GOA UNIVERSITY

Scheme of Instruction & Examination

Second Year Engineering
Electrical& Electronics Engineering
(Revised Course from 2007-2008)

GOA UNIVERSITY

BACHELOR'S DEGREE COURSE IN ENGINEERING (Revised in 2007-08)

SCHEME OF INSTRUCTION AND EXAMINATION

Guidelines for implementing the scheme of instruction and examinations:

The following guidelines for implementing the scheme of instructions and examinations as agreed by the committee are as follows:

i) The course shall be named as B.E. Course (Revised in 2007-08)

ii) The course shall be implemented for first year in 2007-08 and progressively for higher semesters.

iii) No marks shall be allocated for attendance of students.

iv) There shall be only two internal written tests and average marks of these two test shall be taken as marks for sessionals in each subject

v) Internal tests for each subject shall be written in a separate booklet with 40 pages ofA4 size paper specifically printed for that purpose with an index page with details of the institution, class, student, subject, maximum marks etc. for the purpose of identification. This booklet shall be retained by the student till the declaration of the result and shall be called as IT book.

vi) The syllabus of each subject is divided into modules

vii) Each module carries equal weightage

viii) Duration of theory examination shall be as specified in the Scheme of Instruction and Examination.

ix) Question paper in each subject shall have only one section.

x) Maximum number of questions in each subject shall be 8 with a break up of 2 questions per module arranged in the same order.

xi) Students shall answer 5 out of 8 questions with a minimum of one question from each module

xii) Minimum passing mark shall be 40% of maximum marks under each sub-head independently.

xiii) For practical/tutorial sessions batch size shall be of 20 students

xiv) Write-up of practical /assignments shall be submitted in an A4 size paper printed specifically for that purpose with an index page and a certificate

SCHEME OF INSTRUCTION &EXAMINATION
SECOND YEAR (ELECTRICAL & ELECTRONICS ENGINEERING)

Semester III

No	Subject	L	T	P	Duration of Theory Exam	Marks Allotted				
						Theory	S	P	O	Total
EE 3.1	Engineering Mathematics III	3	1	-	3	100	25	-	-	125
EE 3.2	Digital Integrated Circuits	3	1	2	3	100	25	50	-	175
EE 3.3	Electrical Circuit Analysis & Synthesis	3	1	-	3	100	25	-	-	125
EE 3.4	Electrical Machines I	3	1	2	3	100	25	-	-	125
EE 3.5	Electronic Devices & Circuits	3	1	2	3	100	25	50	-	175
EE 3.6	Electrical Measurement & Instruments	3	1	2	3	100	25	-	-	125
	Total	18	6	8	18	600	150	100		850

SCHEME OF INSTRUCTION &EXAMINATION
SECOND YEAR (ELECTRICAL & ELECTRONICS ENGINEERING)

Semester IV

No	Subject	L	T	P	Duration of Theory Exam	Marks Allotted				
						Theory	S	P	O	Total
EE 4.1	Numerical Techniques and Programming	3	1	2	3	100	25	-	-	125
EE 4.2	Linear Integrated Circuits	3	1	2	3	100	25	50	-	175
EE 4.3	Electrical Power	3	1	-	3	100	25	-	-	125
EE 4.4	Electrical Machines II	3	1	2	3	100	25	50	-	175
EE 4.5	Analog and Digital Communication	3	1	2	3	100	25	-	-	125
EE 4.6	Economics Management	3	-	-	3	100	25	-	-	125
	Total	18	6	8	18	600	150	100		850

EE 3.1 ENGINEERING MATHEMATICS-III

Lectures per week	3 Hours
Tutorials per week	1 Hour
Practicals per week	-----
Maximum marks for the paper	100
Maximum marks for practicals	0
Maximum marks for sessionals	25
Duration of the paper	3 hours

MODULE I

Laplace Transforms:

Definition, Existence conditions, Laplace Transforms of 1, k, e^{at}, cos(at), sin(at), cosh(at), sinh(at), Df(t), integral of f(t) between limits 0 to t .First and second shifting theorem, Laplace transform of periodic functions, Laplace transform of Dirac- Delta function, Laplace transform of Unit step function. (8 hours)

Inverse Laplace transforms, Convolution theorem, Applications of Laplace transforms in solving linear differential equations with initial conditions and system of linear simultaneous differential equations. (8 hours)

MODULE II

Fourier series:

