B.TECH. DEGREE COURSE

SYLLABUS

ELECTRICAL
&
ELECTRONICS
ENGINEERING BRANCH

3RD SEMESTER

Course Code	Course No.	Subject	Teaching Hours				Duration of Univ. Exam(Hrs.)	Maximum Marks		
			L	T	P	Total		Sessional	University	Total
A	CMEL PA 301	Engineering Mathematics -II	3	1		4	3	50	100	150
B	E 302	Mechanical Technology	3	1		4	3	50	100	150
C	E 303	Electric Circuit Theory	2	2		4	3	50	100	150
D	E 304	Electromagnetic Theory	3	1		4	3	50	100	150
E	E 305	Electical and Electonic Measurements	2	1		3	3	50	100	150
F	E 306	Power Generation & Distribution	2	1		3	3	50	100	150
G	E 307	Basic Electrical Lab			4	4	3	50	100	150
H	E 308	Mechanical Lab*			4	4	3	50	100	150
		Total	15	7	8	30	24	400	800	1200

*Mechanical Lab consists of: 1) Hydraulic Machines Lab & 2) Heat Engines Lab.
University Exam will be either in Hydraulic Machines Lab or Heat Engines Lab.

4TH SEMESTER

Course Code	Course No.	Subject	Teaching Hours				Duration of Univ. Exam(Hrs.)	Maximum Marks		
			L	T	P	Total		Sessional	University	Total
A	CMELR PTA 401	Engineering Mathematics -III	3	1		4	3	50	100	150
B	E 402	Network Analysis & Synthesis	2	1		3	3	50	100	150
C	E 403	Electronic Circuits	3	1		4	3	50	100	150
D	E 404	Electrical Machines - I	3	1		4	3	50	100	150
E	E 405	Computer Programming	3	1		4	3	50	100	150
F	E 406	Electrical and Electronic Instruments	2	1		3	3	50	100	150
G	E 407	Electrical Measurements Lab			4	4	3	50	100	150
H	E 408	Computer Programming Lab			4	4	3	50	100	150
		Total	16	6	8	30	24	400	800	1200

5TH SEMESTER

Course Code	Course No.	Subject	Teaching Hours				Duration of Univ. Exam(Hrs.)	Maximum Marks		
			L	T	P	Total		Sessional	University	Total
A	CMEL PA 501	Engineering Mathematics -IV	3	1		4	3	50	100	150
B	E 502	Digital Circuits	3	1		4	3	50	100	150
C	E 503	Communication Engineering	2	1		3	3	50	100	150
D	E 504	Industrial management and Economics	3	2		5	3	50	100	150
E	E 505	Linear Integrated Circuits	2	1		3	3	50	100	150
F	E 506	Power Electronics	2	1		3	3	50	100	150
G	E 507	Electrical Machines Lab - I			4	4	3	50	100	150
H	E 508	Electronic Circuits Lab			4	4	3	50	100	150
		Total	15	7	8	30	24	400	800	1200

6TH SEMESTER

Course Code	Course No.	Subject	Teaching Hours				Duration of Univ. Exam(Hrs.)	Maximum Marks		
			L	T	P	Total		Sessional	University	Total
A	E 601	Control Systems - I	3	1		4	3	50	100	150
B	E 602	Electrical Machines - II	3	1		4	3	50	100	150
C	E 603	Electrical Power Transmission	3	1		4	3	50	100	150
D	E 604	Digital Signal Processing	2	1		3	3	50	100	150
E	E 605	Microprocessors and Applications	3	1		4	3	50	100	150
F	E 606	Computer Organisation	2	1		3	3	50	100	150
G	E 607	Digital Lab			4	4	3	50	100	150
H	E 608	Systems Lab			4	4	3	50	100	150
		Total	16	6	8	30	24	400	800	1200

7TH SEMESTER

Course Code	Course No.	Subject	Teaching Hours				Duration of Univ. Exam(Hrs.)	Maximum Marks		
			L	T	Prac./ Proj.	Total		Sessional	University	Total
A	E 701	Electrical Machines -III	3	1		4	3	50	100	150
B	E 702	Electrical Drives and Control	2	1		3	3	50	100	150
C	E 703	Utilisation of Electrical Power	2	1		3	3	50	100	150
D	E 704	Control Systems - II	3	1		4	3	50	100	150
E	E 705	System Design with Microcontrollers	2	1		3	3	50	100	150
F	E 706	Elective - I	3	1		4	3	50	100	150
G	E 707	Electrical Drawing			3	3	3	50	100	150
H	E 708	Control and Power Electronics Lab			4	4	3	50	100	150
I	E 709	Project & Seminar*			2	2				
		Total	15	6	9	30	24	400	800	1200

*The Project Work will be started in the Seventh Semester. Sessional Marks for Seminar will be out of 25 and that for Project will be out of 75.

8TH SEMESTER

Course Code	Course No.	Subject	Teaching Hours				Duration of Univ. Exam(Hrs.)	Maximum Marks		
			L	T	Prac./ Proj.	Total		Sessional	University	Total
A	E 801	Power System Analysis	3	1		4	3	50	100	150
B	E 802	Switch Gear and Protection	3	1		4	3	50	100	150
C	E 803	Instrumentation	2	1		3	3	50	100	150
D	E 804	Electrical System Design	3	1		4	3	50	100	150
E	E 805	Elective - II	3	1		4	3	50	100	150
F	E 806	Elective - III	2	1		3	3	50	100	150
G	E 807	Electrical Machines Lab -II			4	4	3	50	100	150
H	E 808	Project and Seminar**			4	4		100		100
I	E 809	Viva Voce							50	50
		Total	16	6	8	30	21	450	750	1200

**Sessional Marks for Seminar will be out of 25 and that for Project will be out of 75 in which 40 marks will be based on day to day performance assessed by the Guide. The remaining 35 marks are to be awarded based on the presentation of the project by the student in the presence of 2 staff members one of which shall be the Guide.

THIRD SEMESTER

ENGINEERING MATHEMATICS - II

CMELPA 301 **3+1+0**

Module 1

Vector Differential Calculus: Differentiation of vector functions – scalar and vector fields – gradient, divergence and curl of a vector function – their physical meaning – directional derivative – scalar potential, conservative field – identities – simple problems.

Module 2

Vector Integral Calculus: Line, Surface and Volume Integrals, work done by a force along a path – Application of Greens theorem, Stokes theorem and Gauss divergence theorem.

Module 3

Function of Complex Variable: Definition of Analytic functions and singular points – Derivation of C. R equations in Cartesian co-ordinates – harmonic and orthogonal properties – construction of analytic function given real or imaginary parts – complex potential – conformal transformation of function like z^n, e^z, $1/z$, Sin z, $z + k^2/z$ – bilinear transformation. Cross ratio – invariant property – simple problems.

Module 4

Finite Differences: Meaning of Δ, ∇, E, μ, δ - interpolation using Newton's forward and backward formula – central differences – problems using Stirlings formula – Lagrange's formula and Newton's divided difference formula for unequal intervals.

Module 5

Difference Calculus: Numerical differentiation using forward and backward differences – Numerical integration – Newton-Cote's formula – trapezoidal rule – Simpson's $1/3^{rd}$ and $3/8^{th}$ rule – simple problems. Difference eqns. – solutions of difference equations.

References

1. Advanced Engg. Mathematics: Erwin Kreyszig, Wiley Eastern.
2. Higher Engg. Mathematics: Grawal B. S, Khanna Publ.
3. Numerical Methods in Science and Engg: M. K Venkataraman, National Publishing Co.

4. Numerical Methods: S. Balachandra Rao and G.K Shantha, University Press.
5. Advanced Engg. Mathematics: Michael D. Greenberg, Prentice – Hall
6. Numerical mathematical Analysis: James B. Scarborough, Oxford IBH Publishing Co.
7. Theory and Problems of Vector Analysis: Murray R. Spiegel, Schaum's outline series – McGraw Hill.
8. Finite Differences and Numerical Analysis: H.C Saxena, S. Chand & Co.Ltd.

MECHANICAL TECHNOLOGY

E 302 **3+1+ 0**

Module 1

Properties of Fluids: Pressure, density, bulk modulus, dynamic and kinematic viscosity, surface tension, capillary – fluid at rest, Pascal's law, applications, pressure head, vapor pressure, pressure measurement, manometers, gauges and pressure switch – pressure on immersed surfaces – floating body.

Module 2

Fluid in Motion: Euler's equation in one dimension. One dimensional incompressible Bernoulli's equation, interpretation of Bernoulli's equation as a energy equation. Flow through Orifices – measurement of fluid velocity, pitot tube – discharge measurement, venturimeter, orifice meter, Rota meter and notches.

Flow of compressible fluids through pipes – types of flow – critical Reynolds number – friction factors for laminar and turbulent flow – hydraulic gradient – minor losses – transmission of power through pipes.

Module 3

Hydraulic Turbines: Evolution of present day hydraulic turbines from the water wheel – classification – degree of action – Pelton wheel, Francis and Kaplan Turbines – constructional details and characteristics only (no problems based on velocity triangles) – governing of turbines – draft tube – specific speed – cavitation effects.

Module 4

Pumping Machinery: General classification – Dynamic pumps – working of centrifugal pumps, priming, vapour pressure, wear rings, hydraulic balancing, Classification of impellers, single and double suction impellers – types of casings – effect of vapour pressure on lifting of liquid – specific speed – performance pump characteristics: main, operating, ISO efficiency characteristics curves –

NPSH _ multistage pumps – propeller pumps – pump in parallel & series operation – Theory, efficiency, performance curves & application of self-priming pump, jet pump, airlift pump, slurry pump & hydraulic ram (description only).

Module 5

Positive Displacement Pumps: reciprocating pumps, effect of vapour pressure on lifting of liquid – indicator diagram – acceleration head – effect of friction – use of air vessels – work saved – slip – efficiency – pump characteristics – applications – Cavitation in fluid machines – Rotary pumps: Gear, Screw, vane, root pumps – rotary axial & rotary radial piston pumps – thory, efficiency, performance curves – applications (Description only).

References

1. Fluid Mechanics & Hydraulic Machines: Abdulla Sheriff, Standard Publ.
2. Fluid Flows Machines: Govinda Rao N.S, TMH.
3. Fluid Mechanics & Hydraulic Machines: Jagadishlal, Metropolitan publ.
4. Fluid Mechanics: Massey B. S, ELBS
5. Centrifugal and Axial Flow Pumps: Stepanoff John A. J, Wiley & Sons.

ELECTRIC CIRCUIT THEORY

E 303 **2+2+0**

Module 1

Circuit Analysis: Concept of Linearity, Unilateral and Bilateral Systems – Passive and Active networks – Vector and Phasor – Sources of Energy – Independent and Dependent voltage and current Sources – Standard input signals – Source transformations - Mesh and Node Analysis – Driving point Impedance and Transfer Impedance – Driving point Admittance and Transfer Admittance.

Module 2

Coupled Circuits: Self-inductance and Mutual inductance – Coefficient of coupling – dot convention – Ideal Transformer – Analysis of multi-winding coupled circuits – Analysis of single tuned and double tuned coupled circuits.

Module 3

Network Theorems: Star-Delta transformations – Super position, Reciprocity, Substitution, Compensation, Thevinin, Norton, Millman, Tellegen and Maximum power transfer theorems.

Module 4

Three Phase Circuits: Generation of three phase voltages – Phase sequence – Line and Phase quantities – Analysis of unbalanced loads – Neutral shift – Symmetrical components – Analysis of unbalanced system – power in terms of symmetrical components.

Module 5

Graph theory: Introduction – Linear graph of a network – Tie-set and cut-set schedule – incidence matrix – Analysis of resistive network using cut-set and tie-set – Dual of a network.

Introduction to MATLAB and pSPICE – Simulation/Analysis of simple Electric Circuits using MATLAB and pSPICE.

References

1. Network Analysis: M.E Van Valkanburg
2. Circuits and Networks-Analysis and Synthesis: A. Sudhakar, S.P Shyam Mohan
3. Networks and Systems: D. Roy Choudhary, New Age Intl'.
4. Theory and Problems in Circuit Analysis: T.S.K.V Iyer, TMH
5. Electric Circuits: Edminister J, Schaum's Outline series
6. Engineering Circuit Analysis: W.H Hayt and J.E. Kemmerly – Mc Graw Hill.
7. Electric ciruit theory: Rajeswaran – Pearson Education

ELECTROMAGNETIC THEORY

E 304 **3+1+0**

Module 1

Review of Vector Analysis – Cartesian coordinate system – The Vector field – dot cross products – introduction to cylindrical and spherical coordinate systems.

Static Electric Field: Coulomb's law – electric field intensity – field intensity due to point charge, line charge, surface charge and volume charge distributions – electric flux – electric flux density – Gauss's law and its applications – divergence – Maxwell's first equation – the Del operator – Divergence theorem.

Module 2

Energy and Potential – Energy expended in moving a point charge in an electric field – Electric Potential between two points – potential at a point charge – potential at any point – due to discrete as well as distributed charges – Electric field lines and equipotential contours – electric dipoles – potential gradient – conservative nature of a field – Laplace and Poisson equations (Derivation only and not solution).

Module 3

Conductors, Dielectrics and Capacitance – current and current density – continuity equation – point form of Ohm's Law – conductor properties – polarisation – dielectric boundary conditions – capacitance – parallel plate capacitor – capacitance of isolated sphere, spherical shell, coaxial and cylinders and parallel wires – effect of earth on capacitance - method of images – energy stored in electrostatic field – dielectric strength and break down.

Module 4

The steady Magnetic Field – Biot-Savart's law – Ampere's circuital law - Curl – Stoke's theorem – magnetic flux and flux density – the scalar and vector magnetic potentials – magnetic force on a moving charge – force on a moving charge – force on a current element – force between current carrying wires – torque on closed circuits – magnetic boundary conditions – self and mutual inductances – energy stored in a magnetic field – skin effect – inductance of solenoids, torroids and two-wire transmission lines.

Module 5

Time varying fields – Faraday's laws of electromagnetic induction – Motional emf concept of displacement current – Maxwell's equations in point form and integral form – wave equation in free space – applications in transmission lines – Poynting vector and power flow – Poynting theorem – interpretations – instantaneous, average and complex pointing vector – power loss in conductors.

