objective optimization - Utility function method-Global criterion method- Bounded objective function method- Goal programming method-Optimal Control Problem.

Unit V

MODERN OPTIMIZATION TECHNIQUES: Limitation of conventional methods- Modern heuristic techniques for optimization – Genetic algorithm, Adaptive genetic algorithm – Evolutionary programming, Simulated annealing- Particle Swarm Optimization – Ant Colony Optimization- Differential Evolution- Typical applications to power engineering problems.

Text Book

Rao S.S, “Engineering Optimization: Theory and Practice”, New Age International Pvt. Ltd., New Delhi, 2010.

Reference Book

Kalyanmoy Deb, “Optimization for Engineering Design: Algorithms and Examples” Prentice-Hall of India Pvt. Ltd., New Delhi, 2006.

12EE334 POWER ENGINEERING SIMULATION LABORATORY

Credits: 0:0:2

1. Simulation of Buck-Boost Converter using PSIM
2. Simulation of Synchronous Rectifier using PSIM
3. Simulation of Three Phase SVPWM Inverter using PSIM
4. Simulation of Soft Switching Converters using PSIM
5. Simulation of Multilevel Inverter using MATLAB
6. Simulation of SRM Drive using MATLAB
7. Formation of BUS Admittance Matrix using Direct Inspection Method using MATLAB
8. Determination of BUS bar Voltages using FDLF Method using MATLAB
9. Automatic Load Frequency Control using MATLAB
10. Load Flow Studies using ETAP
11. Simulation of SMIB using ETAP
12. Fault Analysis of AC Power System using PSCAD / EMTDC

12EE335 FLEXIBLE AC TRANSMISSION SYSTEMS

Credits: 4:0:0

Course Objective:

- To introduce the students to the concept of FACTS, and familiarize them with the basic design and principle of operation of HVDC systems.
- To understand the implementation of UPFC in real time applications.
- To the design the FACTS controllers for various non-linear structure controls.

Course Outcome:

- Identify, formalize, model and analyze problems in a power network
- Select the suitable FACTS devices to enhance the security, capacity and flexibility of power transmission systems.
- Increase existing transmission network capacity while maintaining or improving the operating margins necessary for grid stability.

Unit I

INTRODUCTION: FACTS-a toolkit, Basic concepts of Static VAR compensator – Resonance damper – Thyristor controlled series capacitor – Static condenser – Phase angle regulator – other controllers**.**

Unit II

SERIES COMPENSATION SCHEMES: Sub-Synchronous resonance – Torsional interaction – torsional torque – Compensation of conventional ASC – NGH damping schemes – Modelling and control of Thyristor controlled series compensators.

Unit III

UNIFIED POWER FLOW CONTROL (UPFC): Introduction – Implementation of power flow control using conventional Thyristors – Unified power flow concept – Implementation of unified power flow controller.

Unit IV

DESIGN OF FACTS CONTROLLERS: Introduction to VSC – Approximate multi-model decomposition – Variable structure FACTS controllers for Power system transient stability – Non-linear variable-structure control – variable structure series capacitor control – variable structure resistor control.

Unit V

MODERN FACTS DEVICES: Basic concepts – Centre Node Unified Power Flow Controller (C-UPFC) – Fault Current Controller (FCC) – Interlined Power Flow Controller (IPFC) – location of FACTS.

Text Books

1. Xiao-ping Zhang, Christian Rehtanz, Bikash Pal, "Flexible Ac Transmission Systems: Modelling and Control", Springer-verlag Publisher, New Delhi, 1st Edition, 2006.
2. Narain G. Hingorani, "Understanding FACTS", Standard Publishers Distributors, New Delhi, 1st Edition, 2001

Reference Books

1. Padiyar.K.R., "Facts Controllers In Power Transmission And Distribution", Anshan Publisher, Kent (United Kingdom), 1st Edition, 2009.
2. Song Yong Hua, " Flexible AC Transmission Systems", Shankar's Book Agency Pvt. Ltd., Kolkata, 2009.

3. R. Mohan Mathur, Rajiv K. Varma, Mathur, “Thyristor-Based FACTS Controllers For Electrical Transmission Systems”, IEEE Computer Society Press, New Delhi,
4. Annotated Edition, 2002.

12EE336 INDUSTRIAL ELECTRONICS AND INSTRUMENTATION

Credits: 4:0:0

Course Objective

- To understand the concepts of Conventional and Digital Transducers
- To study the concepts of Industrial heating, Photoelectric devices and Smart Transducers
- To study the Microprocessor based instrumentation

Course Outcome

- Select the type of transducer for the Industrial application.
- And apply in case studies and mini projects in industries.
- Design the Microprocessor based Controllers.