Periodic functions, Trigonometric series, Euler's formulae, Dirichlet's condition, Even and odd functions, Half Range Series, Parseval's identity. (7 hours)

Fourier Transforms: Fourier transform, inverse Fourier transforms, applications, convolution theorem. (7 hours)

MODULE III

Partial Differential Equations:

Equations governing transverse vibrations of elastic string (one dimensional wave equation), solution using Fourier series. Variable heat flow in one dimension, derivation and solution using variable separable method. (7 hours)

Introduction to Z transforms: Basic Z transforms, properties, inverse Z transforms, convolution theorem, applications to difference equations. (7 hours)

MODULE IV

Complex Variables:

Integration of complex functions, Cauchy's integral theorem for simply connected regions, Cauchy's integral formula, extension to multiply connected regions, Maximum modulus theorem. (8 hours)

Taylor's and Lorentz's expansion, singularities-Zeros and poles, Residue theorem, Liouville's theorem, Contour integration. (8 hours)

Text Books:

1. Applied Mathematics-P.N. Wartikar and J.N. Wartikar; Pune Vidhyarhi Griha Prakashan
2. Higher Engineering Mathematics-B.S. Grewal; Khanna Publishers

Reference Books:

1. Engineering Mathematics-III- Veerarajan, Tata McGraw Hill
2. Engineering Mathematics Vol-III, P. Kandasamy, S. Chand Publication
3. Applied Mathematics- III, R.M.Baphana , Technova Publications

EE 3.2 DIGITAL INTEGRATED CIRCUITS

Lectures per week	3 Hours
Tutorials per week	1 Hour
Practical per week.	2 Hours
Maximum marks for the paper	100
Maximum marks for practicals	50
Max. Marks for sessional	25
Duration of the paper	3 Hours

MODULE I

Introduction to Digital Systems: Number systems: Binary, Octal, Decimal, Hexadecimal system and conversion from one system to the other. Codes: Excess 3 code, Gray code, ASCII code, Error detection and correction codes. Compliments, Representation of signed numbers, Binary arithmetic – Binary addition, subtraction (1's and 2's complement method), Binary multiplication and division. Fixed an floating point numbers, BCD numbers, BCD arithmetic. (7Hours).

Basic logic operations (AND, OR, NOT, XOR, NAND, NOR) – truth tables, symbols and logic expressions. De Morgan's theorems, Basic postulates and fundamental theorems of Boolean algebra, Simplification of Boolean functions, Canonical and standard forms, minterm and maxterm representation, SOP (Sum of Products) and POS (Product of Sums) forms, Karnaugh Map representation (2, 3 and 4 variable), Simplification of Logic functions using K – Maps, Don't Care conditions, NAND and NOR implementation of logic functions, Plotting K-map using VEM process, Quine- Mc Cluskey tabular method. (8 Hours).

MODULE II

Combinational Logic Design: Design of Half/Full adder, Half/Full subtractor, binary parallel adder, Look ahead carry generator, Two's complement circuit, BCD adder, BCD subtractor, Magnitude comparator, Parity generator/checker. Code converters Binary to Gray, Gray to Binary, Combined Gray to Binary – Binary to Gray converter, Excess-3 to BCD converter, BCD to Excess-3 converter. (7Hours)

Encoders: Priority encoder, decimal to BCD encoder, Octal to binary encoder.

Decoders: 2-to-4 decoder, 3-to-8 decoder. Design of BCD to decimal decoder with and without false data rejection, BCD to seven – segment decoder.

Multiplexers and demultiplexers: Internal logic diagram of multiplexer and demultiplexer, Combinational logic design using multiplexer, demultiplexer and decoder. (8hours)

MODULE III

Memory: Memory organization, Operation, characteristics and addressing, Types of memories: ROM, PROM, EPROM, EEPROM, RAM-SRAM, Flash Memory. Dram operation modes- Single bit read, page mode read, Extended data out mode, Burst read, serial mode read, DRAM refresh operation modes- ROR refresh, CBR refresh, self refresh. ROM: Logic construction of 32x4 ROM, ROM implementation of logic function. (10 Hours).

PLA: Block diagram, Logic diagram, PLA program table, and PLA implementation of logic function, Differences between PAL's and PLA's. (5 Hours).

MODULE IV

Sequential Logic Circuits: Flip Flops: R S (NAND and NOR latch, clocked), D, T, JK flip flops: their schematic symbols, logic diagram, truth table, excitation table, characteristic equation.