References

1. Engineering Electromagnetics: William H. Hayt Jr., McGraw Hill
2. Electromagnetics: John D. Karus and Carver K.R, McGraw Hill
3. Field Theory: Gangadhar K. A
4. Theory and Problems of Electromagnetics: Joseph Edminister, schaum's outline series
5. EMT with applications: B. Premlet

ELECTRICAL AND ELECTRONIC MEASUREMENTS

E 305 **2+1+0**

Module 1

Units and Dimensions: SI Units – Dimensions of Electrical quantities – dimensional equations.

Magnetic Measurements: Theory of Ballistic galvanometer – Flux meter – Lloyd Fischer Square.

Module 2

Measurement of Voltage: Potentiometers – slide-wire, Precision slide-wire, Vernier potentiometer – Calibration of Ammeter, Voltmeter and Wattmeter using potentiometer- AC potentiometer.

Measurement of Resistance: Low, medium, high – Wheatstone bridge- Kelvin's double bridge – Insulation Megger – Earth Megger.

Module 3

AC Bridges: Maxwell's bridge – Hay's bridge, Wien's bridge, Anderson Bridge, High voltage Schering Bridge. (Analysis and Phasor diagram required)

Module 4

Instrument Transformers: Principle of Current and Potential transformers – Phasor diagram – nominal ratio – phase angle error, Ratio error – Constructional features and applications.

Error Analysis in Measurements: Source of error – Instruments errors – Human errors – Environmental errors – Combination of errors – Mean and variance – Standard deviation – Limits of error.

Module 5

Illumination measurements: Units of illumination – laws of illumination – polar curves – Determination of MSCP and MHCP – Integrating meters – Lumer Brodhern type.

Temperature measurement: Thermoelectric effects, laws of thermoelectric circuits – common thermocouples.

References

1. Electrical Measurements and Measuring Instruments – Golding E.W, Wheeler and Co., 1991.
2. Electrical and Electronic Instrumentation and Measurements – Sawhney A.K, Dhanpat Rai and Co., 1992.
3. Modern Electronic Instrumentation and measurement Technique – Albert D. Helfrick and William D. Cooper, PHI, 1992.

POWER GENERATION AND DISTRIBUTION

E 306 **2+1+0**

Module 1

Economic Aspects: Load Curve- Load duration curve-Maximum demand- Average demand- Load factor- Diversity factor-Plant use factor.

Cost of Generation: Fixed and Running Charges- depreciation- straight line and sinking fund method Tariffs- Different types and comparison.

Module 2

Distribution Systems: Feeder- Distributor - Service mains- Radial and Ring mains- AC and DC Distributors- Calculations of voltage drop due to concentrated loads fed at one or more points-LT Lines- LT Capacitors – Installation- Size – Connections- Distribution system maintenance

Module 3

Design of Feeder- Kelvin's law- Limitations- Related 'Indian Electricity Act' Rules regarding generation and supply of electrical energy

Power factor improvement- necessity – methods – economics – capacity of phase advancing plant

Module 4

Underground Cables: Single core and three core cables – Insulation Resistance – Stress and capacitance of single core cables – Grading – Extra high voltage cables – Localisation of cable faults.

Module 5

High Voltage Generation:

D.C: Rectifier circuits - Voltage multiplier-Cascade circuits-Electrostatic machines

A.C.: Cascade transformers – series resonance circuits

Impulse Voltage: Single stages and cascade circuits

References

1. A Course in Electric Power: Soni M.L., P.V.Gupta
2. A Course in Electric Power: Uppal
3. Electric Power Distribution System: A.S. Pabla
4. Transmission and Distribution of Electric Energy: Cotton H
5. High Voltage Engineering: M. S. Naidu, V. Kamaraju

BASIC ELECTRICAL LAB

E 307 **0+0+4**

1. Study of AC and DC supply systems in Electrical Laboratory
2. Study of PMMC / MI voltmeters, ammeters, electro-dynamometer type watt meters, induction type energy meters, various loads like resistive, capacitive and inductive.
3. Testing of insulating oils and H.V testing on insulating materials.
4. Determination of voltage-current characteristics of linear resistance and a nonlinear resistance (e.g. incandescent lamp).
5. Verification of Kirchhoff's laws using resistive network.
6. Verification of superposition theorem in a resistive circuit with two given DC sources.
7. Verification of Thevinin's theorem in a DC circuit.
8. Verification of generalised reciprocity theorem in a DC circuit.
9. Verification of Maximum Power transfer theorem in a DC circuit
10. Three phase star and delta connection – measurement of line and phase values.
11. Measurement of three phase power at different power factors for balanced and unbalanced loads.
12. Study and measurement of symmetrical components for unbalanced system.
13. Determination of BH characteristics of a magnetic specimen.
14. RLC series and parallel circuit: measurement of current in various branches and verification by calculation – drawing of phasor diagram.
15. Determination of locus diagram RL and RC circuit.
16. Study of frequency – current relations of given series RLC circuit and condition for series resonance.
17. Measurement of single phase power – (a) Three ammeter method (b) three voltmeter method
18. Measurement of single phase power and energy using wattmeter and energy meter – calculation of error.
19. Determination of Power and Power factor of a given single phase circuit using watt meter and power factor meter – power factor improvement of the above circuit.
20. Determination of fusing time versus current characteristics for two specimens – fusing factor – study of various types of fuses.
21. Measurement of Neutral shift voltage for an unbalanced star connected system.

MECHANICAL LAB

E 308 **0+0+4**

HYDRAULICS LAB

1. Study of centrifugal pump and components
2. Study of reciprocating pump and components – single cylinder and multi cylinder
3. Study of impulse and reaction turbines
4. Performance characteristics of centrifugal pump
5. Performance characteristics of reciprocating pump
6. Performance characteristics of Pelton Wheel
7. Performance characteristics of Francis turbine
8. Performance characteristics of Kaplan turbine

HEAT ENGINES LAB

1. Load Test (Constant speed test) on petrol engine
2. Load Test (Constant speed test) on diesel engine
3. Variable speed test on petrol engine
4. Variable speed test on diesel engine
5. Cooling curve of I.C engine
6. Performance test on air compressors and blowers
7. Performance test on refrigeration unit
8. Performance test on air-conditioning unit

FOURTH SEMESTER

ENGINEERING MATHEMATICS - III

CMELRPTA 401 **3+1+0**

Module 1

Ordinary Differential Equations: Linear Differential Equations with constant coefficients – Finding P.I by the method of variation of parameters – Cauchy's equations – Linear Simultaneous equations – simple applications in engineering problems.

Module 2

Partial Differential Equations: Formation by eliminating arbitrary constants and arbitrary functions – solution of Lagrange's Linear equations – Charpit's method – solution of homogeneous linear partial differential equation – equation with constant coefficients - solution of one dimensional wave equation and heat equation using method of separation of variables – Fourier solution of one dimensional wave equation.

Module 3

Fourier Transforms: Statement of Fourier Integral Theorems – Fourier transforms – Fourier sine and cosine transforms – inverse transforms – transforms of derivatives – Convolution Theorem (no proof) – Parseval's identity – simple problems.

Module 4

Probability and Statistics: Binomial law of probability – The binomial distribution, its mean and variance – Poisson distribution as a limiting case of binomial distribution – its mean and variance – fitting of binomial and Poisson distributions – normal distribution – properties of normal curve – standard normal curve – simple problems in binomial, Poisson and normal distributions.

Module 5

Population and samples: Sampling distribution of mean (σ known) – sampling distribution of variance, F and Chi square test – Level of significance – Type 1 and Type 2 errors – Test of hypothesis – Test of significance for large samples – test of significance for single proportion, difference proportion, single mean and difference of mean (proof of theorems not expected).

References

1. Higher Engg. Mathematics: Grawal B. S, Khanna Publ.
2. Engineering Mathematics Vol.2: M. K Venkataraman, National Publishing Co.
3. Elements of Partial Differential Equations: Ian N. Sneddon, Mc Graw Hill Intl'
4. Miller and Fread's Probability and Statistics for Engineers: Richard A. Johnson, Pearson education/ PHI.
5. A Text Book of Engg. Mathematics, Vol.2: Bali and Iyengar, Lakshmi Publ. Ltd.
6. Advanced Engg. Mathematics: Erwin Kreyszig, Wiley Eastern.
7. Probability and Statistical Inferences: Hogg and Tam's, Pearson Education Asia.

NETWORK ANAYSIS AND SYNTHESIS

E 402 **2+1+0**

Module 1

Laplace transforms: Properties of Laplace Transforms – basic theorems – Laplace transform of gate function, impulse function and periodic functions – convolution integral – inverse Laplace transform – application of Laplace transforms to solution of Network problems.

Module 2

Fourier series: Evaluation of Fourier coefficients – wave form symmetries as related to Fourier coefficients – exponential form of Fourier series – steady state response to periodic signals.

Fourier Integral: Spectrum envelop for a recurring pulse – the Fourier Integral and Transforms – Application in Network analysis.

Module 3

Network Functions: Network functions for two port – poles and zeroes of network functions – restrictions on poles and zeroes for driving point functions and transfer functions. Two port parameters – short circuit admittance parameter – open circuit impedance parameters – Transmission parameters – Image parameters and Hybrid parameters. Ideal two port devices – ideal transformer – Gyrator – negative impedance converter.

Module 4

Filters: Classification of filters – Characteristics of ideal filters – Image impedance – Constant K low-pass, high-pass, and band-pass filters – m-derived low-pass, high-pass and band-pass filters.

Module 5

Network Synthesis: Realizability concept – Hurwitz property – positive realness – properties of positive real functions – Synthesis of R-L, R-C and L-C driving point functions – Foster and Cauer forms.

References

1. Network Analysis: M.E Van Valkenburg
2. Circuits and Networks – Analysis and Synthesis: A. Sudhakar and S.P Shyam Mohan
3. Networks and Systems: D. Roy Choudhary
4. Network Analysis and Synthesis: Franklin F. Kuo – John Wiley & Sons
5. Engineering Circuit Analysis: W.H. Hayt and J.E. Kemmerly – Mc-Graw Hill.

ELECTRONIC CIRCUITS

E 403 **3+1+0**

Module 1

Transistor Characteristics: CE, CB, CC Configurations – Biasing – Operating Point – Operating point instability – thermal runaway – bias stability – Stability factor – stabilization techniques – Fixed bias – Collector to Base bias – Emitter bias – Voltage divider bias – Stability against variation in I_{CO}.

FET: Principle of operation and characteristics – biasing FETs – self bias – FET amplifier.

UJT: Principle of operation and characteristics.

Module 2

Small Signal Analysis: h-parameter equivalent circuit of a BJT – comparison of CB, CE, and CC configurations – Determination of h – parameters from static characteristics – current and voltage gains, input impedance of a basic amplifier in h-parameters.

Multi-stage Amplifiers: RC coupling – Frequency response characteristics – bandwidth – cascading of amplifiers – gain and bandwidth.

Module 3

Feedback amplifiers: Positive and Negative feedback – types of negative feedback – Typical circuits –effect of negative feedback in amplifier performance.

Oscillators: Barkhausen criterion – classification of oscillators – Principle of operation of RC phase-shift, Hartley and crystal oscillators (analysis not required).

Module 4

Multi-vibrators: Principle of Operation and design of astable multi-vibrators – principle of bi-stable and mono-stable multi-vibrators – circuits.

Sweep generators: Principle of Sweep generation – basic transistor sweep circuit – Equation for sweep amplitude. Sweep generation using UJT relaxation oscillator circuit.

Wave shaping: Clipping and Clamping circuits using diodes – RC differentiating and Integrating Circuits.

Module 5

Power Amplifiers: Class A, B, AB and C operation – Efficiency of Class A and B – Push-pull amplifier – Complimentary Symmetry amplifiers.

References

1. Integrated Electronics: Millman and Halkias, TMH
2. Electronic Devices and Circuit Theory: Robert L. Boylestad and Louis Nashelsky, Pearson Education Asia, LPE.
3. Electronic Principles: Albert Paul Malvino, TMH
4. Electronic Devices and Circuits, An Introduction: Allen Mottershead, PHI

ELECTRICAL MACHINES - I

E 404 **3+1+0**

Module 1

D.C Machines: Generation of D.C – Action of Commutator – constructional details of D.C machine – magnetic circuit of D.C machines – D.C Armature windings – Induced emf – emf equation – torque developed in a D.C machine – generator and motor action – back emf – Armature mmf – magnitude and direction – Air-gap flux distribution curve on load – effect of saturation – Demagnetising and cross – magnetising armature mmf – variation with brush position – compensating winding – Commutation – time of commutation – emf in coil undergoing commutation – reactance emf – effect of brush shift – inter-poles.

Module 2

D.C Generator: Types of excitation – separately excited – self excited shunt, series and compound machines. OCC – Condition for self excitation – field critical resistance – critical speed – Load characteristics of generators – Load critical resistance – parallel operation of shunt, series and compound generators – equalizer connection – Losses – power flow diagram – efficiency - condition for maximum efficiency – applications – special machines – welding generator – Boosters.

Module 3

D.C Motors: Performance characteristics of shunt, series and compound wound motors – starting – 3-point and 4-point starters – Calculation of resistance elements for shunt motor starters – methods of speed control of shunt, series and compound wound motors – effect of an open field circuit – power flow diagram – efficiency – testing D.C machine – Swineburne's test – Hopkinson's test – Field's test – Retardation test.

Module 4

Transformers: Single phase transformer – Constructional details – Core – windings – Insulation – principle of operation – Inrush of switching currents – emf equation – magnetising current and core losses – no-load and load operation – Phasor diagram – equivalent circuit – losses and efficiency – condition for maximum efficiency – voltage regulation – approximate expression for voltage regulation – harmonics in single phase transformers - Magnetising current wave form – OC and SC tests – Sumpner's test.

Module 5

Three phase Transformer: Constructional features of three phase transformers – three phase connection of single phase transformers – oscillating neutral – tertiary winding – Scott connection – open delta connection – three phase to six phase connection – equal and unequal turns ratio – load sharing – distribution transformers – all day efficiency. Autotransformers – saving of copper – applications - tap-changing transformers - cooling of transformers.

