

SEMESTER - I

SEMESTER – III

CODE	COURSE OF STUDY	L	T	P	C
MA205	Transforms and Partial Differential Equations	3	0	0	3
EE203	DC Machines and Transformers	3	0	0	3
EE205	Circuit Theory	3	0	0	3
EE207	Electron Devices	3	0	0	3
ME231	Thermal Engineering	3	0	0	3
CE287	Mechanics of Solids and Fluids	3	0	0	3
EE209	DC Machines and Transformers Laboratory	0	0	3	2
EE211	Circuits and Devices Laboratory	0	0	3	2
Total		18	0	6	22

SEMESTER-IV

CODE	COURSE OF STUDY	L	T	P	C
EE202	Synchronous Machines and Induction Machines	3	0	0	3
EE204	Electromagnetic Fields	3	0	0	3
EE206	Analog Electronic Circuits	3	0	0	3
EE208	Networks and Linear Systems	3	0	0	3
EE210	Electrical and Electronic Measurements	3	0	0	3
EE212	Data Structures	3	0	0	3
EE214	Synchronous and Induction Machines Laboratory	0	0	3	2
EE216	Electronic Circuits Laboratory	0	0	3	2
Total		18	0	6	22

SEMESTER - V

CODE	COURSE OF STUDY	L	T	P	C
MA301	Numerical Methods	3	0	0	3
EE303	Transmission and Distribution of Electrical Energy	3	0	0	3
EE305	Digital Electronics	3	0	0	3
EE307	Linear Integrated Circuits	3	0	0	3
EE309	Control Systems	3	0	0	3
EE311	Object Oriented Programming	3	0	0	3
EE313	Integrated Circuits Laboratory	0	0	3	2
EE315	Computer Software Laboratory	0	0	3	2
	Total	18	0	6	22

SEMESTER - VI

CODE	COURSE OF STUDY	L	T	P	C
EE302	Microprocessor and Micro controllers	3	0	0	3
EE308	Operating Systems	3	0	0	3
EE306	Power Electronics	3	0	0	3
EC316	Communication Systems	3	0	0	3
EC318	VLSI systems	3	0	0	3
	Elective – I	3	0	0	3
EE310	Power Electronics Laboratory	0	0	3	2
EE312	Microprocessor and DSP Laboratory	0	0	3	2
	Total	18	0	6	22

SEMESTER - VII

CODE	COURSE OF STUDY	L	T	P	C
HM401	Industrial Economics	3	0	0	3
EE403	Industrial Electronics	3	0	0	3
EE405	Computer Methods in Power System Analysis	3	0	0	3
IC423	Instrumentation Systems	3	0	0	3
	Elective – II	3	0	0	3
	Elective – III	3	0	0	3
IC425	Instrumentation Laboratory	0	0	3	2
EE409	System Simulation 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
MB492	Management Concepts and Practices	3	0	0	3
EE402	Power System Protection and Switchgear	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 176

LIST OF ELECTIVE SUBJECTS

CODE	COURSE OF STUDY	L	T	P	C
ELECTIVE – I					
EE352	POWER GENERATION SYSTEMS	3	0	0	3
EE354	COMPUTER ARCHITECTURE	3	0	0	3

ELECTIVES –II AND III

EE451	COMPUTER NETWORKS	3	0	0	3
EE453	FUZZY SYSTEMS	3	0	0	3
IC451	EMBEDDED SYSTEMS AND RTOS	3	0	0	3
EC453	DIGITAL IMAGE PROCESSING	3	0	0	3
CLE03	NANO TECHNOLOGY	3	0	0	3

Or any other Elective subject from any other department

ELECTIVES - IV AND V

EE454	ADVANCED TOPICS IN MICROCONTROLLERS	3	0	0	3
EE456	ARTIFICIAL NEURAL NETWORKS	3	0	0	3
MB494	FINANCIAL MANAGEMENT	3	0	0	3
EC454	DISPLAY SYSTEMS	3	0	0	3
IC456	FAULT DETECTION AND DIAGNOSIS	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 category, 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
EE351	UTILISATION OF ELECTRICAL ENERGY	3	0	0	3
EE353	MODERN CONTROL SYSTEMS	3	0	0	3
EE355	HIGH VOLTAGE ENGINEERING	3	0	0	3
EE452	STATIC RELAYS	3	0	0	3
EE455	POWER SYSTEM OPERATION AND CONTROL	3	0	0	3
EE457	EHV AC AND DC TRANSMISSION	3	0	0	3
EE458	POWER SYSTEM DYNAMICS	3	0	0	3
EE459	FLEXIBLE AC TRANSMISSION SYSTEMS	3	0	0	3
OTHER DEPARTMENT RESERVE ELECTIVES					
EC352	EMBEDDED SYSTEM DESIGN	3	0	0	3
EC354	SPEECH PROCESSING	3	0	0	3
CS364	NETWORKED MULTIMEDIA SYSTEMS	3	0	0	3
IC452	POWER PLANT INSTRUMENTATION AND CONTROL	3	0	0	3
IC458	AUTOMOTIVE CONTROL SYSTEMS	3	0	0	3
CLE10	BIOTECHNOLOGY	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. *Kandasamy, P, Thilagavathy, K. and Gunavathy, S., 'Engineering Mathematics' Vol III, Chand and Co.,1994.*
2. *Venkataraman, M.K., 'Engineering Mathematics Vol.4', National publishing company, 1987.*
3. *Grewal.B.S.,Higher Engineering Mathematics,Khanna Publishers.*

EE203 DC MACHINES AND TRANSFORMERS

Constructional features of D.C. machines - EMF equation - Characteristics of different types of DC Generators - commutation and armature reaction.