Triggering of flip- flops, Master – Slave configuration. Detailed timing issues of flip-flop Setup time, clock skew, hold time). (6 Hours).

Counters: Synchronous counters and asynchronous counters, Binary counter, binary up-down counter, binary ripple counter, mod 3 counter, mod 5 counter, decade counter.

Shift Registers: SISO, SIPO, PISO, PIPO, Bi- directional shift register, universal shift register, ring counter. Sequential Logic Design: State diagram, State table, state assignment, state minimization methods, design of counters using state table (with RS, JK, T flip- flop's) (9 Hours).

Text Books

1. Digital Logic and Computer Design – M. Morris Mano, PHI
2. Digital principles and Applications – Donald P. Leach/ Albert Paul Malvino, Tata McGraw
3. Designing with TTL integrated Circuits – Robert L Morris / John R. Miller, McGraw Hill international

Reference Books

1. CMOS digital Integrated circuits Analysis and Design – Sung mo Kang, Tata McGraw
2. An Engineering approach to digital design – William Fletcher, Prentice Hall of India
3. Digital Integrated Electronics – Taub and Schilling, McGraw International

EE 3.3 ELECTRICAL CIRCUIT ANALYSIS AND SYNTHESIS

Lectures per week	3 Hours
Tutorials per week	1 Hour
Practical per week.	2 Hours
Maximum marks for the paper	100
Maximum marks for practicals	0
Max. Marks for sessional	25
Duration of the paper	3 Hours

MODULE I

Network theorem and Network Topology

Thevenin's,Nortan's Superposition, Maximum Power transfer and Millman's, Reciprocity, theorem using D.C and A.C analysis. Solving network using Substitution theorem, Compensation theorem and Tellegen's theorem (7 Hours).

Concept of Network Graph, Terminology used. Incidence matrix, tie-set matrix, cut set matrix, KCL and KVL using Network topology. Network Equilibrium Equations, Principle of Duality. (8 Hours**).**

MODULE II

Resonance and Transients

A.C Transients, Resonance, Series resonance, parallel resonance. Selectivity and Bandwidth, Quality factor. Steady state and Transient response. (7 Hours).

Response of series RL, RC,RLC with D.C excitation. Application of Laplace Transform in circuit analysis, Step, Impulse response of series RL, RC, RLC circuit using Laplace Transform. (8 Hours).

MODULE III

Two port N/W Analysis:

Network elements, Classification of networks. Driving Point and Transfer functions. Network functions. (5 Hours).

Two port networks, Z, Y, ABCD, Hybrid and inverse parameters of two port network interconnection of two port networks. (10 Hours).

MODULE IV

Network Realization and Synthesis:

Concept of Poles and Zeros in a Network function. Introduction to network stability of a system from pole-zero concept. Hurwitz Polynomials, Routh's Hurwitz criterion of Stability of network function. Positive real functions. Sturm's theorem**.** (8 Hours).

Introduction to network Synthesis LC, RL and RC Network synthesis using Foster and cauer forms. (7 Hours).

Text Books

1 Circuit Theory(Analysis and Synthesis) A.Chakrabarth;.Dhanpat Rai &Co
2. Engineering Network Analysis and Design G.G Bhise Chadha and Kulsreshtha.; Umesh Publications
3. Network Analysis – M.E Van Valkenburg; Pearson

Reference Books

1. Electrical Circuit and Network analysis P.M.Chandrashekharaiah. CBS Publishers
2. Circuits and Networks – Sudhakar Tata McGraw Hill
3. Introduction to Modem Network Synthesis - Van Valkenburg- Wiley Eastern Ltd
4. Modern Network Analysis - F.M.Reza & S.Seely. McGraw Hill
5. Network Analysis and synthesis- CL Wadhwa, New age International Publishers

EE 3.4 ELECTRICAL MACHINES -I

Lectures per week	3 Hours.
Tutorials per week	1 Hour
Practical per week	2 Hours
Maximum marks for the paper	100
Maximum marks for Practicals	0
Max marks for sessional	25
Duration of the paper	3 Hours.

MODULE I

Principles of Electromechanical Energy conversion:

Energy in Magnetic systems, field energy and mechanical force. Multiple - Excited magnetic field systems, energy conversion via electrical field, ideal machines, dynamic equation of electromechanical systems. (7 Hours).