Unit I
REVIEW OF CONVENTIONAL TRANSDUCERS: Review of variable resistance transducers – Variable inductance transducers – Variable capacitance transducers – Piezoelectric transducers.

Unit II
DIGITAL TRANSDUCERS: Direct digital transducers – Absolute and incremental displacement transducers – Moiré Fringe transducers – Transducers with frequency output for the measurement of force and pressure – IC sensors for measurements of temperature and pressure.

Unit III
INDUSTRIAL HEATING & PHOTOELECTRIC DEVICES: Industrial Heating using high frequency dielectric heating – Photoelectric devices and their application for industrial measurement and control – Introduction to PLC based industrial control.

Unit IV
MICROPROCESSOR BASED INSTRUMENTATION: Detection of zero crossing of an alternating waveform – microprocessor based triggering of a Thyristor – Microprocessor based Voltmeter and Ammeter – Microprocessor based Speed monitoring Unit to provide protection against over speed – Microprocessor based phase difference and power factor monitoring Unit – Microprocessor based over and under voltage and over current protection.

Unit V
SMART TRANSDUCERS: Concept of smart/intelligent transducer – comparison with conventional transducers – self diagnosis and calibration features – measurement of flow, pH with smart transducers.

Text Books

1. Biswas S.N, “Industrial Electronics”, Dhanpat Rai & Company (P) Ltd.,New Delhi, 2nd Edition, 2008.
2. Murty.D.V.S., “Transducers and Instrumentation”, PHI Learning, New Delhi, 2nd Edition, 2009.

Reference Books

1. Paul Biswanath., “Industrial Electronics & Control: Including Programmable Logic Controller”, PHI Learning, New Delhi, 2nd Edition, 2009.
2. Doebelin E.O, “Measurement Systems, Application and Design”, Mc -Graw Hill Publishing Company Ltd., New Delhi, 5th Edition, 2002.
3. Webb, John W.Reis, Ronald A., “Programmable Logic Controllers Principles and Application”, PHI Learning, 5th Edition, 2009.
4. Ram. B., “Fundamentals of Microprocessors & Microcontrollers”, Dhanpat Rai (P) Ltd., New Delhi 2008.

12EE338 PASSIVE SOLAR ARCHITECTURE

Credits: 4:0:0

Course Objective

- To understand the building laws and architectural design.
- To understand the role the site and its context play in designing a building, with an emphasis on the climate and other environmental conditions.
- To understand the concepts of a comfortable thermal environment and the passive solar design principles, passive ventilation and solar shading to create a comfortable thermal environment.

Course Outcome

- Analyze the site and its context in preparation for designing a building, particularly with respect to climate and other environmental conditions and translate the analysis data into useable design data and design concepts.
- Design and build environments that are both thermally comfortable and thermally delightful by utilizing passive solar design principles.
- Utilize the combined site-specific potentials of sun, light, wind and rain for creating a sustainable, comfortable and delightful built environment.

Unit I

INTRODUCTION: Introduction to architecture; Architecture as the art of science of designing buildings; Building science and its significance; Energy management concept in building.

Unit II

THERMAL ANALYSIS AND DESIGN FOR HUMAN COMFORT: Thermal comfort; Criteria and various parameters - Psychometric chart - Thermal indices, climate and comfort zones - Concept of solar temperature and its significance - Calculation of instantaneous heat gain through building envelope; Calculation of solar radiation on buildings; building orientation - Introduction to design of shading devices - Overhangs; Factors that effects energy use in buildings - Ventilation and its significance - Air-conditioning systems - Energy conservation techniques in air-conditioning systems.

Unit III

PASSIVE COOLING AND HEATING CONCEPTS TYPES: Passive heating concepts: Direct heat gain, indirect heat gain, isolated gain and sunspaces - Passive cooling concepts: Evaporative cooling, radiative cooling - Application of wind, water and earth for cooling; Shading, paints and cavity walls for cooling - Roof radiation traps; Earth air-tunnel.

Unit IV
HEAT TRANSMISSION IN BUILDINGS: Surface co-efficient: air cavity, internal and external surfaces, overall thermal transmittance, wall and windows - Heat transfer due to ventilation infiltration, internal heat transfer - Solar temperature - Decrement factor - Phase lag. Design of day lighting; Estimation of building loads: Steady state method, network method, numerical method, correlations - Computer packages for carrying out thermal design of buildings and predicting performance - Central receiver systems, parabolic trough systems; Solar power plant; Solar furnaces.

