B.Tech. DEGREE

ELECTRICAL AND ELECTRONICS ENGINEERING

SYLLABUS
FOR
CREDIT BASED
CURRICULUM
(With effect from 2011 batch onwards)

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

SEMESTER – III

CODE	COURSE OF STUDY	L	T	P	C
MA205	Transforms and Partial Differential Equations	3	0	0	3
EE201	DC Machines and Transformers	3	1	0	4
EE203	Circuit Theory	3	1	0	4
EE205	Electron Devices	3	0	0	3
ME231	Thermal Engineering	3	0	0	3
CE287	Mechanics of Solids and Fluids	3	0	0	3
EE207	DC Machines and Transformers Laboratory	0	0	3	2
EE209	Circuits and Devices Laboratory	0	0	3	2
	Total	18	2	6	24

SEMESTER-IV

CODE	COURSE OF STUDY	L	T	P	C
MA202	Numerical Methods	3	0	0	3
EE202	AC Machines	3	1	0	4
EE204	Transmission and Distribution of Electrical Energy	3	0	0	3
EE206	Networks and Linear Systems	3	1	0	4
EE208	Analog Electronic Circuits	3	0	0	3
EE210	Digital Electronics	3	0	0	3
EE212	Synchronous and Induction Machines Laboratory	0	0	3	2
EE214	Electronic Circuits Laboratory	0	0	3	2
	Total	18	2	6	24

SEMESTER - V

CODE	COURSE OF STUDY	L	T	P	C
EE301	Power System Analysis	3	1	0	4
EE303	Control Systems	3	0	0	3
EE305	Linear Integrated Circuits	3	0	0	3
EE307	High Voltage Engineering	3	0	0	3
EE309	Data Structures and C++	3	0	0	3
EC319	Communication Systems	3	0	0	3
EE311	Integrated Circuits Laboratory	0	0	3	2
EE313	Computer Software Laboratory	0	0	3	2
	Total	18	1	6	23

SEMESTER - VI

CODE	COURSE OF STUDY	L	T	P	C
EE302	Power Electronics	3	1	0	4
EE304	Measurement and Instrumentation	3	0	0	3
EE306	Microprocessors and Micro controllers	3	0	0	3
EE308	VLSI	3	0	0	3
EE310	Operating Systems	3	0	0	3
	Elective – I	3	0	0	3
EE312	Power Electronics Laboratory	0	0	3	2
EE314	Microprocessor and Microcontroller Laboratory	0	0	3	2
	Total	18	1	6	23

SEMESTER - VII

CODE	COURSE OF STUDY	L	T	P	C
MB491	Management Concepts and Practices	3	0	0	3
EE401	Power System Economics and Control Techniques	3	0	0	3
EE403	Power System Protection and Switchgear	3	0	0	3
EE405	Industrial Electronics	3	0	0	3
	Elective – II	3	0	0	3
	Elective – III	3	0	0	3
EE407	Power System Simulation Laboratory	0	0	3	2
EE409	Instrumentation Laboratory	0	0	3	2
EE447	Compréhensive Viva- Voce	-	-	-	3
	Total	18	0	6	25

SEMESTER - VIII

CODE	COURSE OF STUDY	L	T	P	C
HM402	Industrial Economics and Management	3	0	0	3
EE402	Utilization of Electrical Energy	3	0	0	3
	Elective – IV	3	0	0	3
	Elective – V	3	0	0	3
EE498	Project Work	0	0	15	6
	Total	12	0	15	18

The total minimum credits required for completing the B.Tech. Programme in Electrical and Electronics Engineering is **182**

LIST OF ELECTIVE SUBJECTS

CODE	COURSE OF STUDY	L	T	P	C
	ELECTIVE – I				
EE352	Modern Control Systems	3	0	0	3
EE354	Computer Architecture	3	0	0	3
	ELECTIVES –II AND III				
EE451	Computer Networks	3	0	0	3
EE453	Digital Control Systems	3	0	0	3
EE455	Design With Pic Microcontrollers	3	0	0	3

Or any other Elective subject from any other department

	ELECTIVES - IV AND V				
EE452	Artificial Neural Networks	3	0	0	3
EE454	Power System Restructuring	3	0	0	3

Or any other Elective subject from any other department

LIST OF RESERVE ELECTIVES

From year to year, the first departmental elective subjects listed under elective 1 to elective 5 categories, may be replaced by suitable courses from the following list depending upon the interest of the majority of the students.

CODE	COURSE OF STUDY	L	T	P	C
EE350	Solid State Drives	3	0	0	3
EE356	Embedded System Design	3	0	0	3
EE358	Power Generation Systems	3	0	0	3
EE360	Digital Signal Processing	3	0	0	3
EE362	Design Of Electrical Apparatus	3	0	0	3
EE364	Fuzzy Systems And Genetic Algorithms	3	0	0	3
EE366	Wind And Solar Electrical Systems	3	0	0	3
EE462	Static Relays	3	0	0	3
EE457	Power Electronic Applications In Power Systems	3	0	0	3
EE458	Power System Dynamics	3	0	0	3
EE459	Ehv AC And DC Transmission	3	0	0	3
EE460	Application Specific Integrated Circuits	3	0	0	3

MA205 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

Laplace Transform of Standard functions, derivatives and integrals – Inverse Laplace transform –Convolution theorem-Periodic functions – Application to ordinary differential equations and simultaneous equations with constant coefficients and integral equations

Fourier series – Dirichlet's conditions - Half range Fourier cosine and sine series - Parseval's relation - Fourier series in complex form - Harmonic analysis

Fourier transforms - Fourier cosine and sine transforms - inverse transforms - convolution theorem and Parseval's identity for Fourier transforms - Finite cosine and sine transforms

Formation of partial differential equations eliminating arbitrary constants and functions - solution of first order equations - four standard types - Lagrange's equation - homogeneous and non-homogeneous type of second order linear differential equation with constant coefficients

One-dimensional wave equation and one-dimensional heat flow equation - method of separation of variables - Fourier series solution

1. *Venkataraman, M.K., 'Engineering Mathematics Vol.4', National publishing company,2004.*
2. *Grewal.B.S.,Higher Engineering Mathematics,Khanna Publishers,2000.*

EE201 DC MACHINES AND TRANSFORMERS

Principle of Energy conversion – Basic magnetic circuit analysis Faradays law of electromagnetic induction – singly and doubly Excited magnetic field systems – Torque production in rotating machines and general analysis of electro mechanical system

DC Generator – constriction, principle of operation, types – emf equation – Characteristics - commutation - Armature reaction

DC motor – principle of operation, types – Torque equation – Electrical & Mechanical characteristics – starting – speed control – Various testing – Braking

Transformers – construction, principle of operation, types – Equivalent circuit - regulation and efficiency – Auto transformer

Three phase transformer connection-Scott connection – all day efficiency - Sumpner's test - parallel operation of transformers.

1. *Nagrath, I.J.and Kothari, D.P.,`Electrical Machines', Tata McGraw Hill Publishing Company Ltd., New Delhi, 2006.*
2. *Dr. P.S. Bimbhra, 'Electrical Machinery, 'Khanna Publishers, 2007.*
3. *Vincent Del Toro, 'Electrical Engineering Fundamentals', PHI, 2003*
4. *Parkar Smith, N.N., 'Problems in Electrical Engineering' CBS Publishers and Distributers, New Delhi,1984.*
5. *Irving L. Kosow 'Electric Machinery and Transformers' PHI, New Delhi, 1991.*

EE203 CIRCUIT THEORY

Fundamental concepts of DC and A.C circuits, R, L and C elements - phasor diagram - complex impedance - real and reactive power - series and parallel circuits - loop and nodal analysis

Voltage - current source transformations, Various Network theorems and its applications to dc and ac circuits, star-delta transformations

Resonance in series and parallel circuits, self and mutual inductances, coefficient of coupling - dot convention - analysis of coupled circuits

Three - phase star and delta circuits with balanced and unbalanced loads power measurements - power factor calculations

Time response of RL, RC and RLC circuits for step and sinusoidal inputs

1. *Hayt,W.H. and Kemmerly,J.E.,` Engineering Circuit Analysis ', McGraw Hill, New York, 7th edition, 2007.*
2. *Joseph. A. Edminister, ` Electric Circuits - Schaum's outline series', McGraw Hill International, 4th edition, 2003.*
3. *Arumugam,M. And Premkumar, N., `Electric Circuit Theory', M/S. Khanna Publishers Co.,9th Reprint,1997.*
4. *Charles K. Alexander, Matthew N. O. Sadiku, Fundamentals of Electric Circuits, 2nd Edition, McGraw-Hill Companies.*

EE205 ELECTRON DEVICES

Semi conductors- charge carriers, intrinsic and extrinsic semi conductors-Hall effect