References

1. The performance and Design of Direct Current Machines: A. E. Clayton and N. N Hannock
2. AC Machines: M.G. Say
3. Theory of Alternating Current Machinery: Alexander Langsdorf, TMH
4. Electrical Machines: R.K Rajput

COMPUTER PROGRAMMING

E 405 **3+1+0**

Module 1

Introduction to C: The C character set – identifiers and keywords – data types – user defined data types – constants and variables – declarations – operators – expressions – statements – library input-output functions

Control statements: if, if-else, switch, goto statements – conditional and comma operators.

Module 2

Iterative statements: 'while', 'do-while', 'for' statements – nested loops, break and continue statements.

Functions: Declarations, definition and access – passing arguments to a function – pass by value and pass by reference – recursion.

Storage classes: automatic variables – external variables – register variables – scope and life time of variables.

Module 3

Arrays: single dimensional arrays – multidimensional arrays – definition – initializing arrays- passing arrays to a function – matrix operations – addition, transpose and multiplication.

Strings: Definition – string handling functions – comparison, concatenation and sorting of strings.

Module 4

Pointers: Introduction – pointer declaration – operations on pointers.

Files: File pointers – data files: opening and closing – reading and writing.

Module 5

Structures and union: definition – initialization – accessing structure members – array of structures – passing structure to a function – sorting of structures – binary files – reading and writing of data blocks – union.

Dynamic memory allocation – self referential structures – basic concepts of linked lists – adding and deleting nodes – command line arguments – macros – C preprocessor.

References

1. Theory and Problems of Programming with C: B.S. Gotterfield, TMH
2. Programming in ANSI C: Balaguruswamy, TMH
3. Programming with ANSI & Turbo C: Ashok Kamthane, Pearson Education Asia
4. The Spirit of C, An Introduction to modern programming: Mullish & Cooper, Jaico Publishing Co.
5. Programming in C: Stephen G. Kochan, CBS Publ.
6. Computer Programming in C: V. Rajaraman, PHI EEE

7. The Official Borland Turbo C Survival Guide: Miller & Quilci, Wiley Eastern
8. Programming Techniques through C: M. G Venkateshmurthy, Pearson Education
9. Let us C: Yashwant Kanetkar, BPB publ.

ELECTRICAL AND ELECTRONIC INSTRUMENTS

E 406 **2+1+0**

Module 1

Principle of measuring instruments: Classification – indicating, recording and integrating instruments – Torque acting on the moving system – deflecting torque – methods of production – controlling torque – spring and gravity control – damping torque – electromagnetic and air friction damping.

Constructional features of instruments – torque to weight ratio of the moving system – basic theory of instruments – characteristics – damping coefficient – under damped – over damped and critically damped and critically damped instruments.

Module 2

Permanent magnet moving coil instruments: – Ammeters and Voltmeters – Torque relationship – Milliammeters and voltmeters – shunt and multipliers – sensitivity – multimeters.

Moving iron instruments: Attraction and Repulsion types – constructional features – Ammeters and Voltmeters – Errors and Compensation.

Module 3

Electrodynamometer instruments: Ammeters, Voltmeters and Watt meters – Sensitivity – Torque to weight ratio – methods of connection of current and potential coils- Errors and compensation – low power factor wattmeters – single phase wattmeters.

Induction type instruments: Wattmeters and energy meters – single phase and three phase – constructional features – Theory of operation – Errors and compensation – creep – maximum demand meters – Trivector meters.

Module 4

Rectifier Instruments: Principle of operation – Electrostatic instruments – voltmeters – characteristics, applications.

Electronic voltmeters – basic DC voltmeters – basic AC voltmeter using rectifier – basic electronic multi meter – function generator – RLC meter.

Cathode ray Oscilloscope: Principle – Application – Measurement of Voltage, current, phase and frequency. Multi-channel oscilloscopes – principle of operation and uses.

Module 5

Instruments for phase, frequency, speed, stroboscopic methods – Resonance frequency meters – Power factor meters – Synchroscope – phase sequence indicators.

Symbols for instruments – Indian standards specifications Grading of Instruments – Classification.

References

1. Electrical Measurements and Measuring Instruments – Golding E.W, Wheeler and Co., 1991.
2. Electrical and Electronic Instrumentation and Measurements – Sawhney A.K, Dhanpat Rai and Co., 1992.
3. Modern Electronic Instrumentation and measurement Technique – Albert D. Helfrick and William D. Cooper, PHI, 1992.

ELECTRICAL MEASUREMENTS LAB

E 407 **0+0+4**

1. Extension of instrument range by using
    a. Shunt and multipliers
    b. Instrument transformers
2. Measurement of 3-phase power using
    a. Single watt meter
    b. Two watt meters
    c. Three-phase watt meter
3. Calibration of flux meter using
    a. Standard solenoid
    b. Hibbertz magnetic standard
4. Determination of BH characteristics
5. Hysterisis loop using CRO
6. Separation of core losses in a given magnetic specimen
7. (a) Study of Multi meter
   (b) Measurement of R, L, C using LCR Bridge
8. Measurement of resistance using
    a. Wheatstone Bridge
    b. Kelvin's Double bridge
    c. Voltmeter and Ammeter – calculation of error due to voltmeter resistance

9. Calibration of ammeter, voltmeter and wattmeter and measurement of resistance using
    a. Simple slide-wire potentiometer
    b. Vernier Potentiometer
    c. Precision slide-wire potentiometer
10. Calibration of ammeter, voltmeter, wattmeter and measurement of impedance using A.C Potentiometer
11. Measurement of self inductance, mutual inductance and coupling coefficient.
12. Calibration of single-phase Energy meter by
    a. Direct loading
    b. Phantom loading with and without using phase shifting transformer
13. Calibration of three-phase Energy meter by
    a. Direct loading
    b. Phantom loading
14. Efficiency measurement of Lamps using Lux meter
15. Measurement of displacement using LVDT
16. Measurement of different parameters using Trivectormeter

COMPUTER PROGRAMMING LAB

E 408 **0+0+4**

Part A
Familiarisation

1. Study of Operating systems like DOS, Windows, Linux etc; Commands for use of files and directories, internal commands, external commands etc.
2. Familiarisation with word processing packages like MS Word, PageMaker etc.
3. Familiarisation with spread sheet packages like MS Excel.

Part B
Programming Experiments in C

Programming experience in C to cover control structures, functions, arrays, structures, pointers and files in accordance with syllabus of E 405.

1. Summation of series
2. Preparation of Conversion tables
3. Solution of quadratic equations
4. Array manipulation
5. Functions
6. Recursive functions
7. String manipulation – compare, copy, reverse operations
8. Matrix operations
9. Stack operations and simple programs using linked lists
10. Tabulation of marks and declaration of results – input and output using files
11. Creation of numeric and text files, merging and appending of files.

Part C
Application of numerical methods

1. Solution of algebraic and transcendental equations: bisections, Newton- Raphson method.
2. Numerical Integration – Simpson's $1/3^{rd}$ rule.

FIFTH SEMESTER

ENGINEERING MATHEMATICS - IV

CMELPA 501 **3+1+ 0**

Module 1

Complex Integration: Line integral – Cauchy's integral theorem – Cauchy's integral formula – Taylor's series – Laurent's series – Zeroes and singularities – residues – residue theorem – evaluation of real integrals using contour integration involving unit circle and semi circle.

Module 2

Numerical Solution of algebraic and transcendental equations: Successive bisection method – Regula – Falsi method – Newton – Raphson method – solution of system of linear equation by Jacobi's iteration method and Gauss – Sidel method.

Module 3

Numerical solution of Ordinary Differential Equations: Taylor's series method – Euler's method – Modified Euler's method – Runga – Kutta method (IV order) Milne's predictor-corrector method.

Module 4

z - Transforms: Definition of z – transforms – properties – z-transform of polynomial functions – trigonometric functions, shifting property, convolution property – inverse transform – solution of first and second order difference equations with constant coefficients using z-transforms.

Module 5

Linear Programming: Graphical solution – solution using simplex method (non-degenerative only) – duality in LPT – balanced TP – Vogel's approximation method – Modi method.

References

1. Advanced Engg. Mathematics: Erwin Kreyszig, Wiley Eastern.
2. Numerical Methods in Engg. and Science : Grawal B. S, Khanna Publ.
3. Higher Engg. Mathematics: Grawal B. S, Khanna Publ.
4. Numerical Methods in Science and Engg.: M. K Venkataraman, National Publishing Co.

5. Quantitative techniques: Theory and Problems: P.C Tulsian and Vishal Pandey, Pearson Education Asia
6. Complex Variable and Applications: Churchill and Brown, McGrawHill
7. Engineering Mathematics Vol.3: S.Arumugam, A.T Issac and A.Somasundaram, Scitech Publ.
8. Advanced Mathematics for Engineering students Vol-3: S. Narayanan, T.K.M Pillai & G. Ramanaiah, S.Viswanathan Printers & Publ.
9. Operations Research: Paneer Selvam, PHI

DIGITAL CIRCUITS

E 502 **3+1+0**

Module 1

Number Systems and Codes: Arithmetic using signed and unsigned numbers- Floating point representation- Normalized floating point representation-Gray Codes, ASCII and EBCDIC code.

Logic gates: Elements of Boolean algebra- Logic operations- AND, OR, NOT, NAND, NOR, XOR gates- De Morgan's Theorem- Realisation of combinational circuits using SOP and POS forms - K-map up to 4 variables- Half adder, full adder circuits. Half subtraction and Full subtraction circuits.

Module 2

Logic Families: DTL, TTL and CMOS families- comparison of characteristics- TTL NAND gate internal circuit- TTL characteristics- sinking and sourcing- fan-in and fan-out – CMOS characteristics – CMOS NAND and NOR gates.

Decoders: BCD to decimal, BCD to 7 Segment decoders- Encoders- Multiplexer- Demultiplexer.

Module 3

Sequential Circuits: JK Flip-flops- SR JK, T and D flip-flops- buffers- Tri-state buffers- racing- JK master-slave FF. Truth table and excitation table- conversion of flip-flops from one type to another.

Asynchronous counters: Ripple counter- disadvantages-Decoding errors- maximum frequency of the counter – modulo N ripple counter using CLEAR and PRESET inputs. Asynchronous UP- DOWN counters.

Module 4

Synchronous Counters: Methods to improve counter speed- synchronous serial and parallel counters – synchronous counter design – modulo N counter design for completely specific count sequence – lockout, design without lockout – Synchronous UP/DOWN counters. Counter IC 7490.

Module 5

Shift Registers: SISO, PIPO, PISO, PIPO types – Universal shift registers.

Counters using Shift Registers: Ring counter – twisted ring counter- Design for self starting ring counter.

References

1. Digital Principles and Applications: Malvino & Leach, TMH
2. Digital Fundamentals: Thomas L. Floyd
3. Digital Integrated Electronics: Taub & Schilling, McGraw Hill Intl.
4. Digital Electronics and Microcomputers: R.K. Gaur, Dhanpat Rai & sons
5. Engineering Approach to Digital Design: Fletcher – EEE Edition

COMMUNICATION ENGINEERING

E 503 **2+1+0**

Module 1

Modulation: Need for modulation, Amplitude modulation–Definition- Mathematical representation - Frequency spectrum - Power relations. Principle of single side band transmission – Advantages - Disadvantages. Frequency modulation – Definition – Mathematical representation - Frequency spectrum, Comparison between FM and AM.

Module 2

Transmitter: AM transmitter – high level and low-level systems - functional description of each block. FM transmitter – FET & BJT modulator.

Receiver: AM receiver – TRF receiver – Limitations. Superhetrodyne receiver – block schematic, choice of IF, image signal rejection.

Module 3

Television: Composite video signal – synchronizing pulse – blanking pulse- equalizing pulse, Video BW, Positive and negative modulation, Vestigial side band transmission, Television standards, Block schematic of monochrome TV transmitter and receiver.

Colour Television: Compatibility, characteristics of colour transmission and reception, luminance, hue & saturation, colour difference signal, I & Q signals, frequency interleaving, colour sub carrier.

Module 4

Radar: Basic radar system, radar range equation – performance factors, Pulsed radar, Continuous wave radar – advantages-limitations-applications, CW radar, MTI radar system. Radio navigational aids – ILS – GCA.

Module 5

SATELLITE COMMUNICATION: Geo-synchronous satellites – advantages and disadvantages, uplink & downlink, multiple access techniques – Basic principles of FDMA, TDMA, DA-FDMA, DA-TDMA.

References

1. Electronic Communication Systems: George Kennedy, TMH
2. Electronic Communication Systems: Wayne Tomasi, Pearson Education, LPE
3. Monochrome and Colour Television: R.R Gulati, Wiley Eastern
4. Introduction to Radar Systems: Skoluik, McGraw Hill Intl.
5. Satellite Communications: D.C Agarwal, Khanna
6. Radio Engineering: Mithal, Khanna

INDUSTRIAL MANAGEMENT AND ENGINEERING ECONOMICS

E 504 **3+2+0**

PART A: INDUSTRIAL MANAGEMENT

Module 1

Modern Concepts of Management: Scientific management – functions of management – planning – organizing – staffing – directing – motivating – communicating – coordinating – controlling – Organisational structures – line, line and staff, and functional relationships – Span of control – delegation – Management by objectives.

Module 2

Personnel Management: Objectives and functions of personnel management – recruitment – selection and training of workers – labour welfare – industrial fatigue – Industrial disputes – Trade unions – Quality circles.

Formation of Companies: Proprietary – Partnership – joint stock companies – public sector – joint sector and cooperative sector.

Module 3

Marketing Management: Pricing – Promotion – Channels of distribution – Market research – Advertising.

Production Management: Batch and mass production – inventory control – EOQ – Project planning by PERT /CPM – Construction of network (Basic Ideas only)

References

1. Industrial Management: O.P. Khanna
2. Industrial Management: K.K Ahuja
3. Marketing Management: Philip Kotler

PART B: ENGINEERING ECONOMICS

Module 4

Theory of demand and supply – price mechanisms – factors of production – land, labour, capital and organisation – National income – Difficulties in estimation – Taxation – Direct and indirect taxes – Progressive and regressive – black money – inflation – Causes and consequences.