D.C. motors - Types, Torque equations-characteristics, Swinburne's test- Hopkinson's test-retardation test, Electric braking, starting – speed control.

Transformers – Single phase and three phase transformers - equivalent circuit - regulation and efficiency - auto transformer

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

Design of DC machine: Output equation - main dimensions, Design of Transformers: Output equation – Design of core and coils.

1. *Nagrath, I.J. and Kothari, D.P., 'Electrical Machines', Tata McGraw Hill Publishing Company Ltd., New Delhi, 1990.*
2. *Sawhney, A.K. "A course in Electrical machines Design", Dhanpat Rai and sons, New Delhi, 1984*
3. *Cotton, H., 'Electrical Technology', CBS Publishers, 1984.*

EE205 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 using Laplace transform method.

1. *Hayt, W.H. and Kemmerly, J.E., 'Engineering Circuit Analysis', McGraw Hill, New York, 5th edition, 1993.*
2. *Joseph. A. Edminister, 'Electric Circuits - Schaum's outline series', McGraw Hill International, 3rd edition, 1997.*
3. *Arumugam, M. And Premkumar, N., 'Electric Circuit Theory', M/S. Khanna Publishers Co., 9th Reprint, 1997.*

EE207 ELECTRON DEVICES

Semi Conductors- charge carriers, electrons and holes in intrinsic and extrinsic semi conductors-Hall effect .

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

Bipolar junction transistors - Low frequency and high frequency equivalent circuits – 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. *Millman and Halkias, 'Electronic Devices and Circuits', McGrawHill International student Edition, 5th Reprint, 1993.*
2. *Muhammed H. Rashid, ' Power Electronics' PHI, 3rd Edition, 2003*
3. *David, A.Bell, 'Electronic Devices and Circuits', 3rd Edition, PHI, 1986.*

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 – Torison of Circular shafts – Hollow Shafts – Power transmission.

Vapour Pressure – Pressure at a point its variation – Measurement with Piezometer, manometers and gauges.

Continuity equation in one dimension – Bernoulli’s equation – Venturimeters and Orificie meters – Flow through pipes – Laminar Turbulent flow Major losses.

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

1. *Ramamirtham, S., 'Strength of Materials ', Dhanpat Rai and Sons, New Delhi, 1988.*
2. *Rajput , R.K., 'Strength of Materials ', S.Chand & Co Ltd., New Delhi, 1996.*
3. *Nagarathnam, S. 'Fluid Mechanics', Khanna Publishers,New Delhi, 1989.*

EE209 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 and compound motor.
4. Load test on DC series motor.
5. Speed control of DC shunt motors.
6. Swinburne's test.
7. Retardation test.
8. Hopkinson's test.
9. Open circuit test , short circuit test and load test on single phase transformer.
10. Separation of no load losses in a single phase transformer.
11. Sumpner's test.
12. SCOTT connection.

EE211 CIRCUITS AND DEVICES LABORATORY

1. Verification of Circuit theorems.
2. Half wave and full wave rectifiers.
3. Bridge Rectifier.
4. Volt-ampere characteristics of semi conductor 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.

EE202 SYNCHRONOUS MACHINES AND INDUCTION MACHINES

Alternators - types and constructional features - emf equation - rotating magnetic field - armature reaction - load characteristics - predetermination of regulation. Basic ideas of two reaction theory.

Synchronous motors: Synchronous machines on infinite bus bars-phasor diagram-V and inverted V curves-current and power circle diagrams- Hunting and its suppression - starting methods.

Polyphase Induction motors - types and constructional features - equivalent circuit - starting and speed control, Linear induction motors. Induction generators.

Single phase induction motors -types and constructional features-principle of operation-equivalent circuit based on double revolving field theory.

Output Equation – Choice of specific loadings – Design of main dimensions and stator winding for Induction machines and Synchronous machines.

1. *Nagrath I.J. & Kothari, D.P., 'Electrical machines', Tata McGraw hill, NewDelhi,1990.*
2. *Sawhney , A.K “ A course in Electrical machines Design “ , Dhanpat Rai and sons , New Delhi*
3. *Cotton, H., 'Electrical Technology', CBS Publishers, 1984.*

EE204 ELECTROMAGNETIC FIELDS

Electric charges - Coulomb's Law - Electric Field Intensity - Gauss Law and its application - Electric Scalar Potentials and potential difference Electric field lines and equipotential contours - Potential gradient - electric dipoles

Dielectric boundaries - Capacitance - Capacitance of system of conductors - Dielectric strength - Divergence and curl of vector fields - Divergence theorem - Stoke's theorem - Examples on Laplace's equation.

Magnetic field intensity and magnetic flux density - Biot Savarat law - Torque on closed circuits - Ampere's law - Boundary conditions at magnetic surfaces

Faraday's law of electromagnetic induction - Inductor and inductance - Mutual inductance - Inductors in series and parallel - Energy stored in magnetic field - Pull of an electromagnet - magnetic circuits

Maxwell's equation in point and integral forms - The wave equations - Uniform plane waves - Poynting theorem.

1. *John D. Kraus , 'Electromagnetics ' , McGraw HillBook Co, New York , 3rd Edn, 1984.*
2. *William H.Hayt, 'Engineering Electromagnetics',Tata-McGraw Hill, 5th edition, 1992.*
3. *Gangadhar,K.A., 'Field Theory', Khanna Pub. Delhi, 11th edition, 1994.*

EE206 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. *J. Millman and A.Grabel, ' Micro electronics' McGraw Hill, 1997*
2. *Allen Mottershead"Electronic Devices and Circuits-An Introduction", PHI, 18th Reprint, 1996.*
3. *Robert.L.Boylestad, 'Electronic Circuits and Circuit Theory ' 8 Edition, Pearson 2002.*

EE208 NETWORKS AND LINEAR SYSTEMS

Fourier series representation of periodic inputs - Fourier integral and Fourier transforms - Harmonic analysis of simple circuits.