Diodes-PN junction-current equation -junction capacitance-breakdown characteristics, Zener, tunnel, Schottky diodes

Bipolar junction transistors – Characteristics – analysis of CB, CE, CC amplifier configurations

Uni polar devices - FET, MOSFET, UJT and Opto-Electronic devices-theory and characteristics

Rectifiers and switched mode power supplies - theory and design, filter circuits, applications

1. *David, A.Bell, 'Electronic Devices and Circuits', 5th Edition, PHI, 2008.*
2. *Millman and Halkias, `Electronic Devices and Circuits', McGrawHill International student Edition, 5th Reprint, 1993.*
3. *Allen Mottershead, 'Electronic Devices and Circuits-An Introduction', PHI, 18th Reprint, 2006.*
4. *Malvino, 'Electronic Principles', Tata McGraw Hill, 7th edition, 2008*

ME231 THERMAL ENGINEERING

Definitions of system - system boundary, property, process, cycle, heat, work, reversible and quasistatic processes- Heat and work transfer during different types of processes

First law of Thermodynamics - Closed system application - internal energy - heat transfer calculations - open system applications - non flow and flow System applications

Second Law of Thermodynamics - Heat engine, Refrigerators, Kelvin – Planck statement – Clausius statement – their equivalence – Carnot cycle – Clausius Inequality – entropy change – TS diagram

Entropy change – Gas power cycle -Vapour power cycle-Rankine cycle-reheat cycle-regenerative cycle-calculations for efficiency and power output using steam tables and Mollier chart

Reciprocating air compressors –optimum pressure ratio in multistage compression-inter cooling-effect of clearance volume-Performance and testing of IC engines

1. *Gordan Van Wylen, Richard Sonntag., 'Fundamentals of Classical Thermodynamics', Jhon Wiley and Sons, 1994*
2. *Kothandaraman. C.P., `A Course in Thermodynamics and Heat Engines', Dhanpat, Rai and Sons, 1992.*
3. *Nag, P.K .,`Engineering Thermodynamics', Tata McGraw Hill, 1997.*

CE287 MECHANICS OF SOLIDS AND FLUIDS

Stress – Strain – Elastic constants – Stress in Composite bars – Beams – Types – Shear force and bending moment diagrams for simply supported and overhanging

Columns Long column – Euler's Theory – Short column – Empirical formulae – Torsion of Circular shafts – Hollow Shafts – Power transmission

Vapour Pressure – Pressure at a point its variation – Measurement with Piezo meter, manometers and gauges

Continuity equation in one dimension – Bernoulli's equation – Venturi meters and Orificie meters – Flow through pipes – Laminar Turbulent flow Major losses

Pumps – General principles of displacement and Centrifugal pumps – Efficiency and Performance Curves of Pumps – Caviation in Pumps – Turbines – Efficiency – Governing of turbines

1. *Ramamirtham, S., `Strength of Materials ', Dhanpat Rai and Sons, New Delhi, 2003.*
2. *Rajput , R.K., 'Strength of Materials ', S.Chand & Co Ltd., New Delhi, 1996.*
3. *Nagarathnam, S. 'Fluid Mechanics', Khanna Publishers,New Delhi, 1995.*

EE207 DC MACHINES AND TRANSFORMERS LABORATORY

1. Open circuit and load characteristics of DC shunt generator
2. Load characteristics of DC compound generator
3. Load test on DC shunt motor
4. Speed control of DC shunt motors
5. Swinburne's test
6. Open circuit and short circuit test on single phase transformer
7. Separation of no load losses in a single phase transformer
8. Sumpner's test
9. Load test on single phase transformer
10. Parallel operation of single phase transformer

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EE 209 CIRCUITS AND DEVICES LABORATORY

1. Verification of Circuit theorems
2. Half wave and full wave rectifiers
3. Bridge Rectifier
4. Volt-ampere characteristics of rectifier diode and zener diodes
5. Characteristics of UJT
6. Characteristics of FET
7. Clipping and clamping circuits
8. Transistor characteristics - CE
9. Transistor characteristics – CB

MA202 NUMERICAL METHODS

Solution of linear system - Gaussian elimination and Gauss-Jordan methods - LU - decomposition methods - Crout's method - Doolittle method - Cholesky's method - Jacobi and Gauss-Seidel iterative methods - sufficient conditions for convergence - Power method to find the dominant Eigen value and eigenvector

Solution of nonlinear equation - Bisection method - Secant method - Regula falsi method - Newton- Raphson method -Order of convergence of these methods - Horner's method - Graeffe's method - Birge-Vieta method - Bairstow's method

Curve fitting - Method of least squares and group averages – Least square approximation of functions - solution of linear difference equations with constant coefficients

Numerical Solution of Ordinary Differential Equations- Euler's method - Euler's modified method - Taylor's method and Runge-Kutta method for simultaneous equations and 2^{nd} order equations - Multistep methods - Milne's and Adams' methods

Numerical solution of Laplace equation and Poisson equation by Liebmann's method - solution of one dimensional heat flow equation - Bender - Schmidt recurrence relation - Crank - Nicolson method - Solution of one dimensional wave equation

1. *Kandasamy, P.,Thilagavathy ,K.,and Gunavathy,S.,`Numerical Methods', Chand and Co.,2007.*
2. *Jain, M.K., Iyengar,S.R.,and Jain,R.K.,`Numerical Methods for Scientific and Engineering Computation', Wiley Eastern,1992.*
3. *Gerald,C.F., and Wheatley, P.O.,'Applied Numerical Analysis', M/s. Addison Wesley, 1994.*

EE202 AC MACHINES

Alternators - construction, principle and types - armature reaction - load characteristics - predetermination of regulation - two reaction theory – parallel operation

Synchronous motors - construction, principle and types - starting methods - phasor diagrams -V and inverted V curves - Hunting

Poly phase Induction motors- construction, principle and types - equivalent circuit - circle diagram - starting and speed control - induction generators

Single phase induction motors - construction, principle and types - double revolving field theory - equivalent circuit

Permanent magnet brushless motors - construction, principle and types - phasor diagram, Torque Equation.

1. *Nagrath I.J. & Kothari, D.P.,`Electrical machines', Tata McGraw hill, NewDelhi,3rd edition,2004.*
2. *Say M.G., 'The performance and design of alternating current machines ' CBS Publishers and Distributers, New Delhi,1984.*
3. *Irving L. Kosow 'Electric Machinery and Transformers' PHI, New Delhi, 1999.*
4. *Cotton, H., 'Electrical Technology', CBS Publishers, New Delhi, 6th edition 1984.*
5. *Miller, T.J.E., 'Brushless Permanent Magnet And Reluctance Motor Drives', Clarendon Press- Oxford , 1989.*

EE204 TRANSMISSION AND DISTRIBUTION OF ELECTRICAL ENERGY

Transmission line parameters – resistance, inductance and capacitance calculations - single phase and three phase lines – double circuit line - effect of earth on transmission line capacitance

Performance of transmission lines – regulation and efficiency – tuned power lines power flow through a transmission line – power circle diagrams, formation of corona – critical voltages – effect on line performance

Mechanical design of overhead lines – line supports – insulators - voltage distribution in suspension insulators – string efficiency - testing of insulators stress and sag calculation – effects of wind and ice loading

Underground cables – comparison with overhead line – types of cables – insulation resistance – potential gradient – capacitance of single core and three core cables

Distribution systems – general aspects – Kelvin's Law, A.C. distribution – single phase and three phase - techniques of voltage control and power factor improvement, recent trends in transmission and distribution systems

1. *Wadhawa, C.L. 'Electrical Power Systems', New Age International Publishers, 6th edition, 2009*
2. *D. P. Kothari and IJ Nagrath, 'Power System Engineering' Tata Mcgraw – Hill, 2nd edition, 2008*
3. *Gupta B.R.,' Power system Analysis & Design', S. Chand and Company Ltd.,2nd edition, 2008*

EE206 NETWORKS AND LINEAR SYSTEMS

Frequency response - Harmonic analysis of simple circuits - Fourier series - Fourier integral - Fourier transforms methods

Classification of signals - representation in terms of elementary signals - impulse functions - Time response of circuits - complex frequency - poles and zeros - frequency response from pole-zero configuration – Driving point impedances - two-port networks

Realizability of one port networks – Hurwitz polynomials – Position function – necessary and sufficient condition of positive real functions – testing a positive real function – properties of driving point impedance – synthesis of LC, RL and RC driving point admittance

Differential equations of translational and rotational systems - transfer function - block diagram representation - Block diagram algebra - signal flow graph - Mason's gain formula

Concepts of state and state variables – state space modelling for simple electrical and mechanical systems – state transition matrix - solution of state equations