Unit V
BIOCLIMATIC CLASSIFICATION: Bioclimatic classification of India - Passive concepts appropriate for the various climatic zones in India - Typical design of selected buildings in various climatic zones - Thumb rules for design of buildings and building codes.

Text Books

1. Daniel D. Chiras," The Solar House: Passive Heating and Cooling", Chelsea Green Publising Company, Vermont, 2002.
2. Colin Porteous, Kerr Macgregor, "Solar architecture in cool climates", Earthscan Publications Ltd., UK, 2005.

Reference Books:

1. James Kachadorian, "Passive Solar House" Chelsea Green Publising Company, Vermont, 2006.
2. Daniel D. Chiras, "The Natural House", Chelsea Green Publishing Company, Vermont, 2001.
3. Daniel D. Chiras, "The New Ecological Home", Chelsea Green Publishing Company, Vermont, 2004.

12EE339 GREEN BUILDING

Credits: 4:0:0
Course Objective

- To learn green building concepts and ecological design concepts applicable to modern buildings
- Acquaint students with the principle theories, materials, construction techniques and to create green buildings
- To provide exposure to various national and international rating systems as compliance requirements for green buildings

Course Outcome

At the end of the course, the student will be able to:

- Understand and actively participate in the overall iterative and multidisciplinary process of conceptualizing and designing an environmentally friendly building (low-emissions, low resource-consumption, small environmental footprint),

- Choose and size building components, as well as energy and environmental systems suitable for different categories of buildings, and different climate zones, such as to achieve the smallest feasible life-time environmental impact,
- Evaluate the economic performance of buildings (operating & maintenance costs, real estate value), as related to their resource-consumption and environmental performance.

Unit I

GREEN BUILDING PROCESS AND ECOLOGICAL DESIGN: Conventional versus green building delivery systems - Green building project execution - the integrated design process - green building documentation requirements - design versus ecological design - historical perspective - contemporary ecological design - future ecological design - green design to regenerative design.

Unit II

GREEN BUILDING SYSTEMS: Sustainable sites and landscaping – enhancing ecosystems - building envelop – selection of green materials - products and practices - passive design strategy – internal load reduction – indoor environment quality – building water and waste management – relevance to LEED / IGBC standards.

Unit III

GREEN BUILDING IMPLEMENTATION: Site protection planning - health and safety planning - construction and demolition waste management - reducing the footprint of construction operations - maximizing the value of building commissioning in HVAC System, lighting and non mechanical Systems - costs and benefits relevance to LEED / IGBC standards.

Unit IV

GREEN BUILDING ASSESSMENT: USGBC LEED building assessment standard - LEED certification process – green globes building assessment protocol- international building assessment systems - LEED-NC Platinum / gold / silver building case studies – trends in building rating systems – IGBC standards – ECBC compliances.

Unit V

ECONOMICS OF GREEN BUILDINGS: Business case for high-performance green buildings - the economics of green building - benefits - managing initial costs - cost barrier in project management - long-term environment benefits.

Text Book

1. Jerry Yudelson, "Green building A to Z, understanding the language of green building", New Society Publishers, Canada, 2007.
2. Green building guidelines: Meeting the demand for low-energy, resource-efficient homes. Sustainable Buildings Industry Council, Washington, D.C., 2004.

Reference Books

1. Jerry Yudelson, Green Building through Integrated Design, McGraw Hill, USA, 2009
2. Means, R.S., Green building: project planning & cost estimating, Wiley, Kingston, 2006.
3. Charles J. Kibert, Sustainable Construction: Green Building Design and Delivery, 2nd Edition, Wiley, New Jersey, 2007.

12EE340 DATA MINING FOR RENEWABLE ENERGY TECHNOLOGY

Credits: 3:1:0

Course Objective

- To enlighten the students' on the basic concepts of data mining.
- To improve the students' competence in the algorithms and learning schemes of data mining.
- To enable the students to exploit the data mining techniques for research in renewable energy.

Course Outcome

- understand the importance of data-driven performance optimization of renewable energy technology.
- exploit the vast data base available in the renewable energy sector and devise ways to make renewable energy a competitive source of supply.
- find the various research opportunities provided by this field.