Module 5

Indian Financial System – Reserve bank of India – Functions – Commercial banking system –Development financial institutions – IDBI –ICICI – SIDBI – IRBI- NABARD – Investment institutions – UTI – Insurance companies – Indian capital market – Stock market – Functions – Role of the public sector – Privatisation – Multinational corporations and their impact on the Indian economy.

References

1. Indian Economy: A.N Agarwal
2. Modern Economic Theory: K.K. Dewett
3. Principles of Economics: K.P.M. Sundharam & M.C Vaish.

LINEAR INTEGRATED CIRCUITS

E 505 **2+1+0**

Module 1

Operational Amplifiers: Differential amplifier – block diagram of a typical op amp – characteristics of an ideal op-amp – definitions of CMRR – slew rate – input offset voltage – differential input resistance – input voltage range – SVRR – large signal voltage gain – output voltage swing – output resistance – open-loop configurations – disadvantages – closed-loop configurations – non inverting amplifier – voltage follower – inverting amplifier – summing and scaling amplifier – integrator – differentiator – logarithmic amplifier.

Module 2

Basic Comparator: Astable and mono stable multivibrators - Schmitt trigger – zero crossing detector – precision rectifier – peak detector – sample and hold circuit – function generator (no analysis).

Module 3

Active filters: First order low pass filter, high pass filter, band pass filter, band reject filter (twin T notch filter). D/A converter – binary weighted resistor type – ladder type – A/D converter – simultaneous A/D converter – counter type – successive approximation converter – dual-slope converter – Digital voltmeter.

Module 4

Phase-locked-loop: Basic principles of PLL – block diagram – transfer characteristics – applications of PLL as FM demodulator, AM demodulator and frequency multiplier.

Module 5

Timer: The 555 timer – functional block diagram – astable and mono-stable operation of 555 timers.

Regulated Power Supplies: Zener voltage regulator – series voltage regulator using transistors (analysis not required) – Series op-amp regulator – IC voltage regulator – 723/317 general purpose switching regulator.

References

1. Op-amp and Linear Integrated Circuits: Ramakant Gayakwad, Pearson Education Asia, 4/e, LPE
2. Integrated Electronics: Millman and Halkias
3. Integrated Circuits: Botkar K.R
4. Linear IC: Roy Choudhary
5. Op-amp and Linear IC: Robert F. Coughlin
6. Electronic Devices and Circuit Theory: Robert L. Boylestad and Louis Nashelsky

POWER ELECTRONICS

E 506 **2+1+ 0**

Module 1

Power Semiconductor Devices: Power diodes, Power Transistors, Power MOSFET, IGBTs, Diac, Triac, GTOs – static characteristics and principle of operation.

SCRs: Static and dynamic characteristics – two transistor analogy – gate characteristics

Module 2

SCR ratings and specifications - Device protection – heat sink selection – series and parallel operation of SCRs.

SCR Triggering circuits – R, RC, UJT triggering circuits – diac triggering circuit – single pulse, continuous pulse carrier frequency triggering – pulse transformer – amplification and isolation of SCR gate pulses.

Module 3

Phase control: single phase half wave controlled rectifier circuit – single phase full wave controlled rectifier circuit – R, RL Loads – free wheeling – half controlled and fully controlled bridge with continuous and steady current – Expression for output voltage – wave forms – active and reactive power – effect of source inductance – line commutated inverter – 3-phase half wave and full wave controlled rectifier – expression for output voltage.

Module 4

Commutation of SCRs – classification of commutation schemes

Inverters: series and parallel inverters – single phase and three phase bridge inverters (schematic diagrams and wave forms only) – Mc Murray Inverter – Basic Principle of PWM.

Module 5

Choppers: Basic principle – Classification – Type A, B, C, D and E. (Analysis not required)

Basic Principle of Cycloconverters.

Control Circuits: Generation of control pulses – block schematic of firing circuits – linear and cosine comparison – Digital firing scheme.

References

1. Power Electronics – Circuits, Devices and Applications, M.H. Rashid, PHI/Pearson Edn.
2. Power Electronic Systems – Theory and Design, Jai P. Agarwal, Pearson Education Asia, LPE
3. Power Electronics, P.S Bhimbhra, Khanna publ., New Delhi
4. A Text Book of Power Electronics, S.N Singh, Dhanpat Rai & Co, 2000

5. Power Electronics – Converters, Applications and Design, Mohan N, Undeland T.M and Robbins W.P, John Wiley -1989
6. Power Electronics, Harish C. Rai, Galgotia Publ.

ELECTRICAL MACHINES LAB - I

E 507 **0+0+4**

D.C. Machines

1. Study of 3-point and 4-point starters for D.C machines – mode of connection – protective arrangements
2. OCC of self and separately excited D.C machines – critical resistances of various speeds. Voltage built-up with a given field circuit resistance. Critical speed for a given field circuit resistance
3. Load test on shunt and compound generator – deduce external, internal and armature reaction characteristics. Find load critical resistance.
4. Characteristics of D.C series machine as motor and generator.
5. Swineburne's and retardation test on D.C machines.
6. Brake test on D.C shunt, compound motors and determination o characteristics.
7. Hopkinson's test on a pair of D.C machines.
8. Separation of losses in a D.C machine.
9. Field's test on D.C machine.

Transformers

10. Polarity, transformation ratio, tests of single phase units and star-delta combination for 3-phase operation.
11. O.C and S.C tests on single phase transformers – calculation of performance using equivalent circuit – efficiency, regulation at unity, lagging and leading power factors. Verification by direct loading.
12. Sumpner's test on single phase transformers.
13. O.C and S.C tests on three-phase transformers.
14. Scott connection – check for 2 phase – predetermination of primary current for balanced and unbalanced secondary currents – verification by actual loading.
15. Parallel operation and load sharing of two single phase dissimilar transformers.
16. Separation of losses of single phase transformer into Hysterisis and eddy current losses.
17. Paralleling of Three-phase transformers and load sharing.
18. Auto transformer – equivalent circuit.

ELECTRONIC CIRCUITS LAB

E 508 **0+0+4**

1. Design and testing of clipping, clamping, RC integrator and differentiator circuits – Display of Transfer characteristics on CRO.
2. Design and testing of rectifier circuits – Half wave – Full wave (centre – tapped and bridge) circuits. Filter circuits.
3. Zener regulator design and testing.
4. BJT, FET and UJT characteristics.
5. Design and testing of CE amplifier – frequency response.
6. Design and testing of RC coupled and feedback amplifiers.
7. FET amplifier.
8. Sweep circuits – UJT and BJT based sweep generators – sweep circuit using constant current source (BJT).
9. Design and Testing of RC phase-shift Oscillator and LC Oscillator.
10. Design and Testing of Astable and Bi-stable Multi-vibrators.
11. Relay driving circuit using transistors.
12. Study of IC power amplifiers.

Optional

Simulation of the above circuits using EDA tools like pSPICE.
(Any experiment relevant to E 403 may be added)

References

1. Electronic Principles: A.P. Malvino – TMH
2. Electronic Devices: Floyd – Pearson Education, LPE
3. Electronic Devices and Circuit Theory: Robert L. Boylestad and Louis Nashelsky, Pearson Education Asia, LPE.

SIXTH SEMESTER

CONTROL SYSTEMS - I

E 601 **3+1+0**

Module 1

Introduction: Concept of a system – control system – open-loop system – levels of sophistication in a control system – mathematical model of physical systems – plant representation – transfer functions – block diagrams – signal flow graphs – effects of feedback on parameter variations, system dynamics and disturbance signals.

Module 2

Time response analysis: Type and order of a system – time domain analysis of systems – typical test input signals – response of first order systems to unit step, unit ramp, and unit impulse signals – step response of second order systems – performance characteristics of feed back control systems – time domain behaviour from pole-zero plot

Steady state errors and error constants – generalized error constants – improvement of performance by derivative control, integral control, PID control.

Module 3

Concepts of Stability: BIBO stability – asymptotic stability – Routh Hurwitz stability criterion – relative stability – root locus technique – construction of root loci – root contours – systems with transportation lag.

Module 4

Frequency response analysis: Correlation between time and frequency response – polar plots – bode plots – relative stability – phase margin and gain margin – minimum and non-minimum phase systems.

Module 5

Stability in Frequency domain: Nyquist stability criterion – relative stability.

Control System Components: synchros – resolvers – rotating amplifiers – magnetic amplifier – Amplidyne – Tachogenerators – DC and AC servo motors – Gyroscopes – stepper motor.

References

1. Modern Control Engineering: Katsuhiko Ogatta, Pearson Education Asia

2. Analog and Digital Control System Design: Chi Tsong Chen, Oxford University Press
3. Modern Control Systems: Dorf and Bishop, Addison Wesley, LPE, 9th Ed.
4. Control System Design & Principles: M. Gopal, TMH

ELECTRICAL MACHINES - II

E 602 **3+1+0**

Module 1

Synchronous Machines: Types – selection of alternators – constructional features of cylindrical and salient pole machines.

Armature windings: different types – phase grouping – single and double layer, integral and fractional slot winding – emf equation – distribution factor – coil span factor – tooth harmonic ripples – skewed slots – harmonics, elimination of harmonics – revolving magnetic field.

Module 2

Armature Reaction – Synchronous reactance – circuit model of synchronous machine.

Regulation – predetermination – emf, mmf and potier methods, saturated synchronous reactance – Phasor diagrams – short circuit ratio – two-reaction theory – Phasor diagram – slip test – measurement of X_d, X_q, losses and efficiency of synchronous machines.

Module 3

Parallel operation of alternators – load sharing – synchronising power and torque – governor characteristics – method of synchronising – synchroscope.

Synchronous Motor: Principles of operation – torque and power relationships – Phasor diagram – hunting in synchronous machines – damper winding – starting of synchronous motors.

Module 4

Synchronous machines connected to infinite bus – power angle characteristics of cylindrical rotor and salient pole machines – reluctance power – steady state stability limit – V-curves – inverted V-curves – O-curves – synchronous condenser – symmetrical short circuit of unloaded alternators – steady state, transient and sub-transient reactance – current variation during short circuit.

Module 5

Generalised Machine Theory: Dynamic representation of generalised machines – formation of emf equation – expression of power and torque – representation of DC machines – synchronous machine and Induction motor.

Excitation systems: different types – comparison – exciter ceiling voltage – excitation limits – exciter response – methods of increasing the response of an exciter.

Brushless Alternators: Principle of operation constructional features – excitation methods – voltage regulation.

References

1. The performance and Design of AC Machines: M.G. Say
2. Theory of Alternating Current Machinery: Alexander Langsdorf
3. A course in Electrical Engg. Vol.2: C.L Dawes
4. Power System Stability – Vol. 3: E.W Kimbark
5. Electrical Machines: P.S Bhimbra
6. Generalised Theory of Electrical machines: P. S Bhimbra
7. Theory and performance Electrical Machines: J.B Gupta

ELECTRICAL POWER TRANSMISSION

E 603 **3+1+0**

Module 1

Transmission Line Constants: Resistance – skin effect – proximity effect.

Inductance of single phase line – inductance of three phase line with symmetrical and unsymmetrical spacing – transposed line.

Capacitance of single phase line – capacitance of three phase line with symmetrical and unsymmetrical spacing – transposed lines – effect of earth on line capacitance – geometric mean distance – geometric mean radius

Module 2

Overhead Lines: Mechanical characteristics - Conductor – bundled conductors – line supports – spacing between conductors – sag and tension calculations – effect of ice and wind - sag at the time of erection – vibration and dampers

Line insulators: Different types – pin type – suspension type – strain type – potential distribution of a string of suspension insulator – string efficiency – equalization of potential – testing of insulators

Module 3

Performance of Transmission Lines: Classification of transmission lines – analysis of short lines- medium line by nominal pi and T methods – rigorous solution of long lines – A, B, C, D constants – Ferranti effect – losses in an open circuited line – power flow through transmission lines

Voltage Control: Different methods – static capacitor – tap changing transformer – booster transformer – phase modifier – power circle diagram – calculation

Module 4

Corona: Critical disruptive voltage – visual critical voltage – power loss – factors affecting – methods to reduce corona – radio interference effect

Substations: Types - general layout - neutral grounding – resistance earthing – reactance earthing – arc suppression coil earthing – grounding transformer - Power system earthing - measurement of earthing resistance

Module 5

Extra High Voltage Transmission: Need for EHV transmission – limitations of EHV AC transmission – requirements of EHV lines - reactive compensation in EHV systems – EHV systems in India.

HVDC Transmission - Advantages and disadvantages – Graetz circuit – inversion – kinds of d.c. links – economic distance of DC transmission

References

1. Modern Power System Analysis: Nagrath and Kothari, TMH
2. Electrical Power Systems: C. L. Wadhwa, New Age Int'l
3. Electrical Power: Uppal
4. A Course in Electrical Power Systems: Soni, Gupta, Bhatnagar
5. HVDC Power Transmission System: K. R. Padiyar
6. Power System Analysis: Bergen, Pearson, 2/e

DIGITAL SIGNAL PROCESSING

E 604 **2+1+0**

Module 1

Introduction: Elements of a Digital Processing System - Advantages of Digital over Analog Signal Processing. Applications of DSP.

Discrete-Time Signals and Systems: Elementary Discrete-Time Signals-Classification of Discrete-Time Systems - LTIV systems- -Causality, Stability.

Frequency Domain representation of discrete-time signals: Fourier transform of a sequence - properties of Fourier Transforms.

Module 2

Discrete Fourier Transform: Properties of DFT-Linearity-shifting property, symmetry property, Convolution of a sequence. Fast Fourier Transform Decimation-in time radix- two FFT- decimation in frequency radix-two FFT.

Module 3

Review of z transforms: inverse z-transform - properties of z- transforms.

Realisation of digital filters: Direct and cascaded structures for FIR filters - direct and cascade and parallel structures for IIR filters.

Module 4

FIR filters: characteristics of practical frequency selective filters-characteristics of FIR filters with linear phase - design of linear phase FIR filters using windows-rectangular, Hamming, Hanning and Kaiser windows, FIR filter design using frequency sampling.

Module 5

IIR filters: Properties of IIR filters-design of IIR digital filters from analog filters-Butterworth design-Chebyshev design - impulses invariant transformation-Bilinear transformation.