1. *D.Roy choudhury,"Networks and Systems",New Age International Publisher New Delhi,2005.*
2. *Nagrath I.J. and Gopal M,` Control Systems Engineering', New Age International,5th edition, 2007.*
3. *F.F.Kuo, 'Network Analysis and Synthesis', John Wiley Inc., New York , 1966.*
4. *Cheng.D.K.,` Analysis of Linear Systems', Addision Wesley,1988.*
5. *James W. Nilsson and Susan Riedel, "Electric circuits", Prentice Hall; 8 edition, 2007.*

EE208 ANALOG ELECTRONIC CIRCUITS

Small signal amplifiers - biasing circuits of BJT and FET transistors, analysis and design of BJT and FET amplifiers, chopper stabilized amplifiers

Large signal amplifiers - analysis and design of class A and class B power amplifiers, class C and class D amplifiers, thermal considerations, tuned amplifiers

Feedback amplifiers – gain with feedback - effect of feedback on gain stability, distortion, bandwidth, input and output impedances ; topologies of feedback amplifiers

Oscillators – Barkhausen criterion for oscillation - Hartley & Colpitts oscillators - phase shift, Wien bridge and crystal oscillators - clapp oscillator - oscillator amplitude stabilization

Pulse circuits – attenuators - RC integrator and differentiator circuits - diode clampers and clippers – multivibrators - Schmitt Trigger- UJT Oscillator

1. *Jacob Millman , ' Micro electronics' McGraw Hill, 2006.*
2. *Allen Mottershead, 'Electronic Devices and Circuits-An Introduction', PHI, 18th Reprint, 2006.*
3. *Robet.L.Boylestad, 'Electronic Devices and Circuit Theory ' 9th Edition, Pearson 2005.*
4. *Sedra Smith, 'Microelectronic Circuits', 6th Edition, Oxford university Press,2009.*

EE210 DIGITAL ELECTRONICS

Review of number systems, binary codes, error detection and correction codes. Digital Logic Families - Introduction to RTL, DTL, TTL, ECL and MOSL families - wired and operation, characteristics of digital logic family - comparison of different logic families

Combinational logic - representation of logic functions-SOP and POS forms K-map representations-minimization using K maps - simplification and implementation of combinational logic - multiplexers and demultiplexers - code converters, adders, subtractors.

Sequential logic- SR, JK, D and T flip flops - level triggering and edge triggering - counters - asynchronous and synchronous type - Modulo counters - Shift registers - Ring counters.

Synchronous Sequential Logic circuits-state table and excitation tables-state diagrams-Moore and Melay models-design of counters-analysis of synchronous sequential logic circuits-state reduction and state assignment.

Asynchronous sequential logic circuits-Transition table,flow table-race conditions-circuits with latches,analysis of asynchronous sequential logic circuits-introduction o design –implication table-hazards-programmable logic array and devices.

1. *Morris Mano,M .'Digital logic and computer design', Prentice Hall of India, 2005.*
2. *Donald D. Givone, "Digital Principles and Design", Tata McGraw Hill, 2002.*
3. *Tocci R.J.,Neal S. Widmer, 'Digital Systems: Principles and Applications', Pearson Education Asia, Second Indian Reprint 2002*
4. *Donald P Leach ,Albert Paul Malvino,Goutam Sha,"Digital Principles and Applications"The McGraw –Hill ,sixth edition,2007*

EE212 SYNCHRONOUS AND INDUCTION MACHINES LABORATORY

1. Load test on three phase induction motor.
2. No load and blocked rotor test on three phase induction motor.
3. Load test on grid connected induction generator.
4. Load test on self –excited induction generator.
5. Load test on single phase induction motor.
6. Regulation of three phase alternator by E.M.F. and M.M.F. methods.
7. Load test on three phase alternator.
8. Synchronisation of three phase alternator with infinite bus bar.
9. V and inverted V-curves of synchronous motor.
10. Study of induction motor starters.

EE214 ELECTRONIC CIRCUITS LABORATORY

1. Common emitter amplifier
2. Common collector amplifier
3. RC oscillators
4. Monostable multivibrator
5. Astable multivibrator
6. UJT oscillator
7. FET Amplifier
8. Feedback Amplifier

EE301 POWER SYSTEM ANALYSIS

Modelling of power system components - single line diagram –per unit quantities – bus impedance and admittance matrix

Power flow analysis - Gauss-Seidel, Newton-Raphson and fast decoupled methods

Symmetrical fault analysis - analysis through impedance matrix - circuit breaker rating - current limiting reactors

Unsymmetrical fault analysis - LG, LL, LLG and open circuit faults – analysis through sequence components

Stability studies - steady state and transient stability – swing equation - equal area criterion – multimachine stability analysis

1. *John J. Grainger & Stevenson.W.D., ' Power System Analysis', McGraw Hill International editions 1994*
2. *Hadi Saadat, 'Power System Analysis', Tata McGraw-Hill, 2002*
3. *Duncan Glover, J. Mulukutla S. Sarma & Thomas J. Overbye 'Power System Analysis and Design', Cengage Learning, 4th edition, 2008*

EE303 CONTROL SYSTEMS

Test signals - Response of second order systems – time domain specifications - Generalised error series - Frequency domain specifications - polar plots - Bode plots

Stability Analysis - Routh-Hurwitz criterion - Nyquist criterion - Stability of systems with transportation lag - Gain margin and phase margin

Root Locus Technique – Definitions - Root locus diagram - Rules of constructions of root loci - Effect of pole zero additions on the root loci - Root contours

Gain adjustments for the desired M_p – constant M and N loci - Nichols Chart - Compensator design by Bode and Root locus techniques - PID controller design

Control system components - Error detectors - potentiometers and synchros - a.c and d.c servomotors - stepper motors -Tacho generators – Proportional, integral and derivative controllers

1. *Katsuhiko Ogata, 'Modern control Engineering' 5th Edition , Pearson Education, First Indian Reprint 2009.*
2. *Richard C.Dorf and Robert H.Bishop . 'Modern control systems', Addison - Wesley, Eigth Edition, 8th edition, 1998.*
3. *Nagrath I.J. and Gopal M, 'Control Systems Engineering', New Age International,5th edition, 2007.*
4. *Gene F. Franklin, J. David Powell and Abbas Emami- Naeini, 'Feedback control of Dynamic Systems', Pearson Education, fourth edition, 2002.*
5. *Benjamin C.Kuo and Farid Golnaraghi, 'Automatic Control Systems', John wiley & Sons, 8th edition, 2003.*

EE305 LINEAR INTEGRATED CIRCUITS

Block diagram of a typical op-amp - characteristics of ideal and practical op amp - parameters of op-amp -Inverting and Non-inverting amplifier configurations - Frequency response, circuit stability.

Op- amps- DC and AC amplifiers - summing amplifier - difference amplifier - voltage follower - Differentiator - Integrator - clamper - clipper – filters,comparators,schmitt trigger, window detector.

Oscillators using opamp- sine wave, square wave, triangular wave, saw tooth wave generation

Converters- Analog to digital, digital to analog, sample and hold circuits - voltage controlled oscillator-phase locked loop-operating principles,application of PLL.

IC555 Timer-monostable and astable modes of operation; voltage regulators - fixed voltage regulators, adjustable voltage regulators - switching regulators .

1. *Gayakwad, R.A., 'Op-amps & Linear Integrated Circuits', Prentice Hall of India, New Delhi 3rd edition,1993.*
2. *Sergio Franco,' Design with operational amplifiers and Analog Integrated circuits',Tata McGraw Hill 3rd Edition 2002*
3. *Millman, J. and Halkias, C.C., 'Integrated Electronics-Analog and Digital, Systems', McGraw Hill, 9th Reprint, 1995.*

EE307 HIGH VOLTAGE ENGINEERING

Causes and types of over voltages, effects of over voltages on power system components, Surge diverters, EMI and EMC protection against over voltages ; Insulation coordination

Generation of high AC and DC, impulse and switching voltages - Generation of high impulse currents.

Measurement of high AC, DC, impulse voltages using sphere gaps, peak voltmeters, potential dividers, High speed CRO and digital techniques. Measurement of high currents

Dielectric breakdown – break down in gases , liquids and solids; partial discharges and corona discharges.

High Voltage Testing- testing of circuit breakers, insulators, bushings and surge diverters. Standards and specifications.