Unit I

INTRODUCTION: Data Mining – Kinds of Data – Functionalities – Classification – Primitives – Major Issues –Data Preprocessing – Descriptive Data Summarization - Data Cleaning – Data Integration and Transformation - Data Reduction

Unit II

DATA WAREHOUSE: AN OVERVIEW: Data Warehouse – Multidimensional Data Model – Data Warehouse Architecture – Data Warehouse Implementation – From Data Warehousing to Data Mining. Mining Frequent Patterns, Associations: Basic Concepts and a Road Map – Efficient and Scalable Frequent Item set -Mining Methods- Mining Multilevel Association Rules

Unit III

CLASSIFICATION AND PREDICTION: Issues regarding classification and prediction - Decision tree Induction - Bayesian Classification – Lazy Learners – Other Classification Methods – Prediction – Accuracy and Error Measures.

Unit IV

CLUSTER ANALYSIS: Types of Data – Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical Methods. Mining Stream, Time-Series and Sequence Data Mining- Data Streams – Mining Time-series- Data- Mining Sequence Patterns in Transactional Databases

Unit V

APPLICATIONS IN RENEWABLE ENERGY TECHNOLOGY: Application of Data Mining in Wind Power System -Wind Power Prediction- Modeling and Forecasting of Solar Radiation Data - Analyzing Solar Power Plant Performance

Text Books

1. Jiawei Han, Micheline Kamber, "Data Mining : Concepts and Techniques", II Edition, Morgan Kaufmann Publishers, San Francisco, 2006
2. Ian Witten, Eibe Frank, "Data Mining: Practical Machine Learning Tools and Techniques", III Edition, Morgan Kaufmann Publishers, San Francisco 2011.

Reference Books

1. Sumathi S., S. N. Sivanandam, "Introduction to Data Mining and its Applications", Springer-Verlag Berlin Heidelberg 2006.
2. David Hand, Heikki Mannila, Padhraic Smyth, "Principles of Data Mining", A Bradford Book, The MIT Press, Cambridge, Massachusetts London, England, 2001.
3. Michael J A Berry, Gordon S Linoff, "Data Mining Techniques", II Edition, Wiley India, 2004.

12EE341 SOFT COMPUTING TECHNIQUES

Credits: 3:1:0

Course Objective

- To develop an in-depth understanding of various soft computing techniques.
- To analyze the mechanisms of different AI techniques and modern heuristics algorithms.
- To develop skills to apply the soft computing techniques for various practical optimization problems.

Course Outcome:

- State the mechanisms of various soft computing techniques.
- Understand the techniques of various modern heuristic optimization algorithms.
- Apply the soft computing techniques for practical applications.

Unit I

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

Unit II

ARTIFICIAL NEURAL NETWORKS: Concept of Artificial Neural Networks and its basic mathematical model- McCulloch-Pitts neuron model-simple perceptron - ADALINE, 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 - recurrent network - Neural Network based controller

Unit III

FUZZY LOGIC SYSTEM: Introduction to crisp sets and fuzzy sets- basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control - Fuzzification, inference 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 IV

MODERN HEURISTIC ALGORITHMS

Basic concept of Genetic Algorithm (GA) and detail algorithmic steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. Concept of Tabu

Search (TS) - Evolutionary Programming (EP) and Ant-Colony Optimization (ACO) techniques for solving optimization problems.

Unit V

APPLICATIONS: GA, TS, EP and ACO applications to power system and power electronics optimization problem, Case studies: Identification and control of linear and nonlinear dynamic systems using Matlab-Neural Network toolbox. Stability analysis of Neural-Network interconnection systems. Implementation of fuzzy logic controller using Matlab fuzzy-logic toolbox- Stability analysis of fuzzy control systems.

Text Books

1. Jacek. M. Zurada, "Introduction to Artificial Neural Systems", Jaico Publishing House, Mumbai, 2006.
2. Kosko,B. "Neural Networks And Fuzzy Systems: A Dynamical Systems Approach To Machine Intelligence", Prentice-Hall of India Pvt. Ltd., New Delhi, 2008.

Reference Books

1. Zimmerman H.J. "Fuzzy set theory-and its Applications", Kluwer Academic Publishers, Dordrecht, 2001.
2. D. Driankov, H. Hellendoorn, M. Reinfrank, "Introduction to Fuzzy Control", Narosa Publising houses, New Delhi, 2001.
3. Kalyanmoy Deb, "Optimization for Engineering Design" Prentice-Hall of India Pvt. Ltd., New Delhi, 2003.