Basic concepts in electrical Machines: Elementary machines, generated emf in AC windings, harmonic in emf, mmf in AC machines, torque in round rotor machines, Operation of basic machines, leakage in rotating machines. (8 Hours).

MODULE II

D.C. Machines:

Construction, EMF and torque equation, circuit model, generating & motoring mode. Armature reaction: graphical picture of flux density distribution, compensating winding. (7 Hours)

Commutation - resistance and emf commutation. Methods of excitation of dc machine, Magnetization characteristics, Characteristics of DC generators. (8 Hours).

MODULE III

D.C Motors:

Working Principle of DC. motors, predetermination of external characteristic of DC motors. Starting of DC motors, speed control methods**.** (9 Hours).

Losses and efficiency. Testing of DC machines. (6 Hours).

MODULE IV

Cross-field Machines:

Principle of cross-field machine, constant current generation, compensation, and constant voltage generator applications. (7 Hours).

Armature windings: AC windings - single layer, double layer, DC winding: symmetry requirement, Equalizer rings. (8 Hours).

Text Books

1. Electrical Machinery - Fitzgerald and Kingsly, McGraw Hill.
2. Electric Machinery –Dr P S Bhimbra, Khanna Publisher.
3. Electric Machines - Nagrath & Kothari, Tata McGraw Hill.

Reference Books

1. Electromechanical Energy Conversion - Seely, Pitman; McGraw Hill.
2. Course in Electrical Machine Design - A.K..Sawhney,Dhanpat Rai & Sons.
3. Performance and design of DC Machines - Clayton & Hancock, Pitman, CBS Publisher.

EE 3.5 ELECTRONIC DEVICES AND CIRCUITS

Lectures per week	3 Hours.
Tutorials per week	1 Hour
Practical per week	2 Hours
Maximum marks for the paper	100
Maximum marks for Practicals	50
Max marks for sessional	25
Duration of the paper	3 Hours.

MODULE I

Transistor configurations

Common base, Common Emitter, Common Collector, Common Drain and Common Source.Transistor, biasing circuits types and design. AC and DC load line. Operational characteristics of a BJT in saturation and cut-off regions. Transistor (BJT & MOSFET) as a switch, Transistor as an amplifier (5 Hours).

Transistor AC equivalent circuits:-H-parameter model, re model, ac equivalent circuit of small signal BJT and FET amplifiers. Single stage and two stage amplifiers. Different types of coupling (RC, transformer and Direct) and their frequency response, Lag-Lead networks (10 Hours).

MODULE II

Logic families: Logic Types: Direct Coupled Transistor logic (DCTL), Resistor Transistor logic (RTL), Resistor-Capacitor Transistor logic (RCTL), Diode Transistor logic (DTL), Emitter Coupled logic (ECL), Transistor logic (TTL), Complimentary MOS (CMOS).and advantages and Disadvantages of each type. TTL gates TTL NAND and NOR gates Active pull up TTL gate ,open collector TTL ,wired AND TTL,Schottky clamped TTL,High speed TTL,Low power TTL ,Tri state TTL (8 Hours).

CMOS Circuits: CMOS Inverter,CMOS NOT, NAND, NOR gates, CMOS Characteristics. Advantages of CMOS technology, TTL to CMOS and CMOS to TTL interface.

Levels of Integrated Circuit Complexities: SSI, MSI, LSI, VLSI, and ULSI.

Electrical Characteristics of logic gates Logic Levels, noise margins, fan in, fan out, propagation delay, transition time, power consumption and power delay product**.** (7 Hours).

MODULE III

Feedback concept

Negative Feedback:-Types (Voltage series, Voltage shunt, Current series and current shunt) and its effects. Positive Feedback:-Barkhausen criteria. (7 Hours).

Oscillators:-Concept, Damped and undamped oscillations, Construction, operation and analysis of:RC- Wien Bridge, RC phase shift oscillator LC-Tuned base, Tuned collector, Tuned Drain, Hartley, Colpitts, Clapp Crystal oscillators UJT Relaxation Oscillator. Sweep Circuits:-Miller Sweep circuit, Bootstrap circuit**.** **(**8 Hours**).**

MODULE IV

Voltage regulators, Performance - Line and Load regulation.:

Voltage regulators: Zener diode, Principles of BJT shunt and series (Emitter Follower, Series Pass) Voltage regulators. **(**5 Hours).