1. *Wadhwa,C.L., ' High voltage engineering', Wiley Eastern Limited, New Delhi, 1994.*
2. *Naidu,M.S. and Kamaraju,V., ' High Voltage Engineering', Tata McGraw Hill Publishing Company, New Delhi, , 2nd edition ,1994.*
3. *Kuffel,E and Zaengl W.S.,'High Voltage Engineering Fundamentals ', Pergamon press, Oxford, London,1986.*

EE309 DATA STRUCTURES AND C++

Introduction – Tokens – expressions – structures - functions in C++, classes and objects, constructors and destructors, operator overloading and type conversions

Inheritance, Extending classes, Pointers, Virtual functions and polymorphism, File Handling Templates, Exception handling, Manipulating strings

Algorithm, Analysis, Lists, Stacks and queues, Priority queues - Application, Heaps – hashing - hash tables

Trees - Binary trees, search tree ADT, AVL trees, Graph Algorithms - Topological sort, shortest path algorithm network flow problems - minimum spanning tree - Introduction to NP - completeness

Sorting – Insertion, Shell, Heap, Merge, Quick, Indirect, Bucket, Introduction to Algorithm Design Techniques – Greedy algorithm (Minimum Spanning Tree), Divide and Conquer (Merge Sort), Dynamic Programming (all pairs shortest path problem)

1. *Robert Lafore, Object oriented programming in C++, Galgotia Publication.*
2. *E. Balagurusamy, " Object Oriented Programming with C++", McGraw Hill Company Ltd., 2007.*
3. *Mark Allen Weiss, "Data Structures and Problem solving using C++ ", second edition , Addison Wesley Longman 2000.*
4. *Michael T. Goodrich, "Data Structures and Algorithm Analysis in C++", Wiley student edition, 2007.*
5. *Sahni, "Data Structures Using C++", The McGraw-Hill, 2006.*
6. *Jean – Paul Tremblay & Paul G.Sorenson, An Introduction to data structures with applications, Tata McGraw Hill edition, II Edition, 2002.*
7. *John R.Hubbard, Schaum's outline of theory and problem of data structure with C++, McGraw-Hill, New Delhi, 2000.*

EC319 COMMUNICATION SYSTEMS

Analog Modulation - Principles of Amplitude Modulation, single and double side band - suppressed carrier system and frequency modulation - varactor diode and reactance modulator - AM detectors - FM discriminators - AM and FM transmitters and receivers

Digital communication - Sampling theorem - pulse modulation techniques - PAM, PWM and PPM concepts - PCM encoder and decoder - Data transmission using analog carriers (FSK, PSK, QPSK, MSK &QAM)

Synchronous & Asynchronous transmission - error control techniques – protocols - data communication, link oriented, asynchronous

Modern Communication Systems – Microwaves - optical communication system - Satellite communication system - Mobile communication system

Principles of television engineering - Requirements and standards - need for scanning - types of camera tubes and picture tubes - B/W and colour systems - PAL - CCTV - Cable TV

1. *Kennedy, G.,'Electronic Communication System', McGraw Hill, 1987.*
2. *D.Roddy & J.Coolen , 'Electronic Communications', 4th Edition, Prentice Hall of India1999.*
3. *Simon Haykins, 'Communication Systems', 3rd Edition, John Wiley, 1995.*

EE311 INTEGRATED CIRCUITS LABORATORY

1. Analog Filters
2. Sample and Hold Circuit
3. Generation of square and triangular waveforms
4. Analog-to-Digital Converter
5. Digital-to-Analog Converter
6. Ramp Generator
7. Astable multivibrator using IC 555.
8. Monostable multivibrator using IC 555
9. Study of flip flops
10. Study of encoders and decoders
11. Binary counter
12. Decade counter with decoder/driver and seven segment LED display
13. Ring counter
14. Design of sequential logic circuit
15. Design of combinational logic circuits
16. Electronic gain using bi-directional shift registers

EE313 COMPUTER SOFTWARE LABORATORY

1. Structures
2. Arrays, Stacks and Queues
3. Classes and objects
4. Functions
5. Operator Overloading
6. Pointers
7. Inheritance
8. Virtual Functions
9. Input-Output File handling

EE302 POWER ELECTRONICS

Power Semiconductor Devices –Power diodes -power transistors-SCRs-Triac-GTO-Power MOSFETs-IGBTs-Principles of operation and characteristics, ratings, protection and gate drive circuits

AC to DC conversion- single-phase and three phase semi converters and full converters, effects of source inductance, inverter operations, dual converters

DC to DC conversion, Basic principles of switch mode power Conversion-Buck, Boost, Buck-Boost converters configurations, isolated converters

DC to AC conversion single-phase and three phase voltage source inverters-120 degree and 180 degree modes of operations, voltage control and waveform control, current source inverters

AC to AC conversion: single-phase and three-phase AC voltage regulators using SCR, Triac and self commutating devices - single phase cycloconverters

1. *Rashid, M.H. ,'Power Electronics - circuits, devices and applications', Prentice Hall India, New Delhi, 2006.*

2. *M.D.singh and K.B.Khanchandani, 'Power Electronics',Tata Mc Graw Hills Publishing Company Limited, New Delhi 2006.*

3. *Ned Mohan, Tore M.Undeland, William P Robbins, 'Power Electronics', John Wiley & Sons, Media Enhanced 3rd Edition, 2003.*

EE304 MEASUREMENTS AND INSTRUMENTATION

Analog Instruments - Permanent Magnet Moving Coil and Moving Iron meters – Extension in range for Ammeter and Voltmeter - Measurement of Power and Energy.

Measurements, Instrumentation, Errors in Measurements, Calibration and Standard, Classification and Characteristics of transducers, digital, electrical, Electronic weighing and their Application, Sensors and its different types.

A.F. Generator, Pulse Generator, AM/FM Signal Generator, Function Generator, Sweep Frequency Generator, Wave Analyzer, Spectrum Analyzer, Logic Analyzers, Distortion Analyzers.

Digital voltmeter and Multimeters, Automation in voltmeter, Accuracy of DVM, Guarding Techniques, frequency, period, time interval and pulse width measurements, Automatic vector voltmeter.

CRO, Analog and Digital storage Oscilloscope, Digital Phosphor Oscilloscopes, Analog & Digital Recorders and Printers.

1. *A. K. Sawhney, "A Course in Electrical and Electronic measurements and Instrumentation, Dhanpat rai & sons, 2005.*
2. *Rangan C.S., "Instruments Devices And System", Tata Mc-Graw Hill, 1998.*
3. *Cooper, "Electronic Instrumentation And Measurement Techniques", Prentice Hall Of India, 1998.*
4. *Bowens A.J., "Digital Instrumentation", Tata Mc-Graw Hill, 1996.*
5. *MMS Anand, "Electronic Instruments and Instrumentation Technology", Prentice Hall of India, 2005.*

EE306 MICROPROCESSORS AND MICROCONTROLLERS

8-Bit Microprocessor - 8085 architecture and memory interfacing (RAM & ROM), interfacing I/O devices - instruction set - addressing modes - assembly language programming – interrupts - timing diagram

8051 Microcontroller - Intel 8051 architecture, memory organization, flags, stack, special function registers, I/O, ports - connecting external memory, counters and timers, serial data I/O, Interrupts

Microcontroller instructions - addressing modes, moving data, logical operations, arithmetic operations, jump and call instructions – subroutines - Interrupts and returns

Microcontroller programming - Assembly Language Programming, timer and counter programming, connection to RS 232, Interrupt programming

Peripherals and interfacing - Serial and parallel I/O (8251 and 8255), Programmable DMA controller, Programmable interrupt controller, ADC/DAC interfacing, Waveform generation, speed control of DC motor, Stepper motor control, seven segment LED display

1. *Ramesh S. Gaonkar, "Microprocessor Architecture Programming and Applications with 8085", Fourth edition, Prentice Hall, 2002.*
2. *Kenneth Ayala, "The 8051 Microcontroller", Third edition, Cengage Learning, 2005.*
3. *Muhammad Ali Mazidi, Janice Mazidi , Janice Gillispie Mazidi, "The 8051 Microcontroller and Embedded Systems", Prentice Hall , 1999.*
4. *Ray A.K.Bhurchandi.K.M, "Advanced Microprocessor and Peripherals", Tata McGraw-Hill, 2002.*
5. *Sencer Yeralan, "Programming and Interfacing the 8051 Microcontroller", Addison-Wesley Publications.*

EE308 VLSI

MOS Transistor – Threshold voltage - Pass transistor - Transmission gate - Basic DC equations - Second order effects - MOS modules - Small signal AC characteristics - nMOS inverter - Steered input to an nMOS inverter - Depletion mode and enhancement mode pull ups - CMOS inverter - DC characteristics - Inverter delay – Power consumption in CMOS gates – Static dissipation – Dynamic Dissipation

Wafer processing - Oxidation - Patterning - Diffusion - Ion implantation - Deposition - Silicon gate nMOS process – CMOS processes – n well - p well – Twin tub - Silicon on insulator - CMOS process enhancements - Interconnect - Circuit elements - latchup - Latch up prevention techniques- layer representations – stick diagrams – nMOS design style – CMOS design style – Design rules