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 – PR 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 - solution of state equations.

Difference equations of linear discrete systems - response of linear discrete systems by Z transform method.

1. *Nagrath I.J. and Gopal M, 'Control Systems Engineering', Wiley Eastern India Ltd.,1992.*
2. *F.F.Kuo, 'Network Analysis and Synthesis', John Wiley Inc., New York , 1966.*
3. *Cheng.D.K., 'Analysis of Linear Systems', Addison Wesley,1988.*

EE210 ELECTRICAL AND ELECTRONIC MEASUREMENTS

Measurement of voltage, current- permanent magnet moving coil and moving iron meters – extension range of moving iron and moving coil instruments.

Measurement of power and energy-dynamometer type instruments and Induction type instruments. Errors – Calibration.

Magnetic Measurements -Ballistic galvanometers and flux meters, B.H curve and permeability measurements - iron loss measurements by magnetic squares and C.R.O.

Instrument transformers-Construction, operation and phasor diagrams of Current and Potential Transformers .

Special instruments- KVAh and KVARh meters - Maximum demand indicators – meggar - signal generators and function generators, digital multimeter.

1. *Golding, E.W. and Widdis, F.C., 'Electrical Measurements and Measuring Instruments' A.H.Wheeler and Co.,5th edition,1993.*
2. *Cooper, W.D. and Helfrick, A.D., 'Electronic Instrumentation and Measurement techniques', Prentice Hall of India, 1991.*
3. *Sawhney, A.K., 'A Course in Electrical and Electronic Measurements and Instrumentation', Dhanpat Rai and Sons, New Delhi, 11th edition, 1995.*

EE212 DATA STRUCTURES

Introduction to C – Variables, Arrays, Structures, Pointers. Development of Algorithms- operation on data structures –Primitive Data Structures - stacks, arrays and queues and their applications.

Linear Linked Data Structures - linked allocation – single, double and circular linked list and their applications.

Non – linear data structures - Binary Trees, Tree Traversing – operation on binary trees expressions manipulations - symbol table construction-Applications.

Sorting – Selection Sort – Bubble Sort – Merge Sort – Tree Sort – Partition-Exchange Sort – Searching – Sequential Searching – Binary Searching

File Structures - Storage structures for arrays-structures and arrays of structures-External Storage Devices ,Record Organization.

1. *Jean Paul Tremblay and Paul.G.Sorenson, 'An Introduction to Data Structures with Applications', Second Edition, Tata McGraw Hill,4th Reprinting,1986.*
2. *Lipschitz, 'Data Structures - Schaum Series', McGraw Hill,1986.*

3. S.Sahni, , 'Data Structures, Algorithms and Applications in C++', McGraw Hill, 1998

EE214 SYNCHRONOUS AND INDUCTION MACHINES LABORATORY

1. Regulation of 3 phase alternator by E.M.F. and M.M.F. methods.
2. Regulation of 3 phase alternator by Z.P.F. method.
3. Regulation of salient-pole alternator by slip test.
4. V and inverted V-curves of synchronous motor.
5. Power angle curve of synchronous motor.
6. Load test on 3 phase induction motor.
7. No load and blocked rotor tests on 3 phase induction motor.
8. Load test on grid connected induction generator.
9. No load and blocked rotor tests on 1-phase induction motor.
10. Load test on self –excited induction generator.
11. Study of 3 phase AC windings.
12. Study of induction motor starters.
13. Parallel operation of alternators- (Demonstration).

EE216 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.

MA301 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 eigenvalue 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 2nd 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., 1997.*
2. *Jain, M.K., Iyengar, S.R., and Jain, R.K., 'Numerical Methods for Scientific and Engineering Computation', Wiley Eastern, 1991.*
3. *Gerald, C.F., and Wheatley, P.O., 'Applied Numerical Analysis', M/s. Addison Wesley, 1989.*

EE303 TRANSMISSION AND DISTRIBUTION OF ELECTRICAL ENERGY

A.C. single phase and three phase distribution systems - Calculation of voltage Kelvin's Law and its limitations- distribution automation.

Line performance- Regulation and efficiency - tuned power lines - propagation constant - Power Circle diagrams of constant voltage lines (both sending and

receiving) maximum power transmitted-voltage control -static VAR compensators – recent trends in FACTS.

Formation of corona - critical voltages - losses - effect on line performance - types of insulators - voltage distribution in a string of suspension insulators - grading rings arcing horns - string efficiency - testing of insulators.

Comparison between overhead line and underground cable -Types of cables-insulation resistance - potential gradient - capacitance of single core and three core cables-Laying of cables – HVDC transmission – Types of links – Advantages – Converter stage equipment.

Stress and sag calculation - effects of wind and ice-support at different levels - stringing chart - condition at erection.

1. Wadhwa, C.L.,'*Electrical power systems*',*New age International Pvt Ltd.publishers,1995.*
2. Gupta B.R.,'*Power system Analysis & Design*',*Wheeler Publishing, 1993.*
3. Cotton, H.,'*Transmission and distribution of electrical Energy*', *ELBS, 1972.*

EE305 DIGITAL ELECTRONICS

Review of Number systems - Radix conversion - Complements - Subtraction using complements - Binary codes - Theorems of boolean algebra - Canonical forms - Logic gates

Digital Logic Families - Introduction to RTL, DTL, TTL, ECL and MOSL families - Details of digital logic family -Wired and operation, characteristics of digital logic family - comparison of different logic families

Combinational Logic - Representation of logic functions - Simplification and Implementation of combinational logic - Multiplexers and demultiplexers - Code converters, adders, subtractors.