12EE342 OCEANIC ENERGY

Credits: 4:0:0

Course Objective

- To provide necessary knowledge about the basics, design and analysis of two important oceanic energy components i.e., tidal and wave.
- To make the learner to understand the operation of tidal power plants and wave power plants
- To impart the basic knowledge about integration of tidal and wave power plants with grid

Course Outcome

- Have awareness about the possibilities of power generation from ocean
- Suggest new mechanisms to harvest energy from ocean
- Design efficient tidal and wave power plants

Unit I

INTRODUCTION TO TIDAL ENERGY: Historical Development -Tidal phenomenon-Ocean tides -Types of tides -Propagation of tides in estuaries -Coriolis effect -Barrage effects -Tidal power potential and site selection -Hydroelectric versus Tidal-Electric developments-Site potential estimation-Coefficient of the tide-Major factors influencing project economics-Site selection- Management and organization of investigations-Management-Organization-Feasibility studies

Unit II

TIDAL POWER SCHEMES, MODES OF OPERATION AND MODELS: Single-Basin development, Single-effect mode of operation- Single-basin development, Double-effect mode of operation , Pumping to augment tidal effect, Linked-basin developments - Paired-basin developments - Retiming of tidal energy - Basic data - General physiography of the estuary- Geology - Tides -Waves - Tidal currents - Suspended and mobile sediments - Ecosystem characteristics - Hydraulic and numerical models in feasibility investigations- Hydraulic models - Numerical models for estuaries - Hybrid models - Modeling of barrier effects - Mathematical model for closure activities - Utility system planning and simulation

Unit III
TIDAL POWER PLANTS: Civil works -Dry versus wet Construction - Design parameters - Caisson design- Dikes- Construction schedules- Electromechanical equipment - Specific requirements for tidal generating equipment- Types of turbines - Generators - Electrical equipment – Transmission-Integration of output with electric utility systems - Absorption of raw tidal energy -Enhancing raw tidal energy output - System considerations

Unit IV
INTRODUCTION TO WAVE ENERGY: Wave structure- Wave power calculations- Global wave energy -Wave energy potential- Wave energy technologies- Wave concentration effects- Tapered channel - Oscillating water column- Mighty whale design

Unit V
WAVE POWER PLANTS: Turbines for wave energy - Ocean wave conversion system-Wave energy power distribution-Grid connection-Wave energy-Environmental impacts

Text Books

1. Robert H. Clark, “Elements of Tidal-Electric Engineering”, 1st Edition, Wiley-IEEE Press, USA, 2007.

2. Boyle, “Renewable Energy”, 2nd Edition, Oxford University Press, UK, 2004.

Reference Books

1. Jack Hardisty , “The Analysis of Tidal Stream Power”, Wiley, 1st Edition, UK, 2009
2. Michael E. McCormick, “Ocean Wave Energy Conversion” Dover Publications, 1st Edition, USA, 2009
3. Joao Cruz, Ocean Wave Energy: Current Status and Future Perspectives, Springer, 1st Edition, Berlin, 2010.

12EE343 GEOTHERMAL ENERGY

Credits: 4:0:0
Course Objective:

- To develop a in-depth understanding of the issues associated with the development of geothermal energy
- To make the students to realize the current state of geothermal energy resources and technologies
- To impart the knowledge of exergy analysis applicable to geothermal systems

Course Outcome:

- The students will be able to demonstrate a good understanding of the role which geothermal energy plays in the energy sector
- The students will have knowledge regarding geothermal energy resources and the ability to utilize that resource
- The students will be able to analyze geothermal energy resources based on exergy efficiencies

Unit I

INTRODUCTION: Geology of geothermal regions -The earth and its atmosphere-Active geothermal regions-Model of a hydrothermal geothermal resource-Other types of geothermal resources-Hot dry rock, HDR-Geopressure-Magma energy -Exploration strategies and techniques -Objectives of an exploration program -Phases of an exploration program-Synthesis and interpretation

Unit II

GEOTHERMAL WELL AND RESERVOIR: Geothermal well drilling-Geothermal reservoir and well flow- Well testing - Desired information- Calcite scaling in well casings- Reservoir modeling and simulation

Unit III

GEOTHERMAL POWER GENERATING SYSTEMS: Single-Flash Steam power plants-Gathering system design considerations - Energy conversion system - Thermodynamics of the conversion process -Equipment list for single-flash plants -Double-Flash steam power plants -Gathering system design considerations -Energy conversion system -Thermodynamics of the conversion process -Scale potential in waste brine -Equipment list for double-flash plants -Dry-steam power plants -Origins and nature of dry-steam resources -Steam gathering system -Energy conversion system -Equipment list for dry-steam plants -Binary cycle power plants -Basic binary systems -Working fluid selection -Advanced binary cycles -Equipment list for basic binary plants

Unit IV

ADVANCED GEOTHERMAL ENERGY CONVERSION SYSTEMS: Hybrid single-flash and double-flash systems -Hybrid flash-binary systems -Total-flow systems -Hybrid fossil-geothermal systems -Combined heat and power plants -Hot dry rock (enhanced geothermal systems) Power plants for hypersaline brines

Unit V

EXERGY ANALYSIS APPLIED TO GEOTHERMAL POWER SYSTEMS: First law for open, steady systems - Second law for open, steady systems -Exergy -Exergy accounting for open, steady systems -Exergy efficiencies and applications to geothermal plants.