Simple combinational logic design examples - Parity generator - Multiplexers - Clocked sequential circuits - Two phase clocking - Charge storage - Dynamic register element - nMOS and CMOS - Dynamic shift register - Semi static register - JK flip flop

VHDL-Behavioural Modelling - Data flow Modelling - Structural Modelling - Design of simple circuits using VHDL - Overview of Verilog - Design of simple circuits using Verilog

Full custom and semicustom design - standard cell design and cell libraries - FPGA building block architectures - FPGA interconnect routing procedures

1. *Douglas, A. Pucknell, and Kamran, Eshraghian., "Basic VLSI design", Prentice Hall of India, New Delhi, 3rd Edition, 2004.*
2. *Neil, H. E. Weste and Kamran Eshraghian., "Principle of CMOS VLSI design: A system perspective", Pearson Education, 2nd Edition, 2002.*
3. *Jan M Rabaey, A Chandrakasan, B Nikolic, " Digital Integrated Circuits", Pearson Education, New Delhi, Third Indian Reprint, 2004. / Prentice Hall of India, New Delhi.*
4. *Amar Mukherjee, "Introduction to nMOS and CMOS VLSI system design", Prentice Hall, USA, 1990.*

EE310 OPERATING SYSTEMS

Operating System concepts - Types of OS and OS structure - Processes – Process model - Interprocess communication - IPC problems - Synchronization - Semaphores - Critical regions

Process scheduling – Deadlock - Deadlock avoidance, prevention, detection and recovery - Banker's algorithms

Memory Management – Swapping - Virtual memory - Page replacement algorithms - Design and Implementation issues - Segmentation

Input/output – Principles of I/O Hardware and Software, Disks, Clocks - File System – Files, directories, FS implementation – Security - Basics of cryptography, User authentication, Attacks and protection mechanisms

Introduction - Multimedia Operating systems and Multiple Processor Systems

1. *Andrew S.Tanenbaum, 'Modern operating systems', 10th print, Prentice Hall of India, 2000.*
2. *A.SILBERCHATZ, P.B.GALVIN, "Operating System Concepts", Addison Wesley, VI Edition, 2005*
3. *W.STALLINGS, "Operating Systems", Prentice Hall, V Edition, 2005.*
4. *D M Dhandhere, 'Systems Programming and Operating Systems', TMH, 2nd Revised Edition, 2002.*

EE312 POWER ELECTRONICS LABORATORY

1. SCR triggering circuits.
2. SCR and Triac phase control circuits.
3. Fully controlled single-phase thyristor bridge.
4. Buck Converter.
5. Boost Converter.
6. Three-phase thyristor bridge.
7. Series connected single-phase converters.
8. Series inverters.
9. IGBT and MOSFET single phase inverters.
10. Extinction angle control of converter.

EE314 MICROPROCESSOR AND MICROCONTROLLER LABORATORY

1. 8 bit multiplication and division
2. 16 bit multiplication and division
3. Waveform generation using DAC
4. Interfacing of ADC 0809
5. Interfacing of relay circuit
6. Generation of firing pulses for single phase full converter
7. Generation of firing pulses for three phase full converter
8. Generation of gate pulses for single phase inverter
9. Stepper motor Interface
10. Interfacing of 7 segment LED displays

MB491 MANAGEMENT CONCEPTS AND PRACTICES

Introduction to management, evolution of scientific management, modern management, principles

Elements of management- Planning, Organizing, Staffing, Directing, Co-ordinating, Reporting, Budgeting

Core concepts of marketing, need, want, demand, product, value, satisfaction, marketing mix- product, price, place, promotion

Financial management, Objectives, Scope, Techniques of investment analysis, Pay back period, Accounting Rate of Return, Working capital, Cost of capital - Sources of financing - Technology management, Product design, Types of production system

Plant location - Factors to be considered - Plant layout - Types of layout - Inventory management - Significance of HRM, HR Planning-Job evaluation-Recruitment & selection-Placement and induction-Training-Performance appraisal-Compensation-Industrial relations.

1. *Principles & Practice of Management by L.M.Prasad, Sultan Chand& Sons,1992.*
2. *Philip kotler, 'Marketing Management', 12th Edition, Pearson Education(Singapore) pvt.Ltd; New Delhi,2005*
3. *Financial Management Theory and Practise, by Prasanna chandra 3rd Edition Tata Mcgraw Hill,2004*

EE401 -POWER SYSTEM ECONOMICS AND CONTROL TECHNIQUES

Types of load- components of system loads- Load forecasting- Load dispatching - load curves- load factor, utilization factor, diversity factors, reserve requirements,

Power frequency control – Generator, Governor & Load models - LFC control of a single area and two area systems – steady state and transient response

Reactive power and voltage control- Generation and absorption of reactive power method of voltage control - Injection of reactive power- static shunt capacitor/Inductor, VAR compensator- Tap changing transformers.

Unit commitment – constraints on unit commitment - Co-ordination equations with and without losses--Economic dispatch controller – security constraints.

Recent trends in real time control of power systems; operational restrictions, reliability factors, deregulation and control – congestion management.

1. *Robert H. Miller, James H. Malinowski, 'Power system operation', Tata McGraw-Hill, 2009*
2. *Allen J.Wood, Bruce.F.Wollenbarg,'Power Generation, Operation and Control, Wiley India Edition, 2e, 2009.*
3. *Abhijit Chakrabarti & Sunita Halder, 'Power system analysis-Operation & Control', PHI New Delhi, 2008*

EE403 POWER SYSTEM PROTECTION AND SWITCHGEAR

Relays – General classification, Principle of operation, types, characteristics, Torque equation, Relaying Schemes, Relay Co-ordination.

Apparatus and line protection – Line Protection – Distance, Differential protection and Carrier current protection. Generator protection – protection against abnormal condition, stator and Rotor protection. Transformer Protection – Incipient fault – Differential protection, Feeder and Bus bar protection.

Protection against over voltages – Causes of over voltage Ground wires, Surge absorbers and diverters. Earthling - types. Insulation coordination.

Theory of arcing and arc quenching circuit breakers types – rating and comparison, RRRV, Resistor switching and capacitor switching.

Static relays – Digital relays - Microprocessor based relays – Apparatus and line protection – Basics of Numerical relays.

1. *Badri Ram and Vishwakarma, D.N., 'power system protection and switchgear', Tata-McGraw Hill publishing company Ltd., 1995.*
2. *Sunil S.Rao, 'Protective Switch Gear', Khanna Publishers, New Delhi, 1999.*
3. *Ravindranath , B. and Chander, N., 'Power Systems Protection and Switch Gear', Wiley Eastern Ltd., 1977.*
4. *Y. G. Paithangar, 'Fundamentals of power system protection', Prinitice hall*

EE405 INDUSTRIAL ELECTRONICS

Control of d.c. motors - Single-phase and Three-phase thyristor converters in discontinuous conduction mode, control of d.c. motor using choppers of different configurations

Control of induction motors - Stator voltage control - Control using inverters - Standard PWM techniques - slip energy recovery scheme

Power controllers - Uninterrupted power supplies - Solid state tap changing transformers -solid state exciters - solid state circuit breakers - battery driven vehicles

Programmable Logic controllers - input and output contact program symbols, numbering system, program format, introduction to logic and ladder design

Opto electronics - Opto couplers; LEDS , photo sensors, photo amplifier circuits for counting of moving objects, smoke detection, liquid level indicators

1. *Schuler and Mc.Namee,' Industrial Electronics and Robotics', McGraw - Hill International Edition, 1986.*
2. *Ralph E.Tarter, 'Principles of Solid State Power Conversion' , Howard W.Sams and Co Inc., 1985.*
3. *G.K. Dubey, 'Fundamentals of Electrical Drives', Narosa, N. Delhi and Toppan Singappore, 1994.*
4. *R.Krishnan, 'Electric Motor Drives – Modelling, Analysis and Control', Prentice-Hall of India Pvt Ltd., New Delhi, 2003*

EE 407 POWER SYSTEM SIMULATION LABORATORY

1. Real and reactive power computation
2. Transmission Line parameter calculation
3. Power Circle diagrams
4. Bus admittance matrix formulation
5. Graph theory matrices
6. Load flow analysis
7. Z bus formulation
8. Short circuit analysis
9. Simulation of AC DC Converters
10. Power Electronic applications in Power Systems

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EE409 INSTRUMENTATION LABORATORY

1. Displacement measurement using LVDT
2. Design of V-F converter
3. Design of F-V converter
4. Characteristics of differential pressure transmitter with zero elevation and zero suppression.
5. Analog Multiplexer and Demultiplexer
6. Instrumentation amplifier
7. Microprocessor based stepper motor control
8. Strain gauges.
9. Thermocouple Compensation..
10. Thermistor Linearization transmitter design.
11. Pressure Calibration.
12. Signal conditioning circuit for any resistive pressure, transducer.
13. P.I.D.Controller.
14. Signal conditioning circuit for optical encoder.