Sequential Logic-Flip flops - SR, JK, D and T flip flops - Level triggering and edge triggering - Excitation tables - Counters - Asynchronous and synchronous type - Modulo counters - Shift registers - Ring counters.

Design aspects; asynchronous type: concept of state - state reduction - analysis of asynchronous sequential logic circuits—introduction to design; programmable logic array and devices;finite state machine.

1. *Morris Mano,M .'Digital logic and computer design ', Prentice Hall of India, 1997.*
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*

EE307 LINEAR INTEGRATED CIRCUITS

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

Applications of Operational Amplifiers-I: DC and AC amplifiers - summing amplifier - difference amplifier - voltage follower - Differentiator - Integrator - clamper - clipper - filters.

Applications of Operational Amplifiers-II: Oscillators, sine wave, square wave, triangular wave, saw tooth wave generation, Schmitt trigger, window detector.

Data Converters: Analog to Digital, Digital to Analog, Sample and Hold Circuits. Voltage Controlled Oscillator,

IC555 Timer,monostable and astable modes of operation; phase Locked Loops - operating principles - applications of PLL-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.*

EE309 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 synchronous a.c and d.c servomotors-stepper motors-Tacho generators-Proportional-integral and derivative controllers.

1. *Katsuhiko Ogata , ‘ Modern control Engineering ‘ , Fourth Edition , Pearson,Education , First Indian Reprint 2002.*
2. *Richard C.Dorf and Robert H.Bishop . ‘Modern control systems ‘ , Addison - Wesley, Eighth Edition.*
3. *Nagrath, I.J., and Gopal, M., 'Control systems Engineering', Wiley Eastern Ltd.,1992, Shanmuga Priya publishers, 1998*

EE311 OBJECT ORIENTED PROGRAMMING

Object oriented programming -Traditional approach versus object oriented approach-logical operators, Control Statements, Structures and Functions, storage classes, library functions.

Addresses and pointers -Pointers and strings-pointers to pointers-memory management, Linked list-pointers to objects-Debugging pointer- *this* pointer.

Classes and Objects, Constructors and destructors, Inheritance - Public and private inheritance - Multiple inheritance - Containership classes within classes - Polymorphism.

Templates and exceptions,Virtual functions, Friend functions, Static functions, Function overloading -Inline functions-Pointer and Functions.

Streams - File pointers- Disk I/O with member functions - Error handling - Redirection - Command-line arguments -Printer output- Overloading the extraction and insertion operators.

1. *Robert Lafore, 'Object Oriented Programming in Turbo C++', Galgotia Publications, Pvt.Ltd.,1993.*
2. *Stanley Lippman, 'C++ primer', Second edition, Addison Wesley,1995.*
3. *Bjarne Stronstrup, 'The C++ programming language', Addison Wesley,1997.*

EE313 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 Monostable multivibrator using IC 555.
- 8 Astable 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

EE315 COMPUTER SOFTWARE LABORATORY

Programs on the following topics :

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

EE302 MICROPROCESSORS AND MICROCONTROLLERS

Architecture and Programming of 8085 - functional Block diagrams, bus systems,instruction set, addressing modes - timing diagram and assembly level programmes; Interfacing RAM and ROM sections.

Programmable peripheral interface (8255); Data transfer schemes-programmed and DMA -interfacing of simple keyboards and LED displays.

Interrupts and DMA - Interrupt features, types of interrupts-methods of servicing interrupts programmable interrupt controller, Need for Direct memory access-programmable DMA controller;

Interfacing applications- ADC, DAC, motor control, waveform generation, Seven segment LED display systems-stepper motor control -speed control of DC motor using thyristor converters.

Microcontrollers- architecture of 8051- memory organisations, addressing modes - instruction set -simple programs - interrupt structure-Interfacing with external ROM and RAM, Typical applications -MCS 51 family features.

1. *Ramesh Gaonkar, 'Microprocessor Architecture, Programming and applications', With the 8085/8080A",3rd Edition ,Penram International Publishing house, 2002*
2. *Muhammad Ali Mazidi , Janice Gillispie Mazidi, "The 8051 Microcontroller and Embedded Systems", Pearson, 4th edition 2002.*
3. *Kenneth J.Ayala," The 8051 Micro controller", Penram International Publishing, 1996*

EE304 OPERATING SYSTEMS

Types of operating systems- Components of an operating system-Different views of the operating systems-principles of design and implementation-Processes concept –PCB, schedulers, scheduling Algorithms .

Concurrent processes, Interprocess Synchronization., Mutual Exclusion Algorithms, Interprocess communication. Deadlock characterisation- prevention, avoidance, detection and recovery.

Memory management Techniques. Contiguous allocation-static dynamic partitioned memory allocation-segmentation. Non contiguous allocation -paging -Virtual memory.

File System- directory structure- protection-Device management techniques-device characteristics,Device allocation methods- Disk and Drum Scheduling.

Introduction to UNIX -kernel, shell, types of shell, file system, processor management and memory management. Introduction to distributed systems.

1. *Tanenbaum, A.S., 'Modern operating systems', Prentice Hall of India, 2000.*
2. *Madnick, S.E. and Donovan, J.J., 'Operating systems', McGraw Hill, 1984.*
3. *D M Dhandhere, 'Systems Programming and Operating Systems', TMH, 2nd Revised Edition, 2002*

EE306 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.

Natural Commutation-Principles of phase angle control- single-phase and three phase semi converters and full converters, effects of source inductance, inverter operations, dual converters.