DSP chips: TMS 320C family - features and block schematic of simplified architecture.

References

1. Digital Signal Processing – Alan V. Oppenheim and Ronald W. Schafer, Pearson Education Asia, LPE
2. Digital Signal Processing - John G. Proakis and Dimitris G. Manolakis
3. Digital Signal Processing: A Practical Approach – Emmanuel C. Ifeachor and Barrie W. Jervis, Pearson Education Asia, LPE
4. An Introduction to Digital Signal Processing: Johny R. Johnson

MICROPROCESSORS AND APPLICATIONS

E 605 **3+1+ 0**

Module 1

Evolution of Processors – single chip microcomputer – Intel 8085 Microprocessor – signals – architecture of 8085 – ALU – register organisation – timing and

control unit – microprocessor operations – instruction cycle – fetch, decode and execute operation – T-state, machine cycle and instruction cycle – timing diagram of opcode fetch, memory read, I/O read, memory write and I/O write cycles – wait state.

Module 2

Instruction set of 8085: Classification of instructions – different addressing modes – writing assembly language programs – typical examples like 8 bit and 16 bit arithmetic operations, finding the sum of a data array, finding the largest and smallest number in a data array, arranging a data array in ascending and descending order, finding square from look-up table. Counters and time delays – delay using one register, two registers and register pair.

Module 3

Stack and Subroutines: Stack pointer – stack operations – call-return sequence – examples

Interrupts of 8085: restart instructions – interrupt structure of 8085 – vectored locations – SIM and RIM instructions – software and hardware polling.

Module 4

Memory interfacing **-** ROM and RAM – interfacing I/O devices – address space partitioning – memory mapped I/O and I/O mapped I/O schemes – interfacing I/Os using decoders – the 8212 I/O device – interfacing LED and matrix keyboard – programmable peripheral devices – 8155 and 8255, block diagram, programming simple input and output ports.

Module 5

Different data transfer schemes: synchronous and asynchronous data transfer – programmed and interrupt driven data transfer.

Applications of microprocessor in system design: interfacing ADC 0808 – interfacing DAC 0800. DMA controller 8257-Interfacing of stepper motor – interfacing of 8279 keyboard /display controller- 8275 CRT controller.

Architecture and operation of 8086.

References

1. Microprocessor Architecture, Programming and Applications: R.S. Gaonkar, Penram Intl'
2. Fundamentals of Microprocessors and Microcomputers: B. Ram, Dhanpat Rai and Sons
3. 0000 to 8085: Introduction to Microprocessors and Engineers: P.K Ghosh, PHI
4. Microprocessors and Digital Systems: Douglas V. Hall, McGraw Hill
5. Introduction to Microprocessors: A.P Mathur, TMH
6. Digital Electronics and Microprocessors: Malvino, TMH

COMPUTER ORGANISATION

E 606 **2+0+ 0**

Module 1

Introduction: Functional block diagram of digital computer – processor organization – typical operation cycle: fetch, decode and execute – microprogrammed Vs hardwired control (basic concepts only) – bus structures.

Module 2

Arithmetic and Logic unit: Adders- serial and parallel adders- fast adders- carry look ahead adder- 2's complement adder/subtractor- multiplication and division operations (description using block schematic diagrams only)-design of Logic unit-one stage ALU.

Module 3

Memory System: memory parameters – main memory – cache memory – auxiliary memory – semiconductor RAM – Static RAM –Dynamic RAM – ROM – PROM – EPROM – E^2PROM – Flash Memory.

Programmable Logic Devices: PAL, PLA, FPLA, Applications.

Module 4

Memory Organisation: Internal Organisation of memory chips – cache memory – mapping functions – direct mapping – associative mapping – set associative mapping – memory interleaving – Hit and miss – virtual memory – organization – Address translation.

Module 5

Input/Output Organisation: access to I/O Devices – Interrupts – Enabling and Disabling of Interrupts – Handling multiple devices –Buses – Synchronous and Asynchronous buses.

Data Communication interfaces and standards: parallel and serial ports – RS232, RS423 serial bus standards –GPIB IEEE488 Instrumentation bus standard- PCI, SCSI, USB (basic ideas only).

References

1. Computer Organisation: V. Hamacher – Mc Graw Hill
2. Logic and Computer Design Fundamentals: M. Morris Mano
3. 2/e Pearson Computer Organisation and Design: P. Pal Chaudhari – PHI
4. Digital Computer Fundamentals: Thomas Bastee

DIGITAL LAB

E 607 **0+0+4**

1. Study of TTL gates
2. Characteristics of TTL gates
3. Realisation of sequential circuits
4. Study of SR. JK, D, T and JK Master-Slave Flip Flops
5. Study of seven segment display
6. Testing of different shift registers
7. Design and Testing of decoders and encoders
8. Design and testing of astable and mono-stable multivibrator using 555
9. Design and testing asynchronous and synchronous counters and modulo N counter
10. Design and testing of counters using shift registers
11. Realisation of ADC and DAC
12. Testing of arithmetic circuits using op-amps
13. Design and testing of square wave generation using op-amps
14. Study of IC Regulator Power supplies

SYSTEMS LAB

E 608 **0+0+4**

1. 8085 assembly language programming experiments
    a. 8-bit and 16 bit arithmetic operations
    b. Arranging a data array in descending and ascending order
    c. BCD to binary and binary to BCD conversion
    d. Finding square root of a number
    e. Finding out square root of a number using look-up table
    f. Setting up time delay and square wave generation
    g. Interfacing of LEDs, 7 segment displays
    h. Traffic control signals
    i. Interfacing of stepper motor
    j. Interfacing of ADC
    k. Interfacing of DAC
    l. Generation of firing pulses for SCR.
    m. Interfacing of Power devices

    n. Interfacing LCD displays
2. VCO circuits using IC 566, 4046B etc.
3. PLL systems using IC 565, 4046B etc.
4. Multiplexed Displays

SEVENTH SEMESTER

ELECTRICAL MACHINES - III

E 701 **3+1+ 0**

Module 1

Three phase Induction Motor: Construction – squirrel cage and slip-ring motor – principle of operation – slip and frequency of rotor current – mechanical power and developed torque – Phasor diagram – torque slip curve – pull out torque – losses and efficiency.

No load and locked rotor tests – equivalent circuit – performance calculation from equivalent circuit – circle diagram – operating characteristics from circle diagram – cogging and crawling and methods of elimination

Module 2

Starting of three phase squirrel cage induction motor – direct online starting – auto transformer – star-delta starting – starting of slip-ring motor – design of rotor rheostat – variation of starting torque with rotor resistance.

Speed control – pole changing – rotor resistance control – frequency control – static frequency conversion – Applications of Induction machines – single phasing – analysis using symmetrical components.

Module 3

Induction Generator: Theory – Phasor diagram – equivalent circuit - **Synchronous Induction motor**: – construction – rotor winding connections – circle diagram – pulling into step.

Single phase Induction motor: revolving field theory – equivalent circuit – torque slip curve – starting methods – split phase, capacitor start-capacitor run and shaded pole motors.

Module 4

Single phase Series Motor: Theory – Phasor diagram – circle diagram – compensation and interpole winding – Universal motor

Repulsion Motor: torque production – Phasor diagram – compensated type of motors – repulsion start and repulsion run induction motor – applications

Reluctance motor – Hysterisis motor

Module 5

Deep bar and double cage induction motor – equivalent circuit – torque slip curve – Commutator motors – principle and theory – emf induced in a commutator winding - - Poly-phase commutator motors – three phase series and shunt type – Schrage motor – characteristics – applications – use of commutator machines as frequency converters, phase advancers – expedor type and susceptor type –

Walker and Scherbius advancers – Linear Induction motor – operation and application

References

1. Performance and Design of AC machines – M.G Say
2. Theory of Alternating Current machines - Alexander Lagnsdorf
3. A.C Commutator motor – Openshaw Taylor
4. Alternating Current machines – Puchstein & Lloyd

ELECTRICAL DRIVES AND CONTROL

E 702 **2+1+0**

Module 1

DC motors: Methods of Speed control – single phase rectifiers with motor load- single phase fully controlled bridge rectifier drives – half controlled bridge rectifier drives – freewheeling with regeneration – speed torque characteristics – power in load and source circuits

Module 2

3 Phase fully controlled bridge rectifier drives – free wheeling, freewheeling with regeneration – Dual converter fed DC motor drives – chopper fed drives – single, two and four quadrant chopper drives

Module 3

(**Qualitative treatment only)**

Speed control of 3 Phase induction motors – stator voltage control – principle – controller configurations – operation and applications

Slip power recovery scheme – principle – static Kramer's drive – static Scherbius' drive – applications

V/f control – constant torque and constant power control

Module 4

(**Qualitative treatment only**)

Voltage Source Inverter – Application to induction motor drives – v/f, e/f, flux weakening schemes of control – applications

PWM inverter drive

Current Source Inverter – application to induction motor drives – operation under fixed frequency – operation under variable frequency – applications

Module 5

(**Qualitative treatment only**)

Speed control of synchronous motors – adjustable frequency operation of synchronous motors – principles of synchronous motor control – Voltage Source Inverter Drive with open loop control – self controlled synchronous motor with electronic commutation – self controlled synchronous motor drive using load commutated thyristor inverter.

Principle of Vector control

References

1. Power Electronic Control of AC motors – J.M.D Murphy and F.G Turnbill, Pergumon Press 1988
2. Power Semiconductor controlled Drives – G.K Dubey, Prentice hall, 1989
3. Modern Power Electronics and AC Drives – Bose B.K, Pearson Education Asia -2002
4. Electric Drives – N.K De and P.K Sen, PHI New Delhi 2001

5. Power Electronics – M.D Singh and K.B Khanchandani, TMH, 1998
6. Mohammad A and E.L Sharkaw – Fundamentals of Electric Drives – Thomson Learning
7. Power Semiconductor Drives – Vedam Subramaniam, TMH

UTILISATION OF ELECTRICAL POWER

E 703 **2+1+0**

Module 1

Electric Drives: Advantages of Electric drives – factors affecting choice of motors – mechanical characteristic of DC and AC motors – motors for particular applications llike textile mill, steel mill, paper mill, mine, hoists, cranes – size and rating of motors.

Electrical Braking – plugging – dynamic and regenerative braking – energy returned to the mains

Module 2

Electric Traction: Advantages and disadvantage - speed time curves – analysis using trapezoidal speed time curve - mechanics of train movement – tractive effort – specific energy consumption – factors affecting specific energy consumption - train resistance – adhesive weight – coefficient of adhesion - traction motor & characteristics

Series-parallel control of D.C. series motor – shunt and bridge transition - energy saving by series parallel control.

Module 3

Electric Heating and Welding: Electric heating – resistance types – design of heating element – induction heating – types of high frequency heating – dielectric heating – methods of high frequency generation – direct and indirect arc furnaces – power supply and control for different types of arc furnaces – application.

Electric welding – resistance welding – arc welding – electronic welding control

Module 4

Illumination: Review of definitions and laws of illumination – requirements of good lighting -polar curves – Rousseau's construction - lighting calculation – design of interior and exterior lighting system - factory lighting – flood lighting – street lighting.

Refrigeration and Air Conditioning: Types of refrigeration and air conditioning systems – refrigerants – no frost refrigeration – trouble shooting – working of electrical systems – protection of motors.

Module 5

Energy Management: Necessity for Energy Management – Energy Saving – adopting non-conventional sources – Energy Management techniques (case study) applied to 1) Residential Buildings, 2) Industries/Organisations – Energy auditing

References

1. Utilisation of Electrical Energy: Openshaw Taylor
2. A Course in Electrical Power: Soni Gupta

3. Generation, Distribution & Utilization: C.L Wadhwa
4. Utilisation of Electric Power: N.V Suryanarayana, New Age Int'l.
5. Energy Conservation Handbook: Utility publication

CONTROL SYSTEMS - II

E 704 **3+1+0**

Module 1

Compensation and design of Control Systems: cascade compensation – lag, lead and lag-lead compensators – frequency domain methods – Bode plot method – Root-locus methods

Module 2

Digital Control Systems: the process of sampling – sample and hold circuits – Review of z transforms and its properties – solving difference equation by z transform methods – inverse z transform – the pulse transfer function – response between sampling instants – system characteristic equation – Jury's stability test.

Module 3

Non-Linear Control Systems: Common physical non linearities – the phase plane method – basic concepts – describing functions of saturation, dead zone non linearities – stability analysis using describing functions.

Module 4

State Variable Approach: state space representation – block diagram representation of linear system in state variable form – non uniqueness of the set of state variables – Eigen values of an n X n matrix – eigen vectors – transfer function – solution of homogeneous state equation – state transition matrix.

Module 5

State equations from transfer function – decomposition of transfer function – controllability and observability - pole placement compensation – state variable approach to discrete data system – vector matrix difference equation – solution of the general linear time invariant systems – vector matrix difference equation

References

1. Modern Control Engineering – Katsuhiko Ogatta, Pearson Education Asia/PHI
2. Modern Control Systems –Dorf and Bishop, Pearson Education Asia
3. Analog and digital Control System Design – Chi Tsong Chen, Oxford University Press
4. Discrete Time Control of Dynamic Systems – Katsuhiko Ogatta, Pearson Education Asia
5. Digital Control of Dynamic Systems – G.F Franklin, J. David Powell and Michael Workman, Pearson Education Asia

SYSTEM DESIGN WITH MICROCONTROLLERS

E 705 **2+1+0**

Module 1

Microcontrollers and Microprocessors - Comparison.

Intel 8051: Architecture–Block diagram-Oscillator and Clock-Internal Registers-Program Counter-PSW-Register Banks-Input and Output ports-Internal and External memory, Counters and Timers, Serial data I/O- Interrupts-SFRs.

Module 2

Programming of 8051: Instruction syntax-Types of instructions–Moving data-Arithmetic Instructions-Jump and Call Instructions-Logical Instructions-Single Bit Instructions.

Arithmetic programs. Timing subroutines –Software time delay- Software polled timer- Addressing Modes

Module 3

I/O Programming: Timer/Counter Programming-Interrupts Programming- Timer and external Interrupts- Serial Communication- Different character transmission techniques using time delay, polling and interrupt driven-Receiving serial data – polling for received data, interrupt driven data reception.