HM402 INDUSTRIAL ECONOMICS AND MANAGEMENT

Meaning of Industrial Economics – Definitions of Economics – Economic Decision Making Process – Equations – Fundamental Concepts – Decision Environment – Profit Performance from Accounting point of view.

Demand and Supply Analysis – Consumption Laws – Elasticity of Demand – Supply Elasticities – Measurements –

Demand Forecasting Methods – Cost & Revenue Analysis. Competition – Perfect, Monopoly, Monopolistic and Oligopoly – Break Even Analysis – Capital Budgeting Technique – Decision Making under Certainty and Uncertainty – Utility as a Decision Criterion.

Macro Static and Dynamics – Keynesian Theory of Income and Employment – Consumption Function – Saving and Investment Functions – Multiplier and Accelerator – Trade Cycles – National Income Accounting - Index Numbers – Price, Chain Base, Quantity and Value Index Numbers.

Functions of Money – International Trade – Balance of Trade – Balance of Payments – Functions of Central Bank (RBI), Functions of Commercial Banks – Credit Creation by Commercial Banks – Inflation – Exchange Rate Determination Technological Change, Location Theory and Taxation.

Economic and Non – Economic Environment – Market, Economic Planning and Controls – Infrastructure and Business – Contemporary Economic Reforms.

1. *Beri. G. C., "Business Statistics" – TMH.2010*
2. *Koutsoyiannis, "Modern Micro Economics", Macmillan.2008*
3. *Misra. S.K. Puri. V.K., "Economic Environment of Business", Himalaya Pubhshing House.2008*
4. *Peterson. H. Craig, Lewis .W. Chris, Jain. K. Sudhir, "Managerial Economics", Pearson Education.2008*
5. *Vaish. M.C., "Monetary Theory", Vikas Publishing House.2005*

EE402 UTILIZATION OF ELECTRICAL ENERGY

Illumination -lighting calculations - Design of lighting schemes - factory lighting - flood lighting - electric lamps.

Electric Heating-Electric furnaces and welding - Resistance, inductance and Arc Furnaces -Construction and fields of application.

Electric drives and control - Group drive - Individual drive - selection of motors - starting characteristics - Running characteristics.

Traction system – tractive effort calculations - electric braking - recent trend in electric traction.

Refrigeration and Air-Conditioning-Various types of air conditioning system, domestic refrigerator and wiring system.

1. *Uppal, S.L., 'Electrical Power', Khanna publishers, New Delhi, 1992.*
2. *Gupta, J.B., 'Utilisation of Electrical Energy and Electric Traction', S.K.Kataria and sons, 1990.*
3. *Partab, . H., 'Art and Science of Utilisation of Electrical Energy', Dhanpat Rai and Sons, New Delhi, 1998.*

ELECTIVES

EE352 MODERN CONTROL SYSTEMS

Review of state space analysis - State variable systems - Controllability and observability - State variable feedback and its effect on controllability and observability-elements of observer theory.

Common types of non - linear phenomena – linearization - singular points- phase plane method - construction of phase trajectories- describing functions.

Basic concepts - derivation of describing functions-Stability of non - linear systems by describing function method - Liapunov's method of stability studies - Popov's criterion.

Pole placement technique by state feed back for linear SISO time invariant system – Design of state observions and servo system.

Optimal control, adaptive control, Robust control and intelligent control methods- Introduction to distributed control systems.

1. *Nagarath and Gopal, 'Control System Engineering', Wiley Eastern, reprint, 1995.*
2. *Stanley M.Shiners,'Modern Control System theory and Design' John Wiley and Sons, Singapore, 1992.*
3. *Ogata. K.'Modern Control Engineering' P.H.I. New Delhi,4th editions,2002..*

EE354 COMPUTER ARCHITECTURE

Computer -Functional units, Addressing modes, Instruction formats, Stacks and Subroutines. Processing Unit - Execution of instructions - Control step sequence.

Control Design - Hardwired control-design - multiplier control unit - CPU control unit and Micro programmed control - micro instructions - Sequencing - prefecting.

Arithmetic and Logic Unit-Fixed point and floating point numbers and operations. Design of arithmetic units.

Memories - cache memories - virtual memories. Input-Output Organization- Data transfer-synchronization-Interrupt handling-I/O interfaces.

Introduction to parallel processing-Generation of computer systems - Parallelism in uniprocessor system-Parallel computer structures-architectural classification schemes.

1. *Morris Mano.M., 'Computer system Architecture',Third Edition, PHI, New Delhi 1993.*
2. C.Hamacher, Z.Vranesic, S.Zaky, "Computer Organization", V Edition, McGraw Hill, 2002.
3. P.Pal Chaudhuri,'Computer organization and Design',PHI,3rd editions,2008.

EE451 COMPUTER NETWORKS

Introduction - Architecture, Network hardware and software. Physical layer - Guided transmission media - Cable television.

Data Link Layer - Design issues - Channel allocation problem - Multiple access protocols - Ethernet - Wireless LAN - 802.11 architecture.

Network Layer - Design issues - Routing algorithms - Congestion control algorithms - Quality of Service - Internetworking.

Transport Layer - Transport service - Elements of transport protocols - User Datagram Protocol - Transmission Control Protocol.

Application Layer - DNS - Electronic mail - World Wide Web - Multimedia - Network security.

1. *A.S.TANENBAUM, "Computer Networks", Pearson Education, 4th Edition, 2003*
2. *W.STALLINGS, "Data and Computer Communication", Pearson Education, 5th Edition, 2001*

EE453 – DIGITAL CONTROL SYSTEMS

Introduction- Comparison between analog and digital control- Importance of digital control- Structure of digital control- Examples of digital control system- Difference equations- Z-transform- MATLAB examples. Frequency response of discrete time systems- Properties of frequency response of discrete time systems-Sampling theorem

ADC model- DAC model- Transfer function of zero order hold- DAC, Analog Subsystem, and ADC Combination Transfer Function- Closed loop transfer function- Steady state error and its constants.(MATLAB commands)

Definitions of stability (Asymptotic stability, exponential stability etc)-stable z-domain pole placement locations- stability conditions-Stability determination (routh array)-Nyquist criterion

Root locus- root locus design (p-control, Pi- control, pd)- Z-domain root locus- z-domain root locus design-digital implementation of analog controller design (differencing methods forward and backward)- bilinear transformation-direct z-domain controller design- frequency response design- Finite time response settling time.

Concept of state space method-state space representations of discrete time systems- solving discrete time state space equations- Pulse transfer function matrix- Discretization of continuous state space equations-Liapunov stability analysis(discrete time) Controllabilty-observability-design Via pole placement-state observers

1. *Digital control engineering analysis and design by M. Sam Fadalli, Elsiever publication, 2009*
2. *Discrete time control systems By Katsuhiko Ogata, 2nd edition, Prentice Hall International Editions, 1995*

EE455 – DESIGN WITH PIC MICROCONTROLLERS

Introduction to PIC microcontrollers-PIC 16F876 microcontroller –device overview-pin diagrams-memory organisation.

Special Function Registers-I/O ports-Timers –Capture/Compare/PWM modules(CCP).

Analog to digital converter module– Instruction set - instruction description –introduction to PIC microcontroller programming - selection –reset –interrupts-watch dog timer.

Introduction to MPLAB IDE and PICSTART plus –Device Programming using MPLAB and PICSTART plus.

Assembly language programming for –Zero crossing detectors - square wave generation –firing pulse generation for typical single- phase converters and inverters-ADC program.

1. *PIC16F87X datasheet 28/40-pin 8 bit CMOS flash Microcontrollers,Microchip technology Inc 2001.*
2. *MPLAB IDE Quick start guide, Microchip technology Inc.2007.*
3. *John B.Peatman,"Design with PIC Microcontrollers",Pearson Education 2006.*

EE452 ARTIFICIAL NEURAL NETWORKS

Objectives - History- Biological Inspiration- Neuron Model- Single- Input Neuron-Multi-Input Neuron- Network Architectures- A Layer of Neurons-Multiple Layers of Neurons.

Perceptron Architecture- Single-Neuron Perceptron- Multi-Neuron Perceptron- Perceptron Learning Rule- Constructing Learning Rules- Training Multiple-Neuron Perceptrons.

Simple Associative Networks- Unsupervised Hebb Rule- Hebb Rule with Decay-Instar Rule-Outstar Rule- Kohonen Rule.

Adaline Network- Madaline Network -Mean Square Error- LMS Algorithm- Back Propagationa Neural networks – Hopfield Networks

Adaptive Filtering- Adaptive Noise Cancellation- Forecasting – Neural control applications – Character recognition.