Thyristor Choppers based on voltage, current and load commutation, Basic principles of switch mode power Conversion-Buck ,Boost, Buck-Boost converters configurations.

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.

Single stage AC to AC conversion: single-phase and three-phase AC voltage regulators using SCR, triac and AC choppers using self commutating devices, single phase cycloconverters.

1. Rashid, M.H. ,*'Power Electronics - circuits, devices and applications'*, Prentice Hall India, New Delhi, 1995.
2. M.D.singh and K.B.Khanchandani, *'Power Electronics'*,Tata Mc Graw Hills Publishing Company Limited, New Delhi 1998.
3. Ned Mohan, Tore M.Undeland, William P Robbins, *'Power Electronics'*, John Wiley & Sons, Media Enhanced 3rd Edition, 2003

EC316 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: transmission - error control techniques - data communication protocols - link oriented protocols - asynchronous protocols.

Modern Communication Systems: Microwaves and 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 India..
3. Simon Haykins, 'Communication Systems', 3rd Edition, John Wiley, 1995.

EC318 VLSI SYSTEM

VLSI technology- NMOS, CMOS and BICMOS circuit fabrication. Comparison of IC technologies. Fabrication of resistors and capacitors. Latch up, Driver circuits.

VHDL-Behavioral Modeling-Data flow Modeling-Structural Modeling -Design of simple circuits using VHDL. Overview of Verilog -Design of simple circuits using Verilog.

Implementation of logic circuits using MOS and CMOS technology, Operation characteristics, design equations, models and second order effects of MOS transistors.

Timing analysis and power analysis of CMOS circuits-Programmable logic devices.

ASIC :Types of ASICs-Design flow-Programmable ASICs-Programmable ASIC logic cells and interconnect for Xilinx and Altera families –Boundary scan test

1. N.H.E.Weste etal, CMOS VLSI design, (3/e), Pearson , 2005.
2. J. Smith, ' Application Specific Integrated Circuits', Addison Wesley, 1997.
3. Uyemura, 'Introduction to VLSI Circuits and Systems', Wiley, 2002.

EE310 POWER ELECTRONICS LABORATORY

1. SCR triggering circuits.

2. SCR and Triac phase control circuits.
3. Fully controlled single-phase thyristor bridge.
4. Voltage commutated DC chopper.
5. Current commutated DC chopper.
6. Microprocessor based three-phase thyristor bridge.
7. Series connected single-phase converters.
8. Series inverters.
9. IGBT and MOSFET single phase inverters.
10. IGBT and MOSFET choppers.
11. Extinction angle control of converter.

EE312 MICROPROCESSOR AND DSP 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 1 phase Inverter
9. Stepper motor Interface
10. Interfacing of 7 segment LED displays
11. Programming exercises using Code composer for TI DSPs & Microcontroller

HM401 INDUSTRIAL ECONOMICS

Micro economics - Demand and Supply analysis – Elasticity of demand and supply-Demand forecasting (Regression , Time series , smoothing techniques)- Consumption laws.

Cost and Revenue analysis – Break even analysis – Competition – Index numbers - Macro and monetary economics - National income and Trade cycles – Keynesian Theory of Employment and Income.

General and financial management - Contributions of Fayol, Taylor –Managerial functions - Different forms of Business organisation.

Capital budgeting techniques - Marketing management –Definition,Evolution – Buyer Behavior-Market segmentations.

Personnel management - Motivation – Communication – Leadership styles – Job evaluation and performance appraisal.

1. Dewtt.K.K., '*Modern Economic Theor*', S.Chand & Co (r)Ltd(r) 1999.
2. Burton Genie, Thankur Manab(r), '*Management Today*', TMH-1996.
3. Maheswari S.N., '*An Introduction to Accountancy*', Vikas Publishing House Pvt(r) Ltd (r) 1999.

EE403 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.

A.C.motor control - Induction motors - Stator voltage control – control using inverters – slip energy recovery scheme.

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

Opto electronics – opto couplers ; LEDS , photo-voltaic cells, photo- amplifier circuits for counting of moving objects, smoke detection, liquid level indicators etc.

Induction heating –di-electric heating, high frequency power sources, introduction to servo systems , Micro – computer based servo amplifiers.

1. *George M.Chute and Robert O. Chute, ' Electronics in Industry ', International Students Edition, McGraw Hill Ltd.,1981.*
2. *Schuler and Mc.Namee,' Industrial Electronics and Robotics', Mc Graw-Hill International Edition, 1986.*
3. *Ralph E.Tarter, 'Principles of Solid State Power Conversion' , Howard W.Sams and Co Inc., 1985.*

EE405 COMPUTER METHODS IN POWER SYSTEM ANALYSIS

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

Power flow analysis methods - Gauss-Seidel, Newton-Raphson and Fast decoupled methods of load flow analysis.

Fault studies - Symmetrical fault analysis, Analysis through impedance matrix, Current limiting reactors.

Fault analysis - Unsymmetrical short circuit analysis- LG , LL, LLG; Fault parameter calculations – Open circuit faults.

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, 1994.*
2. *Wadhwa, C.L.,'Electrical Power Systems', New age international Pvt.Ltd.Publishers, 1995.*
3. *Stagg ,C.W. and Elabiad, A.H., 'Computer Methods in Power System Analysis', McGraw Hill International Book Company, 1990.*

IC423 INSTRUMENTATION SYSTEMS

Generalised Configuration Of Instrumentation Systems – static and dynamic response, error analysis, evaluation of maximum systematic errors.

Transducer elements – Position transducers, force transducers, peizo-electric transducers, Hall effect trasducers; Acceleration measurement; Pressure measurements.