Power Amplifiers:-Introduction and Classification and analysis (class A – Series fed and transformer coupled, class B- Push pull, complimentary symmetry, class C amplifier).

Multivibrators: Operation and analysis of Bistable – Fixed bias, Self biased and emitter coupled (Schmitt trigger) Monostable and Astable Multivibrator (10 Hours).

Text Books

1. Pulse Digital and Switching Waveforms – Millman and Taub;McGraw Hill
2. Electronic devices & circuits – Robert Boylestead.;PHI
3. Digital Principles and applications Malvino and Leach. Tata McGraw hill

Reference Books

1. A Monograph of Electronic Design Principles – Khetan and Goyal ;Khanna Publication
2. Electronic devices & circuits - S.Salivahanan ; Vikas Publication
3. Electronic devices and circuits - Y.N. Bapat;Tata McGraw Hill
4. Monograph On solid state Electronics -B.S.Sonde;Wiley Eastern

EE 3.6 ELECTRICAL MEASUREMENTS AND INSTRUMENTS

Lectures per week	3Hours.
Tutorials per week	1 Hour.
Practicals per week.	2Hours.
Maximum marks for the paper	100
Maximum marks for practicals	0
Max. marks for sessional	25
Duration of the paper	3 Hours.

MODULE I

Introduction to Measurement and Instruments:

Methods of Measurement, Classification of Instruments, Errors in measurement and their Statistical analysis. Circuit components (Resistors, Inductors, Capacitors and their Residues). Classifiction of Analog Instruments, principle of operation. Operating forces Control system and damping system in the instruments. (7Hours).

Study of PMMC, Moving Iron InstrumentsGalvanometers: DC permanent magnet moving coil type, current and voltage sensitivity. Ballistic Galvanometer and Flux meter, AC vibration Galvanometer of moving coil' and moving magnet type. (8 Hours).

MODULE II

Measurement of Resistance,Inductance and Capacitance:

Measurement of resistance: Measurement of low, medium and high resistance, Wheatstone and Kelvin's bridge methods, ammeter -voltmeter method, Guard-Ring, Mega ohm bridge. Meggers**.** Earth tester (7 Hours).

AC Bridge Methods: Principles of AC bridge circuits for measurements of inductance and capacitance, dielectric loss angle and Q-factor, Detectors.

Potentiometers: Principles of D. C A C potentiometers and their applications. (8 Hours).

MODULE III

Measurement of Power and Energy :

Theory of current and potential transformers, Ratio and Phase angle errors. Testing of Transformers, applications. Measurement of Power in DC and AC circuits Electrodynamometer Wattmeter construction Lower factor wattmeter measurement of power using instrument transformer Three phase wattmeter measurement of reactive power. (8 Hours).

Measurement Of Energy: Theory of Induction type meters, Construction, theory and operation. Polyphase energy meter, Testing of energy meters.

Principles of power factor meter, frequency meters and Synchro-scopes**.** (7 Hours)

MODULE IV

Measurement of Non Electrical Quantities and Magnetic Measurement:

Magnetic Measurements: DC Hysteresis loop and BH curve determination, AC magnetization curve, A.C power loss measurements in sheet steel by wattmeter method. (7 Hours).

Measurement of Nonelectrical quantity: Primary sensing elements and Transducers Electrical transducers, classification of transducers, principle of LVDT and RVDT, Measurement of temperature, torque and pressure. (8 Hours).

Text Books

1. Electrical Measurements and Measuring instruments - A K Sawhney; Dhanpat Rai & Sons.
2. Electrical Measurements and Measuring instruments - Rajendra Prasad; Khanna Publication

Reference Books

1. Fundamentals of Electrical measurements – Baldwin ; Kalyani Publisher
2. Basic Electrical Measurements – Stou; PHI
3. Electrical Measurements and Measuring instruments -Golding and Widdis; English language Book society.