Module 4

Microcontroller system design: External memory and Memory Address Decoding for EPROM and RAM. Interfacing keyboard. 7 segment display and LCD display. Interfacing of ADC (0808) and DAC (808) to 8051.

Module 5

Designing a stand alone Microcontroller system: Typical system design examples (Block-Diagram level only) - Data acquisition system- Measurement of frequency - Temperature control

Introduction to PLCs: Basic configuration of PLCs

Text Books

1. The 8051 Microcontroller and Embedded Systems – Muhammad Ali Mazidi and Janice Gillispie Mazidi, Pearson Education Asia.
2. The 8051 Microcontroller – Architecture, Programming and Applications – Kenneth J. Ayala, Penram International Publishing (India), Second Ed.

Reference

1. Intel Data Book on MCS 51 family

Web Reference

1. www.intel.com

ELECTIVE - I

E 706 **3+1+0**

List of Electives

E 706.1 CMELR Optimisation Techniques (Common to all branches)
E 706.2 HVDC Engineering
E 706.3 Neural Networks
E 706.4 Object Oriented Programming
E 706.5 Biomedical Instrumentation

Note

New Electives may be added according to the needs of emerging fields of technology. The name of the elective and its syllabus should be submitted to the University before the course is offered.

OPTIMIZATION TECHNIQUES

CMLRTA 706-1

Module l

Classical optimization techniques: Single variable optimization - Multivariable optimization with no constraints - Hessian matrix - Multivariable saddle point - Optimization with equality constraints - Lagrange multiplier method.

Module 2

Constrained multivariable optimization: Multivariable optimization with inequality constraints - Kuhn-Tucker conditions - Convex programming problem - Quadratic programming.

Module 3

One-dimensional unconstrained minimization: Elimination methods - unrestricted search method - Fibonacci method -Interpolation methods - Quadratic interpolation and cubic interpolation methods.

Module 4

Unconstrained minimization: Gradient of a function - Steepest descent method - Newton's method -Powells method - Hooke and Jeeve's method.

Module 5

Integer - Linear programming problem: Gomory's cutting plane method - Gomory's method for all integer programming problems, mixed integer programming problems.

References

1. Optimization theory and application - S.S. Rao, New Age International P. Ltd.
2. Optimization Concepts and applications in Engineering - A. D. Belegundu, T.R. Chandrupatla, Pearson Education Asia.
3. Principles of Operations Research for Management - F. S. Budnick, D. McLeavey, R. Mojena, Richard D. Irwin, INC.
4. Operation Research an introduction - H. A Taha, Eastern Economy Edition.

HVDC ENGINEERING

E 706-2

Module 1

Introduction: Comparison of AC, DC transmission – Description of DC transmission systems – modern trends in thyristor valves – Pulse number of converters – choice of converter configuration – Review of Graetz circuit – Valve rating – Transformer rating – Simplified analysis of Graetz circuit without overlap only.

Module 2

HVDC System Control: principles of DC link control – converter control characteristics – system control hierarchy – firing angle control – individual phase control and equidistant phase control – comparison – advantages and

disadvantages – current and extinction angle control – starting and stopping of DC link – power control

Module 3

Converter faults and protection: types of faults – commutation failure –arc through and misfire – protection against over currents – over voltages – surge arresters – protection against over voltages

Module 4

Harmonics and filters: Sources of harmonics in HVDC systems - Smoothing reactors – Corona and radio interference effects – harmonic distortion factor (derivation not required) – types of AC filters – DC filters (design not required)

Module 5

Multi-terminal DC systems: applications of MTDC systems – types – comparison.

Reactive power control: sources of reactive power – static VAR systems – TCR configuration (analysis not required) – Typical control system (block diagram only) for a TCR – operation of Thyristor switched capacitor

Text Book

1. HVDC Power Transmission Systems-Technology and System Interactions: K.R Padiyar, New Age Int'l.

Reference

1. Direct Current Transmission Vol 1: E.W Kimbark, Wiley

NEURAL NETWORKS

E 706-3

Module 1

Introduction: Principles -Artificial neuron - activation functions -Sing|e layer and Multilayer networks - Training artificial neural networks - Perception - Representation - Linear Separability - Learning - Training algorithms.

Module2

Back propogation: Taining Algorithim - Application - Network Configurations - Network Paralysis - Local Minima - Temporal instability.

Module 3

Counter Propogation Networks: Kebenone layer - Training the cohenen layer - Pre initialising the weight vectors - statistical properties Training the Grosbery layer - Full counter propagation network - Application.

Module 4

Statistical Methods: Boltzmann's Training - Cauchy training - Artificial specific heat methods - applications to general non-linear optimization problems

Module 5

Hopfield nets: Recurrent networks - stability - Associative memory-applications - Thermo dynamic systems - Statistical Hopfield networks -Bidirectional associative memories - Continuous BAM - Adaptive resonance theory - Architeture classification - implimentation.

Text Book

1. Neural Computing & Practice - Philip D. Wasserman,

References

1. Adaptive pattern Recognition & Neural Networks - Pay Y.H.
2. An Introduction to neural computing - Chaoman & Hall
3. Artificial Neural Networks - Kishan Mehrota and Etal

OBJECT ORIENTED PROGRAMMING

E 706-4

Module 1

OOP concepts: Objects-classes-data abstraction-data encapsulation-inheritance-polymorphism-dynamic binding-comparison of OOP and Procedure oriented programming-object oriented languages.

OOP using C++: Classes and objects-class declaration-data members and member functions-private and public members-member function definition-inline functions-creating objects-accessing class members.

Module 2

Arrays of objects-objects as function arguments-pass by value-reference variables/aliases-pass by reference-function returning objects-static class members.

Constructors and destructors -declaration, definition and use-default, parameterized and copy constructors-constructor overloading.

Module 3

Polymorphism: function overloading-declaration and definition-calling overloaded functions. Friend classes-friend functions-operator overloading-overloading unary - overloading binary operators- use of friend functions

Module 4

Inheritance: different forms of inheritance-base class-derived class-visibility modes-single inheritance-characteristics of derived class-abstract class

File handling in C++: file stream classes-file pointers-open (), close (), read (), write () functions-detecting end of file.

Module 5

Dynamic memory allocation: pointer variables-pointers to objects-new and delete operators-accessing member functions using object pointers-'this' pointer. **Run time polymorphism:** pointers to base class-pointers to derived class-virtual functions-dynamic binding.

References

1. Object Oriented Programming with C++ - Balagurusamy, McGraw Hill
2. Object Oriented Programming in Turbo C++ - Robert Lafore ,Galgotia Publications
3. C++Programming Language - Bjame Stroustrup, Addison Wesley

4. C++ primer -Stanely B.Lippman, PearsonEducation,Asia
5. Data Abstraction and OOP in C++ - Gordenkeith
6. Object Oriented Analysis & Design - Grady Booch, Addison Wesley

BIOMEDICAL INSTRUMENTATION

E706-5

Module 1

Physiology and generation of bio electric potential Cell Potentials stimulation and thresholds-Action potentials-propagation of action potentials-sodium pump-electro physiology of cardio pulmonary systems - Respiration and circulation - Cardio vascular system - Heart electro cardiogram - Measurement and analysis of EGG waveform-ECG recorder principles-block schematic of ECG recorder.

Module 2

Blood pressure-Characteristics of blood flow-Heart sounds Measurement of blood pressure-Direct and indirect methods-Pacemakers defibrillators- PH of blood- ESR and GSR- Temperature measurement of various parts.

Module 3

Respiratory system-measurement of respiration rate-Measurement of CO2 and O2 of exhaled air-Respiratory therapy equipment-inhalators, ventilators and respirators.

Module 4

Central Nervous systems-Anatomy of Nervous system-neuronal communication-Organisation of brain-Neuronal receptors-somatic nervous systems and spinal reflexes-EEG measurement and characteristic of sleep.

Module 5

Modern imaging systems – X ray machine – computer tomography – magnetic resonance imaging system – NMR components – ultrasonic imaging systems – Therapeutic equipments – dialysers – surgical diathermy machines – laser applications – physiotherapy and electro therapy equipments

References

1. Handbook of Biomedical instrumentation – R.S Khandpur
2. Medical and Clinical Engg. – Brtil Jacobson and John G
3. Biomedical Instrumentation and Measurements – Leslic Cromwell, F.J Weibel

ELECTRICAL DRAWING

E 707 **0+0+3**

PART A

DC Winding

1. Lap winding with equalizer rings.
2. Wave winding, dummy coils.

DC Machines

1. Dimensioned sketches of (a) front and end views of armature (b) commutator (c) brush holders (d) slot details.
2. Dimensioned sketches of yoke and pole assembly.
3. Dimensioned sketches of front and side views of an assembled medium size D.C machine.

Transformers

1. Sections of core type transformer limbs.
2. Dimensioned sketch (external view) of a distribution transformer with all accessories.
3. (a) Dimensioned sketch of sections of transformer limb.
   (b) Assembled sectional view of Power transformer.

PART B

AC Winding

Three – phase AC winding

1. Integral slot lap winding
2. Short chorded winding
3. Fractional slot winding
4. Mush winding

AC machines

Dimensioned sketches of parts and assembled views of

1. Salient pole alternator
2. Cylindrical rotor alternator
3. Dimensioned sketches of parts and assembled views of
4. Squirrel cage induction motor
5. Slip ring Induction motor

References

1. Electrical Engineering Drawing - S. K Bhattacharya
2. Electrical Engineering Drawing – K.L. Narang
3. Electrical Machine Design – A.K Sawhney

(University Examination Pattern: 3 questions from Part A, of which any two must be answered, and 3 questions from part B of which any two must be answered. All questions carry 25 marks each).

CONTROL AND POWER ELECTRONICS LAB

E 708 **0+0+4**

Part A: Control Systems Lab

1. Transfer Function of Separately excited DC generator
2. Transfer Function of Field-Controlled DC motor
3. Transfer Function of Armature-Controlled DC motor
4. Amplidyne characteristics and transfer function
5. Voltage regulation of DC generator using Amplidyne
6. Synchro characteristics, error detection and data transmission, differential Synchro
7. AC servo motor – speed transfer characteristics

8. Step and sinusoidal response of RLC circuits
9. Study of PID controller – design and experimental determination of frequency response of lag and lead networks
10. D.C servo motor position control system
11. Use of MATLAB for simulating transfer functions, closed-loop systems etc.

Part B: Power Electronics Lab

1. Study of V-I characteristic of SCRS triac.
2. Study of BJT, IGBT, GTO & MOSFET.
3. R, RC and UJT firing circuits for the control of SCRS.
4. Design and implementation of Ramp-Comparator and digital firing scheme for simple SCR circuits.
5. Automatic lighting control with SCRs and optoelectronic components.
6. AC phase control using SCR and Triac.
7. Speed control of DC motor using choppers and converters.
8. Generation and study the PWM control signal for Single phase dc to ac inverter.
9. Study and use of the single phase half controlled & fully controlled AC to DC Converter and effect of firing angle control on load voltage & wave Forms.
10. Study and use of back to back connected SCR/ triac Controlled AC Voltage controller and its wave forms with Variation of firing angle.
11. Study & use chopper circuit for the control of DC Voltage using (1) Pulse width control (2) Frequency Control.
12. Study of Single Phase inverter and its wave form.
13. Study of Three Phase firing circuit with synchronisation, and testing with three phase AC to DC bridge converter. Testing of wave forms of digital firing modules.
14. Study and Testing of a Three Phase bridge inverter with different types of loads.
15. Simulation of gating circuits and simple converter circuits.

PROJECT AND SEMINAR

E 709/E808

Each student is required to present a technical paper on a subject approved by the department. The paper should be in general reflecting the state-of-the-art. He/she shall submit a report of the paper presented to the department.

In addition to the seminar he/she shall undertake a project work (as a team or individually) in the 7^{th} semester itself in consultation with the Guides. On completion of the project work, he/she shall present the work done before a panel of staff members, and submit a report of the project work, and submit a report of the project work done to the department.

EIGHTH SEMESTER

POWER SYSTEM ANALYSIS

E 801 **3+1+0**

Module 1

Power System Model: Representation – Single Line Diagram – per unit system – per unit impedance diagram – network model formulation – bus admittance matrix – formation of Y bus and Z bus using singular transformation – symmetrical components – sequence impedance and networks

Module 2

Power Flow Studies: Load flow problem – Gauss Siedal method – Newton Raphson method – algorithm for load flow solution – handling of voltage controlled buses, off nominal transformer ratios and phase shifting transformers

Module 3

Economic Load Dispatch: System constraints – Economic dispatch neglecting losses – optimal load dispatch including transmission losses – physical interpretation of co ordination equations – exact transmission loss formulae – modified co ordination equation – automatic load dispatching

Module 4

Symmetrical and unsymmetrical short circuit analysis: Different types of faults in power systems – symmetrical fault analysis – selection of circuit breakers – use of reactors

Unsymmetrical faults – analysis of single line to ground, line to line and double line to ground faults in power system – analysis of unsymmetrical fault using Z bus.

Module 5

Stability Analysis: Swing equation – power angle equation and power angle curve – inertia constant – steady state stability - transient stability – equal area criterion – application – numerical solution of swing equation – critical clearing time and angle – effect of clearing time on stability –methods of improving system stability – modified Euler's method – Rangakutta method – application to the solution of swing equation and computational algorithms

References

1. Power System Engineering: Nagrath and Kothari, TMH
2. Electrical Power Systems: C. L. Wadhwa, New Age Int'l
3. Power System Analysis: Bergen, Pearson Education Asia, LPE
4. Elements of Power System Analysis: William D. Stevenson
5. Power System Stability Vol. I: Kimbark E. W.

SWITCHGEAR AND PROTECTION

E 802 **3+1+0**

Module 1

Switchgear: Circuit breaker – basic principle of operation – arc phenomenon – initiation and maintenance of arc - arc interruption methods – arc voltage and current waveform in AC circuit breaking – re-striking and recovery voltage – current chopping – DC breakers – rating of circuit breakers - breaking capacity – making capacity – short time rating – working principle and important features of oil CB, minimum oil CB, air blast CB, vacuum CB and SF6 CB – auto high speed re-closing.