1. *Hagan Demuth Beale, 'Neural network design', PWS publishing company, 1995*
2. *Freeman, J.A and Skapura, D.M., 'Neural networks-Algorithms, applications and programming techniques' Addison Wesley, 1991*
3. *Satish Kumar,' ' Neural Networks – A classroom approach', Tata McGraw-Hill Publishing Company Limited, 2004*

EE454 POWER SYSTEM RESTRUCTURING

Introduction – Market Models – Entities – Key issues in regulated and deregulated power markets; Electricity markets - California Market – New England ISO – Midwest ISO - Nordic Pool– Power market in China.

Operational and planning activities of a Genco - Electricity Pricing and Forecasting -Price Based Unit Commitment Design - Security Constrained Unit Commitment design. - Ancillary Services for Restructuring- Automatic Generation Control (AGC).

Introduction-Components of restructured system-Transmission pricing in Open-access system-Open transmission system operation; Congestion management in Open-access transmission systems- FACTS in congestion management - Open-access Coordination Strategies; Power Wheeling-Transmission Cost Allocation Methods

Open Access Distribution - Changes in Distribution Operations- The Development of Competition – Maintaining Distribution Planning

Power Market Development – Electricity Act, 2003 - Key issues and solution; Developing power exchanges suited to the Indian market - Challenges and synergies in the use of IT in power- Competition- Indian power market- Indian energy exchange- Indian power exchange- Infrastructure model for power exchanges- Congestion Management-Day Ahead Market- Online power trading.

1. *Loi Lei Lai, "Power System Restructuring and Deregulation", John Wiley & son LTD, New York, 2001.*
2. *Mohammad Shahidehpour, Hatim Yamin, "Market operations in Electric power systems", John Wiley & son LTD, Publication, 2002.*
3. *Lorrin Philipson, H. Lee Willis, "Understanding Electric Utilities and Deregulation" Taylor & Francis, New York 2006.*
4. *MohammadS hahidehpour, Muwaffaq Alomoush, "Restructured Electrical Power Systems", Marcel Dekker, INC., New York, 2001.*

RESERVE ELECTIVES

EE350 SOLID STATE DRIVES

Introduction to solid state drives, various components-power converters, motors, loads, coupling mechanisms, Stability of drive.

Modeling of d.c.motor drives. Transfer function and state-space models. Experimental determination of drive parameters. Speed control using ac to dc converters, Input performance parameters, Speed reversal schemes.

Chopper fed d.c.motor drives. Four quadrant operation. Input filter design. Dynamic braking with dc chopper. Type-c chopper fed regenerative braking. Operation with non-receptive lines.

Power converters for induction motor speed control. Harmonic behaviour of induction motors-harmonic currents and harmonic torques using per phase equivalent circuit. Stator voltage control schemes. Speed control of wound type motors.

State-space modeling of induction motors. Voltage source-Inverter fed operation. Field oriented control schemes. Current source –inverter drives. Principle of vector control.

1. *Thyristor DC drives" P.C.Sen, John wilely & sons, New York, 2008.*
2. *"Electric motor drives-modeling, analysis, and control" R.Krishnan, Prentice Hall of India, New Delhi, 2001.*
3. *"Modern Power Electronics and AC drives" B.K.Bose, Pearson Education(Singapore), Fifth Indian reprint,2005*

EE356 EMBEDDED SYSTEM DESIGN

Embedded System Architectures – ARM processor and SHARC processor - architectural design - memory organization - data operation - bus configurations. System on-chip, scalable bus architectures, Design example: Alarm clock, hybrid architectures.

Sensor and Actuator I/O – ADC, DAC, timers, Servos, Relays, stepper motors, H-Bridge, CODECs, FPGA, ASIC, diagnostic port.

Real time operating systems (RTOS) – real time kernel – OS tasks – task states – task scheduling – interrupt processing – clocking communication and synchronization – control blocks – memory requirements and control – kernel services.

Embedded Networks - Distributed Embedded Architecture – Hardware and Software Architectures, Networks for embedded systems– I2C, CAN Bus, Ethernet, Internet, Network–Based design– Communication Analysis, system performance Analysis, Hardware platform design, Allocation and scheduling, Design Example: Elevator Controller.

System Design – Specification, Requirements and Architectural design of PBX systems, Set-top box, Ink-jet printer, Laser printer, Personal digital Assistants.

1. *Wayne Wolf, "Computers as Components: Principles of Embedded Computing System Design", Morgan Kaufman Publishers, 2008.*
2. *C.M. Krishna, Kang G. Shin, "Real time systems", Mc-Graw Hill, 2010.*
3. *Gajski D. D., Vahid F., Narayan S., "Specification and Design of Embedded Systems", Prentice Hall, 1994.*
4. *Herma K., "Real Time Systems: Design for Distributed Embedded Applications", Kluwer Academic, 1997.*
5. *William Hohl, "ARM Assembly Language, Fundamentals and Techniques", CRC Press, 2009.*

EE358 POWER GENERATION SYSTEMS

Thermal Stations- layout- main components- boiler- economizer- air preheater- super heater- reheater- condenser- feed heater- cooling powers- FD and ID fans- Coal handling plant- water treatment plant- Ash handling plant- Types of boilers and theirs characteristics- Steam turbines- and their characteristics- governing system for thermal stations.

Hydro Electric Stations- Selection of site- layout- classification of hydro plants- general arrangement and operation of a hydro-plant- governing system for hydel plant- types of turbines-pumped storage plants.

Economic operation of steam-hydro plants- inter connected operations- division of load in inter-connected system, economic loading of steam and hydro power plants.

Nuclear power plants - principle of power generation, location, advantages and disadvantages of nuclear power plants; Reactor control- reactor safety waste disposal.

Non-conventional power plants - basic concepts , principles of working and Fuel cells, OTEC, solar, wind, tidal, biomass and geothermal power generation.

1. Soni, Gupta, Bhatnagar and Chakrabarti, ' A text book on Power Systems Engg.' Dhanpat Rai and Sons, New Delhi, 1997.

2. Wadhwa, C.L.,` Generation, Distribution and Utilisation of Electrical Energy', Wiley Eastern Ltd, N.D.1992.

3. Deshpande M.V.,`Elements of Electrical Power station Design Pitman, NewDelhi', TMH , 1990.

EE360 DIGITAL SIGNAL PROCESSING

Linearity, shift - invariance - Unit sample response characterisation - Convolution summation , causality , linear difference equations with constant coefficients and their solution using Z-transform - System function concept.

Discrete Fourier Transform and its properties - Circular convolution - Linear convolution of two finite length sequences through circular convolution, Sectioned convolutions -Relationship between Z-Transform, Fourier Transform and the Discrete Fourier Transform, Digital filter sampling, Introduction to radix-2 FFT - decimation in time and decimation in frequency radix2 algorithm.

Amplitude and phase response of FIR filters - Linear phase filters - Windowing technique for the design of linear phase FIR filters - Rectangular - Hamming and Kaiser windows - Frequency sampling technique - Introduction to optimal filters.

Properties of IIR digital filters - Design of IIR filters from continuous time filters - Impulse invariance and Bilinear transformation technique .

Architecture and features of signal processor and motion controller.

1. *Oppenheim and Schaffer, 'Discrete time Signal processing', PHI, 1992.*

2. *Ludemann L. C., "Fundamentals of Digital Signal Processing", Harper and Row publications, 1992.*

3. *Rabiner & Gold, "Theory and applications of Digital signal processing", PHI, 1992.*

4. *Hamid A. Toliyat and Steven G. Campbell "DSP Based Electro Mechanical Motion Control" CRC Press New York, 2004.*

EE362 DESIGN OF ELECTRICAL APPARATUS

General concepts in the design of rotating machines-output equation-Magnetic and electric loadings-Commin design features of all rotating machines-Conducting, insulating and magnetic materials used in electrical apparatus-mmf calculation for the magnetic circuit of rotating machines-Leakage reactance calculation.

Armature winding –output equation-Choice of specific loadings-Choice of poles-design of conductors, winding, slot, air gap, field poles and field coils, commutator and brush-Predetermination of efficiency, temperature rise and open circuit characteristics from design data(qualitative treatment only)

Output equation-Design of core and coils for single phase and three phase transformers-Design of tank and cooling tubes-Predetermination of circuit parameters, magnetising current, losses, efficiency, temperature rise and regulation from design data (qualitative treatment only)

Output equation-Choice of specific loadings-Design of stator-Design of squirrel cage and slip ring rotors-Stator and rotor winding designs-Predetermination of circuit parameters, magnetising current, efficiency and temperature rise from design data (qualitative treatment only).