Temperature measurement – Thermo-couple, Thermistors, IC sensors, signal conditioning circuits ; Flow measurements – Hotwire anemometer and EM flow meters.

Signal conditioners–Instrumentation amplifiers, voltage – current converters, voltage-frequency converters, analog multiplexers and de-multiplexers; Introduction to EMI & EMC.

Micro sensors - Introduction – classification- basic fabrication systems, case studies.

1. *Murthy, D.V.S., ' Transducers and Instrumentation', Prentice Hall of India,1995.*
2. *Doebelin E.O., 'Measurement systems- Application and Design', 1983.*
3. *Sawhney A..K., ' A Course in Electrical and Electronic measurements and Instrumentation ',M/s Dhanpat Rai & sons,1999.*

IC425 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.

EE409 SYSTEM SIMULATION LABORATORY

1. Determination of Transmission line parameters and performance
2. Power Circle diagrams
3. Guass – Seidel method of load flow
4. Newton-Raphson method of load flow
5. Short circuit of a three phase alternator
6. Z_{bus} formation
7. Unbalanced fault calculations
8. Single bus connected to infinite bus stability studies
9. Simulation of AC – DC drives
10. Power Electronics, DSP applications in power systems.

MB492 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.
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

EE402 POWER SYSTEM PROTECTION AND SWITCH GEAR

Relays – Principle of operation, types, characteristics; Torque equation; Electromagnetic and solid state relays ; Relaying Schemes .

Apparatus and line protection – Feeder protection, Ring main protection , Bus bar protection , Carrier current protection of transmission lines, Generator and Transformer protection..

Protection against over voltages – Ground wires, Surge absorbers and diverters. Earthing – neutral earthing. Insulation coordination.

Theory of arc quenching and circuit breakers – rating of circuit breakers, RRRV, Types of circuit breakers.

Static relays –Introduction-current relays-Generation and transmission line protection-Carrier protection- Microprocessor based relays – concepts of digital relaying.

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.

ELECTIVES

EE351 - 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, 1986.

EE352 - POWER GENERATION SYSTEMS

Economics of generation - Load duration curve - load, demand and diversity factors, Plant capacity and plant use factors-choice of type of generation - choice of size and number of units - cost of energy generated – tariffs.

Thermal and hydro power systems- comparison of power systems, layout and working of steam , diesel, low & high head hydro-power plants - 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 layout of MHD,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 systems Design Pitman, New Delhi', TMH , 1990.*

EE353 -MODERN CONTROL SYSTEMS

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 - Theory of high feedback advantages-Pole placement technique along with high gain feedback control.

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,1982.*

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 Microprogrammed control - micro instructions - Sequencing - prefetching.

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 1992*
2. *Stalling, W.,'Computer Organisation and Architecture', Pearson Education , 2003*
3. *Tanenbaum, A.S. 'Structured Computer Organisation', Third Edition, Prentice Hall of India, 1983.*

EE355 - 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.

EE451 -COMPUTER NETWORKS

Computer Network –structure and architecture. Topology of networks, Transmission modes- categories of networks- The OSI reference model- Transmission Media, Switching methods.

Medium access sub layer and data link layer: Medium Access sub layer-channel allocations, LAN-topology-Protocols-Data link layer –Design issues.

Network and Transport Layer - Network layer: Design issues- routing algorithms, congestion control algorithms- Transport layer- Design issues – connection management.

Application layer – Design issues-File transfer, Access and management, Electronic mail, Virtual Terminals, other applications.

TCP/IP: Introduction to TCP/IP – Addressing –Subneting – Protocols in the network layer TCP and UDP.

1. James F. Kurose and Keith W. Ross, ‘Computer Networking’, 2nd Edition, Pearson Education, 2003.
2. Tanenbaum, A.S., 'Computer Networks', 3rd Edition, Prentice Hall of India, 1999.
3. Stallings, W., 'Data and Computer Communication',PHI,5th edition, 2000.

EE452 - 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, 1984.
3. Van.C.Warrington, *'Protective Relays - Their Theory and Practice'*, Vols. I & II, Chapman & Hall Ltd. London, 1969.

EE453 - FUZZY SYSTEMS

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 - DC motor speed control - Neuro Fuzzy systems, Fuzzy Genetic Algorithms.

1. Zimmermann, H.J., *'Fuzzy set theory and its applications'*, Allied publishers limited, Madras, 1966.

2. Klir, G.J., and Folger, T. 'Fuzzy sets, uncertainty and information', PHI, New Delhi, 1991.
3. Earl Cox, 'The Fuzzy Systems Handbook', AP professional Cambridge, MA 02139, 1994.

EE454 - ADVANCED TOPICS IN MICROCONTROLLERS

Intel 8096 Microcontrollers – architecture-hardware description-addressing modes-instruction set- Assembly level programming.

Intel 8096 Microcontrollers applications-integrated battery management system-energy management controller for induction motor-uninterruptible power supplies.

PIC Series Microcontrollers – architecture-hardware description-addressing modes-instruction set- Assembly level programming.

Interrupt structure and Timers-high speed inputs and outputs- analog interface-PWM output-serial port-I/O ports-status and control registers-Watch dog timer.

Interfacing and Applications: Hardware design – hardware connections-drive and interface levels-bus timing and memory interface-EPROM programming.

1. Douglas V.Hall , ' Microprocessors and Interfacing - Programming and Hardware ', Tata McGraw- Hill , Eleventh edition , 1997.
2. Kenneth J.Hintz and Daniel Tabak , 'Microcontrollers - Architecture, Implementation and programming' McGraw Hill, USA, 1992.
3. John.B.Peatman, 'Design with microcontrollers', McGraw Hill International Ltd, 1989.