Module 2

Protective relaying: Main and back up protection – basic requirements of protective relaying – classification of relays – induction type – principle - inverse time characteristics – directional over-current and power relays – distance relays – definite distance and distance time relays – differential relays - negative phase sequence relay – static relays – basic static relay – block diagram of static over-current, static directional, static distance and static differential relays.

Module 3

Generator Protection: External and internal faults – differential protection – biased circulating current protection – self balance system – over-current and earth fault protection – protection against failure of excitation

Transformer protection: Differential protection – self-balance system of protection – over-current and earth fault protection – buchholz' s relay and its operation.

Module 4

Feeder protection: Protection of radial feeders – protection of parallel feeders – protection of ring mains – differential pilot protection for feeders – Merz Price voltage balance system – transley system

Transmission Line Protection: Definite distance and time distance protection – phase and earth fault protection – carrier current protection

Module 5

Surge Over-voltages: Causes – lightning and switching surges – protection against over-voltages – surge diverters thyrite and horn gap types – use of ground wires – insulation coordination.

Wave propagation:

Wave propagation on OH lines and UG cables – transmitted and reflected waves – surge impedance – velocity of propagation

References

1. Power System Protection and Switchgear: Ravindranath and Chander
2. Electrical Power Systems: C. L. Wadhwa, New Age Int'l
3. A Course in Electrical Power Systems: Sony, Gupta, Bhatnagar
4. Elements of Power System Analysis: William D. Stevenson
5. Traveling Waves on Transmission Systems: Bewsley L. V.
6. Power System Protection: M. A Date, B. Oza and N.C Nair,

INSTRUMENTATION

E 803 **2+1+0**

Module 1

Transducers: Classification – characteristics – static and dynamic characteristics – Instrumentation System – Functional description – input / output configuration – interfering and modifying inputs – Methods of correction – Loafing effect – Instrumentation amplifiers – Isolation amplifier – charge amplifier.

Module 2

Displacement Transducers: Resistance potentiometer – linearity and sensitivity – types – Resistance strain gauges – working principle – gauge factor – strain gauge circuitry – temperature effect and its compensation – load cells – LVDT – working principle – equivalent circuit – LVDT circuitry – Capacitive transducers – different types – piezoelectric transducers – working principle – piezoelectric crystal equivalent circuit.

Module 3

Temperature Measurement: Thermo electric effects – Laws – thermocouples – thermo electric circuits – Resistance Temperature Detector (RTD) – Bridge circuits – Thermistors – characteristics – pyrometer – radiation and optical pyrometers.

Module 4

Absolute acceleration – null type and servo type – strain gauge Accelerrometer – piezo electric accelerometer – Electromagnetic flow meter – ultrasonic flow

meter – transit type and Doppler flow meter – Ultrasonic flaw detector – Optical transducers.

Module 5

PH measurement – Low Pressure measurement – McLaud gauge – Pirani gauge – ionisation gauge – thermal conductivity gauge – spatial encoder for angular measurement – wave analyser and spectrum analyser (block schematic) – scintillation counter – Hygrometer.

References

1. Measurement Systems – Application and Design: E.O Doeblin, TMH
2. Principles of Industrial Instruments: D. Patranabi, TMH
3. Industrial Instruments Fundamentals: E. Fribance, TMH
4. Electronic Instruments: H.S Kalsi
5. Instrumentation Devices and Systems: V. Rangan, G.R Sharma and V.S.V Mani

ELECTRICAL SYSTEM DESIGN

E 804 **3+1+0**

Module 1

Design of D.C Machines: Design specifications – output equation – output coefficient – specific loadings – choice of speed and number of poles – calculation of D and L – Armature design – choice of type of winding – number of sots – number of conductors per slot – current density – cross sectional area – slot insulation – length of air gap – field winding design – field ampere turns – excitation voltage per coil – conductor cross section – height of pole – design of ventilating ducts – design of commutator and brushes – Carter's coefficient – real and apparent flux density.

Module 2

Transformers: Design **–** single phase and three phase – output equation – specific magnetic loading – core design – single, stepped core - windings – number of turns – current density – area of cross section of conductors – types of coils – insulation – window area – window space factor – overall dimensions – cooling – design of cooling tank with tubes – design of distribution and power transformers – design of small transformers like 230V/6-0-6V.

Heating, cooling and temperature rise calculation – Continuous, short time and intermittent rating.

Module 3

Design of Synchronous Machines: Specific loading – output equation – output coefficient – main dimensions – types of winding – design of field system – turbo alternator – main dimensions – stator design – rotor design – damper winding design – comparison of water wheel and turbo alternators, cooling of turbo alternator.

Design of three phase Induction motors: output equation – output coefficient – main dimensions – rotor bar currents.

Module 4

Estimate the quantity of materials required and draw the electrical wiring layout of (a) residential building (b) Multi-storied building using rising mains (c) factory with one number of small and high rating motor at LT ot HT supply and many number of connected loads with suitable starters/switches and control panels (d) Cinema hall

Module 5

a. Design, layout and estimation of power supply arrangement for (1). A bulk Industrial consumer (2) An under ground power supply (3) An Over head line to a rural consumer.
b. Estimate and draw the layout of (1) indoor (2) outdoor 11KV transformer station with all accessories – single line diagram and physical layout
c. Design and draw the typical earthing installation like (1) pipe earthing (2) Plate earthing (3) earth mat / grid
d. Study the electrical wiring diagram of a typical automobile clearly showing all connected loads/ sources with specifications.

References

1. Electrical Machine Design: A.K Sawhney
2. Performance and Design of D.C Machine: Clayton
3. Performance and Design of A.C Machines: M.G Say
4. Design of Electrical Machines: V. N Mittal
5. Electrical Design Estimating and Costing: Raina & Bhattacharya

ELECTIVE - II

E 805 **3+1+0**

List of Electives:

E 805.01 CMELR Advanced Mathematics
E 805.02 Computer Aided Design of Induction Machines
E 805.03 Robotics
E 805.04 Advanced Power Systems
E 805.05 Advanced Microprocessors
E 805.06 System Software
E 805.07 Advanced Power Electronic Systems

Note

New Electives may be added according to the needs of emerging fields of technology. The name of the elective and its syllabus should be submitted to the University before the course is offered.

ADVANCED MATHEMATICS

CMELRT 805-1

Module 1

Green's Function

Heavisides, unit step function - Derivative of unit step function - Dirac delta function -properties of delta function - Derivatives of delta function - testing functions - symbolic function - symbolic derivatives - inverse of differential operator - Green's function -initial value problems - boundary value problems - simple cases only.

Module 2

Integral Equations

Definition of Volterra and Fredholm Integral equations - conversion of a linear differential equation into an integral equation - conversion of boundary value problem into an integral equation using Green's function - solution of Fredhlom integral equation with separable Kernels - Integral equations of convolution type - Neumann series solution.

Module 3

Gamma, Beta functions

Gamma function, Beta function - Relation between them - their transformations - use of them in the evaluation certain integrals - Dirichlet's integral - Liouville's extension, of Dirichlet's theorem - Elliptic integral - Error function.

Module 4

Power Series solution of differential equation

The power series method - Legendre's Equation - Legendre's polynomial - Rodrigues formula - generating function - Bessel's equation - Bessel's function of the first kind - Orthogonality of Legendre's Polynomials and Bessel's functions.

Module 5

Numerical solution of partial differential equations.

Classification of second order equations- Finite difference approximations to partial derivatives - solution of Laplace and Poisson's equations by finite difference method - solution of one dimensional heat equation by Crank - Nicolson method - solution one dimensional wave equation.

References

1. Linear Integral Equation: Ram P.Kanwal, Academic Press, New York
2. A Course on Integral Equations: Allen C.Pipkin, Springer - Verlag
3. Advanced Engg. Mathematics: H.K.Dass, S.Chand
4. Advanced Engg. Mathematics: Michael D.Greenberge, Pearson Edn. Asia
5. Numrical methods in Engg. &Science: B.S.Grewal, Khanna Publishers
6. Generalized functions: R.F. Hoskins, John Wiley and Sons.
7. Principles and Techniques of Bernard Friedman: John Wiley and sons Applied Mathematics
8. Principles of Applied Mathematics: James P.Keener, Addison Wesley.
9. Numerical methods: P.Kandasamy, K.Thilagavathy, K.Gunavathy

COMPUTER AIDED DESIGN OF INDUCTION MACHINES

E 805-2

Module 1

CAD Orientation of Engineering design problems to computers. Design by analysis and synthesis approach – simulation of non-linearity – stator windings for 3 phase and single phase induction motors

Module 2

Main dimensions of three phase induction motors – standard specification – constructional features – specific electric and magnetic loading – output coefficient – main dimensions – computer programmes

Module 3

Core design – leakage reactances – rotor winding design – equivalent resistances – computer programmes

Module 4

Calculations from design data – Carters coefficient – no load current – equivalent circuit parameters – torque – efficiency and temperature rise – computer programmes

Module 5

Main dimensions of single phase induction motors – auxiliary winding and capacitor design – equivalent circuit parameters - torque – efficiency and temperature calculations using design data – computer programmes

References

1. Computer Aided Design of Electrical Equipments – Ramamoorthy M, Affiliated East-West press pvt. Ltd., New Delhi
2. Performance and Design of A.C Machines – M.G Say
3. Computer Aided Design of Electric Machinery – Venott C. G, MIT Press, London

ROBOTICS

E 805-3

Module 1

Introduction: Historical development-classification of robots-applications-robots kinematics- joints and links-degree of freedom-description of position, orientation, frames-mapping from one frame to another-compound transformations-inverse of transform matrix-transform equations-kinematics of three degree of freedom manipulators-Description of links-intermediate links in chain-First and last links in chain -Link parameters-affixing frames to links-derivation of link transformation matrix-Description of an industrial robot.

Module 2

Inverse manipulator kinematics - Workspace-solvability-multiple solutions-Algebraic solution.

Drive and control systems for robots: hydraulic systems and DC servomotors

Position control for robots-simple position control system-position control along a trajectory

Module 3

Robot end- effectors: Classification of end-effectors-drive System for grippers-mechanical grippers magnetic grippers-vacuum grippers-gripper force analysis and gripper design.

Module 4

Sensors and intelligent robots: need for sensing systems- sensing devices-piezoelectric sensors-linear position and displacement sensing absolute optical encoding-incremental optical encoder-position and direction measurement-velocity measurement—force and torque sensors-proximity sensors-range sensors-robot vision systems

Module 5

Trajectory planning for Robots: Joint space schemes-cubic polynomials with via points-Blending schemes - interfacing to microprocessors and computers.

References

1. Robotics and Image Processing - PA Janakiraman
2. Robotic Technology and flexible Automation - S R Deb
3. Robotics for engineers - Yoram Koren
4. Introduction to Robotics- Analysis, Systems and Applications: Saeed B. Nikku, Pearson Education Asia, LPE

ADVANCED POWER SYSTEMS

E 805-4

Module 1

Automatic generation and voltage control - load frequency Control (single area case) -turbine speed governing system - model of Speed system - Turbine model- generator load model - steady state analysis- dynamic response - control area concept.

Module 2

Unit commitment - constraints in unit commitment-spinning spinning reserve - thermal unit constraints - other constraints - unit commitment solution methods - priority - list methods - dynamic programming solution.

Module 3

Hydrothermal co-ordination - long range and short range hydro scheduling- hydro electric plant models - scheduling problems - the short term hydrothermal scheduling problem - short - term hydro— scheduling: a gradient approach - hydro units in series-dynamic programming solution to the hydrothermal scheduling problem.

Module 4

Interchange evaluation and power pools - economy interchange economy interchange evaluation - interchange evaluation with unit commitment multiple interchange controls -after - the fact production costing - other types of interchange - power pools - the energy broker system - centralized economic despatch of a power pool - allocating pool savings.

Module 5

Power system security - factors affecting power system security-contingency analysis: Detection network problem - network sensitivity methods - calculation of network sensitivity factors - correcting the generation despatch - sensitivity methods - linear programming.

References

1. Power System Engineering - I.J.Nagrath, D.P.Kothari
2. Power generation, operation and control - Allen J.Wood, Bruce Wollenberg, John Wiley & Sons

ADVANCED MICROPROCESSORS

E 805-5

Module 1

Intel 8086 - Pin out signals and functions - Internal architecture - Registers and flags - bus buffering and latching bus timing – Pipelining
Operating modes - minimum mode and maximum mode.

Module 2

Introduction to 8086 assembly language programming - addressing modes – instruction set classification - Writing simple programs eg. Arithmetic operations, reading data from input port etc.
8086 memory interface – memory bank – separate bank decoders and signals

Module 3

8087 internal block diagram and interfacing (Programming not required).
Intel 80186 Architecture - block diagrams - different integrated peripherals
Intel 286 - Block diagram - Hardware features - Additional instructions (Programming not required)

Module 4

Intel 8038 - memory system - I/O system - Protected mode – mmu - Descriptors and selectors - TSS, Memory paging mechanism.
Intel 80486 - Internal Architecture - memory management and cache memory.

Module 5

Introduction to Pentium - processors – memory system – I/O system - special Pentium registers - Pentium memory management.
Pentium II - Introduction - software changes Pentium III - Introduction - chip set, Bus
Pentium *IV* - Memory interface, Hyper pipelined technology (elementary treatment only).
Concept of RISC – comparison of CISC and RISC

References

1. The 80x86 Family - John Uffenbeck - Pearson
2. Microprocessor and Interfacing - Douglas V. Hall - McGraw Hill
3. The Intel Microprocessors - Barry B. Brey (6^{th} edition) – Pearson LPE
4. Advanced Microprocessors and Peripherals – A.K Ray and M. Bruchandy – TMH
5. An Introduction to the Intel family of Microprocessors – James L. Antonokos, Pearson LPE

SYSTEM SOFTWARE

E 805-6

Module 1

Introduction: Concept of system software - Classification of system software- Relationship of system software with the machine and the user. Assemblers: overview of the assembly process- single pass and two pass assemblers. Elementary ideas of macros -Macro definition- macro call macro expansion - macro processors.

Module 2

Linkers and Loaders: translated, linked and load time addresses- relocation and linking concepts- object module- loader- absolute loader, relocating loader- linking loaders -(elementary ideas only).