Text Book:

1. Ronald DiPippo, Geothermal Power Plants: Principles, Applications and Case Studies and environmental impact, 2nd Edition, Elsevier Science, USA, 2008.
2. Boyle,"Renewable Energy", Oxford University Press, 2nd Edition, UK, 2004.

Reference Books:

1. Ernst Huenges, Patrick Ledru, “Geothermal Energy Systems: Exploration, Development, and Utilization”, Wiley, 1st Edition ,Weinhim, 2010.
2. Harsh K. Gupta ,Sukanta Roy, “Geothermal Energy: An Alternative Resource for the 21st Century” Elsevier Science; 1st Edition, The Netherlands, 2006.

12EE344 OPTIMAL CONTROL OF WIND ENERGY SYSTEMS

Credits: 4:0:0

Course Objective
- To understand the importance of optimal control in wind energy systems
- To impart the basics of modeling of wind energy conversion system
- To introduce the various parameters that need to controlled in wind energy systems

Course Outcome
- Learn the various techniques that can be used to obtain optimal control
- Lay the basics of efficient control of wind energy systems and thus to make wind power a main source of renewable energy

Unit I
WECS MODELLING: Electrical Generator Modeling – Drive Train Modeling – Power Electronics Converters and Grid Modeling – Linearization and Eigen value analysis – Case study

Unit II
WIND TURBINE CONTROL SYSTEMS: Control Objectives – Physical Fundamentals – Principles of WECS Optimal Control – Main Operation Strategies – Optimal control with Mixed Criterion – Gain Scheduling Control – Control of generators in WECS – Control System for Grid connected operation and Energy Quality Assessment.

Unit III
WECS OPTIMAL CONTROL WITH ENERGY EFFICIENCY CRITERION: MPPT strategies – PI control – ON/OFF control – Sliding mode control – Feedback Linearization Control – QFT Robust Control.

Unit IV
WECS OPTIMAL CONTROL WITH MIXED CRITERION: LQ control of WECS – Frequency separation principle – 2LFSP applied to WECS with Rigidly-coupled generator and flexibly- coupled generator.

Unit V
VOLTAGE AND REACTIVE POWER CONTROL: Voltage control – Voltage control capabilities of wind turbines – Voltage control capability and converter rating – Voltage regulation: VAR support on a wind dominated grid.

Text Books

1. Iulian Munteanu, Antoneta Iuliana Bratcu, Nicolaos-Antonio Cutululis, Emil Ceang, “Optimal Control of Wind Energy Systems - Towards a Global Approach”, Springer-Verlag, London, 2008.
2. Thomas Ackermann, “Wind Power in Power Systems”, John Wiley & Sons Ltd., England, 2005.

Reference Books

1. Fernando D. Bianchi, Hernan De Battista, Ricardo J. Mantz, “Wind Turbine Control Systems: Principles, Modelling and Gain Scheduling Design”, Springer-Verlag, London, 2007.
2. Olimpo Anaya-Lara, Nick Jenkins, Janaka Ekanayake, Phill Cartwright, Mike Hughes, “Wind Energy Generation- Modelling and Control”, John Wiley & Sons Ltd., UK, 2009.
3. Siegfried Heier, “Grid Integration of Wind Energy Conversion System”, Second Edition, John Wiley & Sons Ltd., England, 2006.

12EE345 WIND RESOURCE ASSESSMENT AND FORECASTING METHODS

Credits: 3:1:0

Course Objective

- To understand the basics of assessing potential sites for wind farms
- To learn the mathematical basics involved in forecasting of data
- To equip the student with the latest forecasting techniques

Course Outcome:

- Understand the technical and economical aspect of wind resource assessment
- Enable the student to understand the basics of available forecasting models
- Equip the students to develop accurate forecasting models

Unit I

WIND RESOURCE ASSESSMENT: Guiding Principles – Siting of monitoring systems – Measurement parameters – Monitoring station instrumentation – Installation of Monitoring stations – Station operation and maintenance - Data collection and handling – Data validation, processing and reporting – Cost and Labour requirements.