EE 4.1 NUMERICAL TECHNIQUES AND PROGRAMMING

Lectures per week	3 Hours
Tutorials per week	1 Hours
Practicals per week	2 Hours
Maximum marks for the paper	100
Maximum marks for practicals	0
Maximum marks for sessionals	25
Duration of the paper	3 hours

MODULE I

Matrices:- Types of matrices, Determinant, adjoint, inverse of a matrix, Elementary row and column transformations, Elementary matrices, Rank of matrix, Reduction to normal form, Canonical form, Rank using elementary transformation, Linear independence and dependence of vectors, System of the form A X = 0 , and A X = B, and their solutions. (8 hours)

Eigen values, Eigen vectors with properties, Cayley-Hamilton theorem with its applications, minimal polynomial, Diagonalization, Quadratic forms (8 hours)

MODULE II

Finite difference and interpolation:- Forward, Backward, Central, Divided differences, Difference tables, Taylor's operator –d, Shift Operator –E, averaging operator -μ , difference of polynomials, factorial polynomials. (8 hours)

Newton Forward & backward difference interpolation, Lagrange's interpolation, Newton divided difference interpolation (derivation, problem solving, algorithm and computer programming), Stirling's and Bessel's central difference interpolation formula. (8 hours)

MODULE III

Solutions of Equations:- Solution of non-linear equations of single variable using Bisection method, False position method, Newton-Raphson method, secant method (problem solving, algorithm and computer programming), Order of convergence of these methods, comparison of these methods. (6 hours)

Numerical Integration: Newton- Cote's Quadrature formula, Trapezoidal rule, Simpson's 1/3 & 3/8 rules, Weddle's rule(problem solving, algorithm and computer programming), Romberg's integration (Richardson's Extrapolation). Comparison of the above methods and their error estimation. (8 hours)

MODULE IV

Ordinary differential equations(1^{st} order and 2^{nd} order only): Taylor's series method, Picard's method, Euler's method, Euler's modified method, Runge- Kutta methods, milne's Predictor Corrector method. (8 hours)

Solution of Linear algebraic simultaneous equations by Gauss Elimination, Gauss-Seidal and Jacobi's iterative methods. (6 hours)

Textbook:

1. Numerical Methods: B. S. Grewal; Khanna Publications

Reference Books:

1. Numerical Methods: P. Kandasamy; S. Chand & Co., New Delhi
2. Engineering Mathematics part III: Dr. D. S. C. ;Prism Books pvt ltd.
3. Numerical Methods: E. Balagurusamy ;Tata McGraw Hill
4. Computer Oriented Numerical Methods: V. Rajaraman; PHI

EE 4.2 LINEAR INTEGRATED CIRCUITS

Lectures per week	3Hours
Tutorials per week	1 Hour
Practical per week.	2 Hours.
Maximum marks for the paper	100
Maximum marks for practicals	50
Max. marks for sessional	25
Duration of the paper	3 Hours

MODULE 1

Differential amplifier:

Differential Amplifier: Configurations (Single input unbalanced output, Single input balanced output, Dual input unbalanced output, Dual input balanced output), D.C and A.C Analysis. Constant current bias, Current Mirror, Level translator. (6 Hours)

Operational Amplifier characteristics:-Input Offset Voltage, Input Offset Current, Input Bias current, CMRR, SVRR, Input and output resistance. Specifications of OP-AMP 741. Frequency compensation, stability, offset control, slew rate. Basic op amp circuits, inverting and non-inverting amplifier.

(8Hours).

MODULE II

Operational Amplifier Applications:

Basic applications, Amplifier circuit, differentiator, integrator, summing and subtracting amplifier, instrumentation amplifier, V-I and I-V converters, voltage follower and inverter.

Non Linear Application: Log, antilog op amp, multiplier and divider circuits using AD633, Charge amplifiers, Peak detectors, Precision rectifiers, Sample and hold Circuits, Gyrators. (7Hours).

Comparators, & Converters: Basic comparator & its characteristics types and applications, Zero crossing detector, Schmitt trigger, v/f & f/v converters, window detectors, clippers & clampers, peak detector, sample and hold circuit.

Digital To analog converter: weighted resistor network, binary ladder circuit, Analog to Digital conversion methods. Simultaneous conversion successive approximation types of ADC (8 Hours).

MODULE III

Filters and Multivibrators:

Active filters, first order low pass & high pass butterworth filter, second order high pass butterworth filter, band pass & band reject filters, all pass filter, Notch filter design using IC741 Oscillator principles, Types, Design of phase shift and Wien bridge oscillator. Wave generation and shaping using linear IC's: Square wave, triangular wave and sawtooth wave generator. (10Hours)

Monostable and Astable Multivibrator using IC555 and its applications (5 Hours)

MODULE IV

Applications of PLL, VCO:

Voltage Controlled Oscillator 566 and its applications.