EE455 -POWER SYSTEM OPERATION AND CONTROL

Regulation of system frequency and voltage - p-f and Q-V control structure-Recent trends in real time control of power systems; operational restrictions.

Load dispatching - load curves- load factor, utilization factor, diversity factor; reserve requirements .

Load forecasting – components of system loads, types of load forecasting ; unit commitment- constraints on unit commitment.

Power frequency control - LFC control of a single area and two area systems – steady state and transient response - co-ordination equations with and without losses -Economic dispatch controller added to LFC .

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 transformer.

1. Olle I. Elgerd, 'Electric Energy System Theory -An Introduction' Tata McGraw Hill Publishing Company, New Delhi, 2nd edition ,1991.
2. Allem. J.Wood. Bruce.F.Wollenbarg,'Power Generation, Operation and Control,' John Wiley and Sons, 1984.
3. Weedy, B.M. ,'Electric Power System' John Wiley and Sons, Elsevier Publishing Company, Amsterdam , 1972.

EE456 - 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 Network- Unsupervised Hebb Rule- Hebb Rule with Decay- Instar Rule- Kohonen Rule.

Adaline Network- Single Adaline- Mean Square Error- LMS Algorithm- Analysis of Convergence- Adaptive Filtering- Back propagation algorithm.

Hopfield Model- Lyapunov Function- Invariant Sets-Examples- Hopfield Attractors- Hopfield Design- Content - Addressable Memory- Liapunov Surface.

1. Hagan, Demuth,Beale, 'Neural network design', PWS publishing company, 1995.
2. Zurada, . J.M.,' Introduction to artificial neural systems', Jaico publishing house, Bombay, 1994.
3. Freeman, J.A. and Skapura, D.M., 'Neural networks- Algorithms, applications and programming techniques' ,Addison Wesley,1991.

EE457 - 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. Padiyar, K.R., 'HVDC transmission systems', Wiley Eastern Ltd., New Delhi, 1992.
2. Arrilaga, J., 'High voltage direct current transmission', Peter Peregrinver Ltd., London, U.K., 1983.
3. Rakosh Das Begamudre, 'Extra HVAC Transmission Engineering', Wiley Eastern Ltd., Madras, 1990.

EE458 - POWER SYSTEM DYNAMICS

Stability considerations - Dynamic modeling 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 – djustment 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, 1981.
3. Krause, P.C., *'Analysis of Electric Machinery'* McGraw-Hill International Editions, 1986.

EE459 –FLEXIBLE AC TRANSMISSION 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.

PART-2

(Subjects Handled for students of other Branches of Engineering)

SYLLABUS

FOR

CREDIT BASED CURRICULUM

(Applicable for 2006-2010 batch onwards)



**DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY
TIRUCHIRAPPALLI – 620 015
INDIA**

PART-2

Subjects Handled for students of other Branches of Engineering:

SEMESTER -III

CODE	COURSE OF STUDY	L	T	P	C
EE221	Electrical Engineering Laboratory (For Students of Chemical Branch)	0	0	3	1
EE223	Applied Electrical Engineering (For Students of Mechanical Engineering Branch)	2	0	2	3
EE225	Applied Electronics (For students of production Engineering Branch)	3	0	0	3
EE227	Digital Electronics (For students of Chemical Engineering Branch)	3	0	0	3

SEMESTER -IV

CODE	COURSE OF STUDY	L	T	P	C
EE220	Electrical Technology (For Students of Metallurgical Engineering Branch)	2	0	2	3
EE222	Electrical and Control Systems Engineering (For Students of Production Engineering Branch)	3	0	0	3
EE224	Electrical and Electronics Engineering Laboratory (For Students of Production Engineering Branch)	0	0	3	1

EE221 - ELECTRICAL ENGINEERING LABORATORY

(For Chemical Engineering Department)

1. Open circuit characteristics of dc shunt generator
2. No load speed characteristics of DC shunt motor
3. Load test on DC shunt generator
4. Equivalent circuit of single phase transformer
5. Load test on single phase transformer
6. Power measurement in Three phase circuit using two wattmeter method
7. Starting of Three phase induction motors
8. Swinburne's test
9. Calibration of Wattmeter
10. Calibration of Ammeter and Voltmeter.

EE 223 - APPLIED ELECTRICAL ENGINEERING

Composite Subject : (Theory 2 credits + Laboratory 1 credit) (For Mechanical Engineering Department)

DC machines -Constructional features of D.C. machines - EMF equation
-Characteristics of different types of DC Generators - commutation and armature reaction.

Transformers – Single phase transformers - equivalent circuit - regulation and efficiency - auto transformer.

Three phase Induction Motors - Cage and Slip ring rotors - Torque - Slip Characteristics- Equivalent circuit - Starting and speed control .

Single phase Induction Motors - Universal Motor-Electric drives - Individual & group drives - Factors governing selection of drives.

Motors for domestic uses. Cranes, lifts, General factory, Textile mill, Paper mill, Mining work, Cement mill, Machine tools. Belt Conveyors, Ships, Refrigeration and Air conditioning.

1. Theraja.B.L., 'Electrical Technology', Vol-2 , S.Chand & Company ,1998.
2. Gupta.J.B., ' A Course in electrical Power' , S.K.Kataria & Sons , 1997.
3. Millman.J and Grabel.A, ' Micro Electronics ' , McGraw Hill , 1987 .

LABORATORY COMPONENT

1. No load speed characteristics of DC shunt motor
2. Load test on DC shunt generator
3. Equivalent circuit of single phase transformer
4. Load test on single phase transformer
5. Starting of Three phase induction motors

EE225 APPLIED ELECTRONICS

(For Production Engineering Department)

Theorems AND Linear Electronic Circuits - Thevenin and Norton theorems, Review of junction diodes, zener diodes, (BJT) and (FET) – applications.