Unit II

FORECASTING PERSPECTIVE AND BASIC FORECASTING TOOLS: Overview of forecasting techniques – Basic steps in forecasting task – Time series and cross-sectional data- Graphical summaries – Numerical summaries – Measuring forecast accuracy – Prediction Intervals – Least squares estimates – Transformations and adjustments

Unit III

TIME SERIES DECOMPOSITION AND EXPONENTIAL SMOOTHING METHODS: Principles of decomposition – Moving averages – Local regression smoothing – Classical decomposition – Census Bureau method - STL decomposition – Forecasting and decomposition - Forecasting scenario - Averaging methods – Exponential smoothing methods – General aspects of smoothing methods.

Unit IV

FORECASTING TECHNIQUES: Simple Regression: Regression methods – non-linear relationships Multiple Regression: Regression with time series – Multiple regression and forecasting – Econometric models Box-Jenkins methodology of ARIMA models: Examining correlations in time series data – Examining stationarity of time series data - ARIMA models for time series data – Forecasting with ARIMA models

Unit V

ADVANCED FORECASTING MODELS: Regression with ARIMA errors – Dynamic regression models – Intervention analysis – Multivariate autoregressive models – State space models – Non-linear models – Neural network forecasting.

Text Books

1. S. Makridakis, S. C. Wheelwright, R. J. Hyndman, “Forecasting – Methods and Applications”, Third Edition, Wiley-India Edition, Delhi, 2011
2. Wind Resource Assessment Handbook, AWS Scientific Inc., New York 1997.

Reference Books:

1. Michael Brower, Daniel W. Bernadett, Kurt V. Elsholz, Matthew V. Filippelli, Michael J. Markus, Mark A. Taylor, Jeremy Tensen, “Wind Resource Assessment: A Practical Guide to Developing a Wind Project”, John Wiley & Sons, London, 2012.
2. J. Scott Armstrong, “Principles of Forecasting: A Handbook for Researchers and Practitioners”, Springer Science+Business Media Inc., USA, 2001.
3. Douglas C. Montgomery, Cheryl L. Jennings, Murat Kulahci, “Introduction to Time Series Analysis and Forecasting”, John Wiley & Sons, New Jersey, 2008.

12EE346 DESIGN OF TURBINES FOR RENEWABLE ENERGY SYSTEMS

Credits 3:1:0

Course Objective

- The students will be exposed to different turbines for renewable energy
- Designing turbines for different power generation schemes using the renewable energy will be highlighted
- Any flaws and faults related to turbines and its design will be discussed

Course Outcome

- Students will have a clear idea about the Turbines, its behavior under various conditions.
- Student will be capable of designing turbines for different power generation
- Students will have an exposure to drawbacks and faults associated with the existing system.

Unit I

INTRODUCTION TO TURBINE DESIGN: Concept of Energy conversion – Types of Turbines – Turbines for Power Generation – Solar Energy based, Wind Energy, Hydro Energy, Tidal Energy, OTEC and Geothermal Energies- Introduction. General Turbine design aspects.

Unit II

TURBINE DESIGN FOR SOLAR BASED POWER GENERATION: Solar based power generation types- organic fluid based low temperature system, solar tower based high temperature system- Turbine Models used – designing – Drawbacks and faults related to turbines- Problems.

Unit III

WIND TURBINE DESIGN: Horizontal and vertical axis wind turbines- design- problems related to design - Faults related to wind turbines- softwares for turbine design-overview

Unit IV

TURBINES FOR HYDRO POWER GENERATION: Introduction to hydro power generation- conventional, pumped storage - Different types of hydro turbine designs- Francis, Pelton, Kaplon turbines - Design problems.

Unit V

TURBINES FOR GEOTHERMAL AND OCEAN ENERGY: Turbine for Geothermal plant- Turbine design for Tidal power- Turbines for Ocean thermal energy conversion systems. Design issues- problems

Text Books

1. David.M. Eggleston., "Wind Turbine Engineering design", Amazon publications, 1st Edition, 1987.
2. Peter Jamieson., " Innovation in Wind turbine design" Wiley, 1st Edition, 2011.

Reference Books

1. Jeremy Thake., "The Micro-Hydro Pelton Turbine Manual: Design, Manufacture and Installation for Small-Scale Hydro-Power" Amazon, 2001
2. Shylakhin., "Steam Turbines: Theory and Design" Amazon, 2005

12EE347 COMPUTER NETWORKS AND PROTOCOLS

Credits 4:0:0

Course Objective:

- Study the communication networks in computer
- Know various data communication techniques.
- Know the various applications using network protocols

Course Outcome:

- Understand the concepts of Computer Communication
- Understand the peripheral connections in a computer.
- It also gives broad idea on networking which are available for daily use.