Constructional features-SCR-Output equation-specific loadings-Main dimensions-Stator design-Design of salient pole field coil.

1. *1.Sawhney,A.K.,'A course in Electrical Machines Design',Dhanpat Rai and sons,New Delhi,1999.*
2. *2.Sen,S.K.,'Principles of Electrical Machine Design with computer Programmes',Oxford and I.B.H Publishing Co.Pvt.Ltd,New Delhi,2001.*
3. *3.Rai,H.M.,'Principles of Electrical Machines Design',Sathya Prakash,New Delhi,1994.*

EE364 FUZZY SYSTEMS AND GENETIC ALGORITHMS

Different faces of imprecision – inexactness, Ambiguity, Undecidability, Fuzziness and certainty, Fuzzy sets and crisp sets.

Intersections of Fuzzy sets, Union of Fuzzy sets, the complement of Fuzzy sets - Fuzzy reasoning .

Linguistic variables, Fuzzy propositions, Fuzzy compositional rules of inference- Methods of decompositions and defuzzification.

Methodology of fuzzy design - Direct & Indirect methods with single and multiple experts ,Applications - Fuzzy controllers – Control and Estimation.

Gentic Algorithms- Basic structure coding steps of GA, Convergence characteristics, Applications.

1. *Zimmermann, H.J., `Fuzzy set theory and its applications', Allied publishers limited, Madras,1996.*
2. *Klir, G.J., and Folger, T. `Fuzzy sets, uncertainty and information', PHI, New Delhi,1991.*
3. *M.Mitchell,"Introduction to Genetic Algorithms", Indian reprint, MIT press,Cambridge,USA,1996.*

EE366 WIND AND SOLAR ELECTRICAL SYSTEMS

Basic characteristics of sunlight – solar spectrum – isolation specifics – irradiance and irradiation - pyranometer - solar energy statics - Solar PV cell – I-V characteristics – P-V characteristics – fill factor – maximum power point.

PV module – blocking diode and bypass diodes – composite characteristics of PV module – PV array – PV system – PV- powered fan – PV fan with battery backup – PV-powered pumping system – PV powered lighting systems – grid-connected PV systems.

Wind source – wind statistics - energy in the wind – turbine power characteristics - aerodynamics - rotor types – parts of wind turbines – braking systems – tower - control and monitoring system.

General characteristics of induction generators – grid-connected and self-excited systems – steady-state equivalent circuit - performance predetermination – permanent magnet alternators – steady-state performance.

Power electronic converters for interfacing wind electric generators – power quality issues - hybrid systems - wind-diesel systems – wind-solar systems.

1. *Roger A. Messenger and Jerry Ventre, Photovoltaic systems engineering, CRC press, second edition, 2004.*
2. *M. Godoy Simoes and Felix A. Farret, Renewable Energy Systems – Design and Analysis with induction generators, CRC press, first edition, 2004.*
3. *Ion Boldea, The electric generators hand book - Variable speed generators, CRC press, 2006.*
4. *S N Bhadra, S Banerjee and D Kastha, Wind Electrical Systems, Oxford University Press, first edition, 2005.*

EE462 STATIC RELAYS

Power systems protection and its requirements - conventional Vs static relays - steady state and transient performance of signal deriving elements, signal mixing techniques and measuring techniques.

Over current protection - instantaneous over current relay – directional over current relay – applications – differential relays - generator and transmission line protection.

Static relay circuits for generator loss of field, under frequency, distance, impedance, reactance, mho and special characteristics - reverse power relays

Static relay circuits for carrier protection and testing of relays - Static relay circuits - tripping circuits using thyristor.

Microprocessor/Microcontroller based Relays-Hardware and software for the measurements of voltage, current, frequency and phase angle-implementation of over current, directional, impedance and mho relays.

1. *Ram.B., `Fundamentals of Microprocessors and Microcomputers', M/s. Dhanpat Rai & sons, New Delhi, 1992.*
2. *Madhava Rao, T.S., 'Power System Protection - Static Relays', McGraw Hill, New Delhi, 1991.*
3. *Van.C.Warrington, 'Protective Relays - Their Theory and Practice', Vols. I & II, Chapman & Hall Ltd. London, 1994.*

EE457 POWER ELECTRONIC APPLICATIONS IN POWER SYSTEMS

Fundamentals of ac power transmission, transmission problems and needs, emergence of FACTS-FACTS control considerations, FACTS controllers.

Principles of shunt compensation – Variable Impedance type & switching converter type- Static Synchronous Compensator (STATCOM) configuration, characteristics and control.

Principles of static series compensation using GCSC, TCSC and TSSC, applications, Static Synchronous Series Compensator (SSSC).

Principles of operation-Steady state model and characteristics of a static voltage regulators and phase shifters- power circuit configurations.

UPFC -Principles of operation and characteristics, independent active and reactive power flow control, comparison of UPFC with the controlled series compensators and phase shifters.

1. *Song, Y.H. and Allan T. Johns,'Flexible ac transmission systems (FACTS)', Institution of Electrical Engineers Press, London, 1999.*
2. *Hingorani ,L.Gyugyi 'Concepts and Technology of flexible ac transmission system', IEEE Press New York, 2000 ISBN – 078033 4588.*
3. *IEE Tutorials on 'Flexible ac transmission systems' published in Power Engineering Journal, IEE Press, 1995.*

EE458 POWER SYSTEM DYNAMICS

Stability considerations - Dynamic modelling requirements- angle stability – equal area criterion-Critical fault clearing time and angle-numerical integration techniques.

Synchronous machines - Park's transformation – flux linkage equations – formulation of normalized equations – state space current model – simplified models of the synchronous machine – turbine, Generator – steady state equations and phasor diagrams.

Dynamics of Synchronous machines - Mechanical relationships – electrical transient relationships – adjustment of machine models – Park's equation in the operational form.

Induction motor equivalent circuits and parameters - free acceleration characteristics – dynamic performance – effect of three phase short circuit and unbalanced faults.

Transient and dynamic stability distinction – linear model of unregulated synchronous machine and its oscillation modes – distribution of power impacts – effects of excitation on stability – supplementary stabilization signals.

1. Elgerd, O.I.,'Electric Energy Systems Theory', TMH, New Delhi, 2nd edition ,1991 .

2. Anderson, P.M. and Fouad, A.A.,'Power System Control and Stability', Galgotia Publ., New Delhi, 2003.

3. Krause, P.C. , 'Analysis of Electric Machinery' McGraw-Hill International Editions, 2000.

EE459 EHV AC AND DC TRANSMISSION

General aspects and converter circuits - HVAC and HVDC links – comparison, reliability, choice of best circuit for HVDC converters- transformer connection.

Bridge converters - analysis and control – power reversal- desired features of control - actual control characteristics .

Misoperation of converters and protection - Converter disturbance - bypass action in bridges - commutation failure - basics of protection - DC reactors - voltage and current oscillations - circuit breakers – over voltage protection.

Harmonics, filters and converter charts- Characteristics and uncharacteristic harmonics - troubles due to harmonics - harmonic filters - converter charts of direct current and voltage - active and reactive power.

Design of EHV lines based on steady state limits and transient over voltages - design of extra HV cable transmission - XLPE cables - gas insulated cables – corona.

1. *1 Padiyar, K.R., `HVDC transmission systems', Wiley Eastern Ltd., New Delhi, 1992.*
2. *2.Arrilaga,.J.,`High voltage direct current transmission', Peter Peregninver Ltd., London,U.K.,1983.*
3. *Rakosh Das Begamudre, ` Extra HVAC Transmission Engineering', Wiley Eastern Ltd.,Madras,1990.*

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EE460 APPLICATION SPECIFIC INTEGRATED CIRCUITS

Introduction to ASICs – Types of ASICs – Design flow – ASIC Cell libraries – CMOS logic- CMOS transistors – CMOS process – Design rule – Logic cells – combinational – sequential – data path.

ASIC Library design – Programmable ASICs – Anti fuse – Static RAM – EPROM and EEPROM technology – programmable ASIC Logic cells – programmable ASIC interconnects.

Logic synthesis – Comparator/ MUX – HDL and Logic synthesis – multiplexers, decoders, adders and other combinational circuits. Shift registers, instantiation and clocking – finite state machine synthesis.

Simulation – types of simulation – cell models – delay models – static timing analysis - Formal verification.

Physical design – floor planning and placement – routing – Global and detailed routing.

Testing – Boundary scan test – Automatic test pattern generation (ATPG) – Built in self test – Faults and Fault models.

1. *Michael John Sebastian Smith, "Application-Specific Integrated Circuits (The VLSI Systems Series)",Addison – Wesley pearson education, 1997.*
2. *Rabey J. M., A.P. Chandrakasan, "Digital Integrated circuits – a design perspective", PH, 1995.*