Compilers: Overview of compilation process - phases of a compiler - analysis phase -synthesis phase - lexical analysis - parsing - static and dynamic storage allocation-intermediate code generation - code generation (basic ideas only).

Module 3

Operating systems: Definition of operating system -functions of operating system - types of services-Types of operating systems- batch processing multiprogramming, multitasking - timesharing, real-time, distributed systems (brief descriptions only).

Process management- process concept- process states- scheduling - FCFS, Shortest Job first, round robin scheduling policies.

Module 4

Memory management- contiguous memory allocation - static and dynamic partitioning -swapping - non-contiguous allocation- fragmentation- concept of virtual memory- paging-page tables - page replacement- FIFO and LRU page replacement policies - segmentation -caching of secondary storage information.

File system - directory structures - file system implementation - sharing and security. Device management - basic principles of I/O device controllers - I/O scheduling policies.

Module 5

Introduction to distributed operating system: characteristics of distributed systems -advantages -client server model - remote procedure call.

Real time operating systems - Basic requirements - hard and soft real time systems - issues in real time systems- basic ideas of real time scheduling - reentrancy- real time embedded systems (basic ideas only).

References

1. Introduction to System Software - Dhamdhere D.M., Tata McGraw Hill
2. Systems Programming - Donovan J.I, McGraw Hill
3. Systems Programming - Dhamdhere D.M., Tata McGraw Hill & Operating Systems
4. Principles of compiler design - Aho & Ullman, Narosa Publishing
5. Operating System- Milenkovic, McGraw Hill
6. Operating System concepts - Peterson & Silberschatz, Addison Wesley
7. Real time systems & programming languages- Burns, Wellings, Addison Wesley
8. Introduction to RTS - Martin
9. Real time embedded Systems - Mathai Joseph, CERN

ADVANCED POWER ELECTRONIC SYSTEMS

E 805-7

Module 1

DC-DC converter topologies: Buck and boost converters - continuous and discontinuous current modes - buck-boost, C'uk converter - operation – control of dc-dc converters –PWM method - Full-bridge with bipolar and unipolar switching – output voltage equations.

Module 2

SMPS topologies: Basic block schematic of SMPS – isolated dc-dc topologies – forward and flyback – principles – (circuit and operation only). Push-pull topology – half bridge

Basics of SMPS control methods – voltage-mode and current-mode control (block diagrams and description only).

Module 3

Resonant Converters: Advantages of resonant converters over PWM converters – Classification - series and parallel resonant converters – half-bridge operation – discontinuous and continuous current modes (basic modes only, no analysis required) Principles of Zero voltage and Zero current switching (ZVS and ZCS switches only – no analysis required)

Module 4

PWM Inverters: Need for PWM techniques – various PWM techniques – principle of sinusoidal PWM – bipolar and unipolar PWM - modulation index – application to single phase bridges - disadvantages of SPWM – brief introduction to other PWM methods – current-mode control schemes (tolerance band control and fixed frequency control – description with block diagram only)

Module 5

Applications: Power factor correction – Actual power factor – Displacement factor and distortion factor – principles of input line current shaping using boost rectifiers. UPS – Different topologies – block schematics.
Electronic ballast – block schematics.

References

1. Power Electronics: Converters, Applications and Design – Mohan, Undeland and Robbins, John Wiley and Sons, 2nd ed.
2. Power Electronic Systems: Theory and Design – Jai P. Agrawal , Pearson Education Asia, LPE
3. Modern Power Electronics – P.C Sen, Wheeler Publ.

ELECTIVE - III

E 806 **2+1+0**

List of Electives:

E 806.01 Digital Protection of Power Systems
E 806.02 Insulation Technology
E 806.03 Computer Networks
E 806.04 Artificial Intelligence and Expert Systems

E 806.05 Opto-Electronics and Communication
E 806.06 VLSI Technology

Note

New Electives may be added according to the needs of emerging fields of technology. The name of the elective and its syllabus should be submitted to the University before the course is offered.

DIGITAL PROTECTION OF POWER SYSTEMS

E 806-1

Module 1

Need for protection-nature and causes of fault -zones of protection-classification of protective relays based on technology and function-instrument transformers used in protection circuit.
A/D converters- analog multiplexers-sample and hold circuits.

Module 2

Computer applications to protective relaying - simulation of power system disturbances-simulation of current and voltage transformers-simulation of distance relays during transient conditions.

Module 3

Offline application of computers-on line application of computers –Relay co-ordination programmes.

Module 4

Microprocessor based protective relays - multistage frequency relay - measurement of power system signals through phase locked loop interface - protection of alternators against loss of excitation.

Module 5

Microprocessor based over current relays-impedance relays- directional relay-reactance relay - distance relay - measurement of R and X - mho relay - quadrilateral relay - generalized interface for distance relays.

References

1. Madhava Rao T.S, "Power System Protection-Static relays"
2. Bddri Ram, "Power System Protection and Switchgear"
3. Singh L.P, "Digital Protection-Protective Relaying from electromechanical to microprocessors"
4. Arun G. Phadke, James S. Thorp, "Computer Relaying for Power systems"

INSULATION TECHNOLOGY

E 806-2

Module 1

Insulating materials - classification, brief study of preparation and properties of ceramics, mica, paper, PVC, PE Epoxy resin, teflon, SF6 transformer oil, polychlorobiphenyls (PCB) vacuum purification of transformer oil- drying and degassing. Impregnation of paper and cotton insulation.

Module 2

Dielectric properties - permittivity, complex permittivity, dielectric loss factors influencing permittivity, permittivity of mixtures, factors influencing tan delta, Measurement of resistivities, dielectric loss and constant, testing for tracking partial discharge measurements.

Module 3

Polarisation - internal fields, Clausins - Mossotd relation limitations, different types of polarisaiton. Electric fields in homogeneous dielectrics, mechanical force under electric fields, absorption currents.

Insulation problems in high voltage transformers, surge phenomena, insulation design to withstand surges in transformers, Elementary de-sign of insulating system of capacitors.

Module 4

Breakdown phenomena in gases - ionization processes, de-ionization processes, breakdown mechanisms, T ownrend's theory. Steramer theory, Paschen's law, breakdown in electronegative gases, uniform fields, non-uniform fields penning effect.

Module 5

Breakdown mechanisms in vacuum-breakdown in liquid dielectrics pure liquids and commercial liquids, breakdown in solid dielectrics - different types - intrinsic, electronic, thermal, electromechanical, tracing and tracking, partial discharges, partial discharges.

References

1. High Voltage Engineering: Naidu and Kamaraju
2. Ionisation, Conductivity and Breakdown in Liquids: Adam Czawski
3. High Voltage Engineering: Kuffel and Zeamgl
4. SF6 and Vacuum Insulation for High Voltage Applications: Naidu and Maller

COMPUTER NETWORKS

E 806-3

Module 1

Introduction: Goals and applications of networks - Network Topologies - Broadcast - Point to point - bus, star, ring, tree - Types of networks - LAN, MAN, WAN OSI reference model - TCP/IP reference model - Client server computing Physical layer - Packet switching -Transmission media - Fibre optic networks – ISDN

Module 2

Data link layer: Services - Data framing - Error handling - Data link protocols – Elementary protocols - Sliding window protocol(basic concepts only) - data link layer in the Internet- SL1P/PPP.

Module 3

Medium access sub layer: Channel allocation - static vs dynamic channel allocation - CSMA protocol - collision detection - wireless LANs - IEEE 802 standards - Ethernet - Token bus -Token ring - Bridges – FDDI

Module 4

Network layer: services - Routing - congestion control - internetworking - Principles - Gateways - Host - backbone network - Network layer in the Internet - IP protocol - IP address - Internet control protocols. Transport layer: Services - Internet Transport protocols - TCP and UDP.

Module 5

Application layer: services - Network security - Cryptography - DNS - DNS Namespace -Name servers - Network Management concepts. Internet services: E-mail - USENET - FTP -TELNET - gopher - WWW - WAIS – Archie

References

1. Computer Networks (3r edition) - Tanenbaum, Pearson Education Asia
2. Data and computer communications - William Stalling, Pearson Education Asia

3. Data Communication, Computer networks - F. Halsall, Addison Wesley and open systems
4. Computer Networks, A system approach - Peterson & Davie, Harcourt Asia
5. The Internet Book- Douglas E. Comer, Pearson Education Asia
6. Internet Complete Reference - Harley Harn Osborne

ARTIFICIAL INTELLIGENCE & EXPERT SYSTEMS

E 806-4

Module 1

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

Module 2

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

Module 3

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

Module 4

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

Module 5

Knowledge acquisition techniques- cognitive behavior - knowledge representation development.

Expert system tools: Expert system shells -narrow tools -large hybrid expert system tools -PC based expert system tools knowledge acquisition tools.

References

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

OPTOELECTRONICS AND COMMUNICATION

E 806-5

Module 1

Review of P-N jn-characteristics - semiconductor-hetero junction-LEDs (-spontaneous emission-LED structure-surface emitting-Edge emitting-Injection efficiency-recombination efficiency-LED characteristics-spectral response-modulation-Band width.

Module 2

Laser diodes-Basic principle-condition for gain-Laser action-population inversion-stimulated emission-Injection faster diode-structure-temperature effects-modulation-comparison between LED and ILDs.

Module 3

Optical detectors-optical detector principle-absorption coefficient-detector characteristics-Quantum efficiency-responsivity- response time-bias voltage-Noise in detectors P-N junction-photo diode-(characteristics-P-I-N-photo diode-response-Avalanche photo diode (APD) multiplication process-B. W-Noise-photo transistor.

Module 4

Optical Fibre-structure-advantages-Types-propagation-wave equation-phase and group velocity-transmission characteristics-attenuation-absorption-scattering losses-dispersion-fibre bend losses-source coupling, splices and connectors-wave length division multiplexing.

Module 5

Optical fibre system-system design consideration-fibre -optic link-optical transmitter circuit-source limitations-LED drive circuit-Laser drive circuit-pre-amplifier-equalization-Fibre-optic link analysis-typical lira design.

References

1. Semiconductor Opto electronics Devices-Pallab Bhattacharya (Pearson Education)
2. Optical fibre Communication Systems-Principles and practice- John M Senior (PHI)
3. Optical communication Systems-John Gower (PHI)
4. Optical fibre Communication- Gerd keiser (PHI)

VLSI TECHNOLOGY

E 806-6

Module 1

Process steps in 1C fabrication: Crystal growth and wafer preparation-Czochralski process- apparatus- silicon shaping, slicing and polishing- Diffusion of impurities-physical mechanism- Pick's I and II law of diffusion- Diffusion

profiles- complementary (erfc) error function- Gaussian profile- Ion implantation- Annealing process- Oxidation process- Lithography- Photolithography, Fine line lithography, electron beam and x-ray lithography- Chemical vapour deposition (CVD)- epitaxial growth- reactors-metallisation- patterning- wire bonding and packaging.

Module 2

Monolithic components: Isolation of components- junction isolation and dielectric isolation- Transistor fabrication- buried layer- impurity profile- parasitic effects-monolithic diodes- schottky diodes and transistors- FET structures- JFET- MOSFET-PMOS and NMOS, control of threshold voltage (Vth)- silicon gate technology-Monolithic resistors- sheet resistance and resistor design- resistors in diffused regions-MOS resistors- monolithic capacitors- junction and MOS structures- 1C crossovers and vias.

Module 3

CMOS technology: Metal gate and silicon gate- oxide isolation- Twin well process- Latch up- BiCMOS technology- fabrication steps- circuit design process- stick diagrams- design rules- Capacitance of layers- Delay- Driving large capacitance loads- Wiring capacitance- Basic circuit concepts- scaling of MOS structures- scaling factors- effects of miniaturization.

Module 4

Subsystem design and layout- Simple logic circuits- inverter, NAND gates, BiCMOS circuit, NOR gates, CMOS logic systems - bus lines- arrangements- power dissipation-power supply rail distribution- subsystem design process- design of a 4 bit shifter.

Module 5

Gallium Arsenide Technology: Sub-micro CMOS technology- Crystal structure- Doping process- Channeling effect- MESFET- GaAs fabrication- Device modeling.

References

1. VLSI technology. S M Sze, Me Graw Hill pub,
2. Basic VLSI design: Douglas Pucknell, PHI
3. Principles of CMOS VLSI Design: H E Weste, Pearson Edn.
4. Integrated Circuits: K R Botkar, Khanna Pub.
5. CMOS circuit design layout and simulation: Barter, IEEE press.
6. Introduction to VLSI: Conway, Addison weslay.

ELECTRICAL MACHINES LAB II

E 807 **0+0+4**

1. Alternator regulation by synchronous impedance and mmf methods
2. Alternator regulation by Potier method
3. Alternator regulation by Blondel's method and verification by direct loading
4. Alternator V – curves for constant input/output
5. Synchronous motor V – curves and compounding curves
6. Alternator regulation by feeding back power to mains – use of synchroscope
7. Study of starters and load tests on double cage and single phase induction motors
8. Characteristics of cage / slip ring motors by circle diagram
9. Characteristics of induction generator and rotor hysterisis by Link's method
10. Synchronous Induction motor – predetermination of excitation current and verification
11. Characteristics of pole changing motor
12. Characteristics of Schrage motor – torque variation with load, predetermination of speed variation with brush shift and verification
13. Characteristics of cascade induction motor set
14. Experimental determination of torque slip curve of induction motor in unstable region upto about 40% slip
15. Experimental determination of variation of starting torque with rotor resistance in slip-ring induction motor
16. Predetermination of line current. Torque, power of a 3-phase induction motor under single phasing - verification
17. No load and blocked rotor tests on single phase induction motor and determination of equivalent circuit parameters
18. Determination of
    a. Continuous rating for specified temperature rise
    b. One hour rating by heat run test of a machine

PROJECT AND SEMINAR

E 709/E808

Each student is required to present a technical paper on a subject approved by the department. The paper should be in general reflecting the state-of-the-art. He/she shall submit a report of the paper presented to the department.

In addition to the seminar he/she shall undertake a project work (as a team or individually) in the 7^{th} semester itself in consultation with the Guides. On completion of the project work, he/she shall present the work done before a panel of staff members, and submit a report of the project work, and submit a report of the project work done to the department.