Operational Amplifiers - Characteristics - applications as comparators, inverting amplifier, non-inverting amplifier. Adder, subtractor, differentiator, integrator, rectifiers, sample and hold circuit, Schmitt trigger.

Review of binary arithmetic (signed and unsigned), seven segment display . Boolean Algebra simplification of algebraic expression , Basic logic gates.

Combinational Logic. D/A and A/D Converters – Principles and various Techniques.

MEMORIES - Functions & types of memories - Read Only Memory (ROM) - Erasable Programmable ROM (EPROM)- Electrically Erasable and Programmable ROM (EEPROM) - Random Access Memo (RAM) - a typical RAM static and dynamic RAM.

1. *Millman and C.Halkias: " Integrated Electronics ", TMH*
2. *Ranmkant A Gayakwad, "OP-amps and linear integrated circuit technology"*
3. *Morns Mano, " Digital Design" PH*

EE227 DIGITAL ELECTRONICS

Basics Of Digital Systems: Introduction, Binary logic, Boolean algebra, Logic Gates - synthesising Basic logic gate circuits, Multiplexers and Demultiplexers, Binary based codes.

Filp-Flops Counters And Memory Devices: Flip -Flops, Shift Registers, Asynchronous counters, Synchronous counters, Semiconductor Memories.

Digital Arithmetic & Data Converters: Addition, Subtraction ALU, Binary Multiplication and Division, Fixed point and Floating point numbers. DAC and ADC.

Microprocessor Basics: Evolution of Microprocessors, Architecture of INTEL 8085 - Addressing modes and decoding - Wait, Hold and Halt states - Interrupts, Bus cycles, Transition state diagram.

Microprocessor Programming: Instruction set of INTEL 8085, Writing programs in HEX code, Assembler and Assembler directives.

1. William H. Gothmann, "Digital Electronics", 2nd Edn. , Prentice Hall of India (P) Ltd., New Delhi 1986.
2. Douglas V.Hall, "Microprocessors and Digital systems", 2nd Edn. McGraw Hill Book co., International Student Edn. 1983
3. Ramesh Gaonkar, 'Microprocessor Architecture, Programming and applications', With the 8085/8080A", 3rd Edition, Penram International Publishing house, 2002

EE 220 ELECTRICAL TECHNOLOGY

Composite Subject : (Theory 2 Credits + Laboratory 1 Credit) (For Metallurgy Department)

DC Machines- Constructional features of D.C. machines - EMF equation -Characteristics of different types of DC Generators - commutation and armature reaction.

D.C. motors - Types, Torque equations-characteristics, Swinburne's test-Electric braking, starting – speed control.

Transformers – Single phase transformers - equivalent circuit - regulation and efficiency - auto transformer- Welding transformers.

AC Machines-Principle of operation -Synchronous Machine-Induction Motors: Torque - Speed Characteristics - Speed control and starters - Single phase Induction motors.

Electric heating - resistance, inductance and dielectric heating; design -Power and efficiency calculations, applications; welding-resistance, arc and ultrasonic welding, DC and Ac welding sets, applications.

1. Theraja, B.L., 'Electrical Technology', Vol. I & 2, S. Chand & Co.Ltd.,New Delhi 1998.

2.. Hughes, E., 'Electrical Technology', The English Language Book Society and Longman group Ltd., 6th Edn., 1987.

3. Cotton, H., 'Electrical Technology', CBS Publishers, 1984.

LABORATORY COMPONENT

1. No load speed characteristics of DC shunt motor
2. Load test on DC shunt generator
3. Equivalent circuit of single phase transformer
4. Swinburne's Test
5. Starting of Three phase induction motors

EE 222 ELECTRICAL AND CONTROL SYSTEMS ENGINEERING

(For Production Engineering Department)

DC machines - generators - motors - Starting and speed control of DC motors. Transformers: (Single phase only)- EMF equation - equivalent circuit & regulation - losses and efficiency - auto transformer.

Alternators - EMF equation - regulation by synchronous impedance method - Synchronous motors - starting and applications.

Three - phase induction motor - Cage and slip ring motors -torque slip characteristics - speed control of induction motors - single phase induction motors and universal motors.

Electric drive for general factory, textile mill - pump, blowers, hoists, traction etc. - group and individual drives - Construction and working of dynamometer type wattmeters and induction type energy meters.

Open loop and closed loop systems- transfer function - time response of second order system - frequency response method - polar plot . Concept of stability - application of routh and Nyquist stability criterion for simple systems.

1. *Nagrath, I.J., and Gopal, M., 'Control systems Engineering', Wiley Eastern Ltd.,1992.*
2. *Shanmuga Priya publishers, 1998*
3. *Palani, S. "Control Systems ", Shanmuga Priya Publishers, 1995.*
4. *Theraja, B.L., " Electrical Technology", Vol. I & 2, Nitia Construction & development Co.Ltd., 1988.*

EE224 ELECTRICAL AND ELECTRONICS ENGINEERING **LABORATORY**

(For Production Engineering Department)

1. No load speed characteristics of DC shunt motor
2. Load test on DC shunt generator
3. Equivalent circuit of single phase transformer
4. Swinburne's test
5. Starting of Three phase induction motors
6. Semiconductor junction diode V-I characteristics
7. Semiconductor Zener diode V-I characteristics
8. Inverting and non inverting operational amplifiers
9. Uni junction transistor(UJT) and silicon controlled rectifier
Characteristics.
10. Logic gates