Unit I

INTRODUCTION TO COMPUTER NETWORKS: Computer networks – advantage – structure of communication network - point -to-point, circuit switched, packet switched; network topologies; network protocols; OSI reference model, example networks; physical layer and data transmission – analog and digital; transmission impairments; delay, distortion; transmission media; twisted pair, co-axial, optical fibre, terrestrial microwave, satellite microwave, radio; data encoding and communication: recap on PCM; AM; asynchronous and synchronous transmission; error detection techniques; interfacing: RS-232C, X.21 Digital interface; modems, multiplexer, demultiplexer.

Unit II
MEDIA ACCESS CONTROL AND DATA LINK LAYER: Media access control and data link layer – framing; error detection and correlation methods; stop-and-wait ARQ; Back-N ARQ; Selective Repeat ARQ etc; media access protocols: ALOHA, slotted ALOHA, CSMA/CD, Token Ring, Token Bus, FDDI-I, FDDI-II, ATM.

Unit III
NETWORK LAYER: Network layer – connection oriented vs. connectionless services; routing; X2.5; IP; congestion control, internetworking, network layer in the Internet; IP protocol, IP addresses, subnets, OSPF, BGP, CIDR; network layer in ATM.

Unit IV
TRANSPORT LAYER: Transport layer – transport services and protocols; the Internet transport protocols; TCP and UDP, Remote procedure call, ATM AAL layer protocols.

Unit V
APPLICATION LAYER: Application layer – network security, DNS, SNMP, FTP, Telnet, E-mail, X-400, digital networks-ISDN; B-ISDN

Text Books

1 Andrew Tannenbaum., "Computer Networks", Prentice Hall of India, New Delhi, 4th Edition, 2003
2 Forouzan, "Introduction to Data Communication and Networking", Tata McGraw - Hill Education India Private Limited, New Delhi, 4th Edition, 2004.

References Books

1 William, Stallings, "Data and Computer Communication", Prentice Hall of India, New Delhi, 7th Edition, 2003.
2 Keiser, G.E., "Local Area Networks", Galgotia Publications, Pune, 2nd Edition, 2002.
3 Uyless, Black., "Computer Networks, Protocols, Standards and Interfaces", Prentice Hall International Edition, 2nd Edition, 2002

12EE348 MICROCONTROLLERS APPLICATIONS IN POWER ELECTRONICS

Credits :4:0:0

Course Objective

- To make students aware of various microcontrollers
- To learn and understand the architecture of 8051, 8096 and PIC microcontrollers.
- To understand the design and interfacing of microcontroller based embedded systems.

Course Outcome

- Design simple Microcontroller based systems.
- Write simple program using various Microcontrollers
- Interface / Apply in standard applications.

Unit I
INTEL 8051
Architecture of 8051- Memory organization- Register Banks- Bit addressable area- SFR area- Addressing modes- Instruction set- Programming examples. Interrupt structure- Timer modules- Serial features- Port structure- Power saving modes.

Unit II
16-BIT MICRO CONTROLLER: 8096/8097 Architecture-CPU registers –RALU-Internal Program and Data memory Timers- High speed Input and Output –Serial Interface-I/O ports – Interrupts –A/D converter-Watch dog timer –Power down feature –Instruction set- External memory Interfacing –External I/O interfacing.

Unit III
PIC MICROCONTROLLERS: Program memory – CPU Registers – Register file structure – Block diagram of PIC 16C74 – I/O Ports - Timers 0,1 and 2 features – Interrupt Logic – Serial Peripheral Interface – I^2C Bus – ADC – UART.

Unit IV
TYPICAL APPLICATIONS TO POWER CONVERTERS & INVERTERS: Firing schemes for single phase and three phase rectifiers - 3-phase AC Voltage Controller, Firing at variable frequency environment, Firing scheme for DC choppers, voltage and current commutation, Inverters, types of pulse width modulation techniques and their implementation using microprocessors.

Unit V
TYPICAL APPLICATIONS TO DRIVES: Stepper motor control – DC motor control –Induction Motor Control – Synchronous Motor control.

Text Books

1. Mazidi and D.MacKinlay "8051 Microcontroller and Embedded Systems using Assembly and C", Pearson Education Low Price Edition, New Delhi, 2006.
2. John B Peatman, "Design with PIC Micro Controllers", Pearson Education India Series, New Delhi, 2005.

Reference Books:

1. "8-Bit Embedded Controllers", Intel Corporation, 2011.
2. John B Peatman, "Design with Micro Controllers", McGraw- Hill International Edition, Singapore, 1988.