PLL: Operating principle, block diagram, applications of LM565. (8 Hours).

Voltage regulator, adjustable voltage regulator, switching regulators. functional block diagram and applications of IC 723 as high and low voltage regulator (7Hours).

Text books

1) Operational amplifier and Linear Integrated Circuits- Ramakant Gayakwad;Pearson
2) Integrated Circuits- K R Botkar; Khanna Publishers
3) Introduction to system Design using Integrated Circuits- B S Sonde;Wiley Eastern ltd.

References Books

1) Applications and Design with Analog Integrated Circuits- J.Michael Jacob.;PHI
2) Operation Amplifier-Design and Application – Jerald Graeme and Gene Tobey.;Mc Graw Hill
3) Operational Amplifiers and Linear Integrated Circuits - Coughlin, Driscoll;PHI

EE 4.3 ELECTRICAL POWER

Lectures per week	3Hours
Tutorials per week	1 Hour
Practical per week.	----
Maximum marks for the paper	100
Maximum marks for practicals	0
Max. marks for sessional	25
Duration of the paper	3 Hours

MODULE I

Method of Bulk Energy Generation: Introduction to Thermal, Hydel, Nuclear& Gas power plants (Block diagram approach), Choice of sites for power plants, Concept of Cogeneration. (06 Hours)

New Energy resources:- Elementary ideas of Electric generation by Wind, Solar ,Tidal ,Geothermal, Fuel cells & MHD.

Economic aspects:- Capital cost ,Annual fixed & operating costs of plants,Depreciation.Diversity factor, Load factor, Plant capacity factor, Plant utilization factors, Load curves, Tariffs, objectives, general tariff forms, Interconnection of power stations. (09 Hours)

MODULE II

Transmission: Basic network of Electric power system, Transmission line constants, Resistance, Inductance & capacitance of single phase & Three phase Transmission lines, Effect of earth, Line transposition, steady state analysis of short, medium & long transmission lines, ABCD constants, calculation of regulation & efficiency, sending end /receiving end circle diagrams (09 Hours).

Mechanical Design: Transmission line conductors ,Line supports, Insulators, Voltage distribution in Insulator string ,grading, string efficiency. Sag & tension calculations. Stringing charts & sag templates, conductor erection & stringing. (06 Hours).

MODULE III

Distribution: Feeders & distributors, criterion for selection of cross section of conductors in Distributors & feeders. Different types of DC & AC Distribution systems, Voltage drop calculation, Kelvin's law. (07Hours).

Cables:- Constructional features of LT &HT cables ,Dielectric stress & grading, thermal characteristics

Substation: - Layout, Line diagrams, Bus bar arrangement, current limiting reactors.

Grounding systems: - Neutral & equipment earthing, lightning & its effects. (08Hours).

MODULE IV

Utilisation: Illumination: - Introduction to lighting schemes, types of lamps, efficiency, principles of lighting calculations, design of indoor & outdoor lighting schemes. (06 Hours).

Electric Heating: - Different methods Resistance, Induction & Dielectric. Operation of Arc furnace & Induction furnace. Electric Welding

Electric Traction: - Systems of Electric Traction, Power supply system for track electrification, comparison & application of different systems, traction methods. (09 Hours).

Text Books

1. Electrical Power: - Dr. S.L Uppal.;Khanna Publications
2. Power system Engineering: - Soni, Gupta Bhatnagar;Dhanpat Rai & Co.
3. Course in Electrical power:- B.R.Gupta; Katharia & Sons

Reference Books

1. Electrical power systems: - C.L Wadhwa;New Age International Ltd.
2. Art & Science of Utilisation Of Electrical Energy: - H Partab ;Dhanpat Rai & Sons
3. Transmission & Distribution of Electric Energy: - H Cotton;B.I. Publishers

EE 4.4 ELECTRICAL MACHINES II

Lectures per week	3 Hours.
Tutorials per week	1 Hour.
Practicals per week	2 Hours.
Maximum marks for the paper	100
Maximum marks for Practicals	50
Max marks for sessional	25
Duration of the paper	3 Hours.

MODULE I

Single phase Transformers:

Construction and Practical consideration, single-phase transformers on no-load, ideal transformer, realistic transformers and equivalent circuit. Transformer losses, testing of transformers, per unit system, efficiency and voltage regulation, condition for maximum efficiency and minimum regulation.

(10 Hours).

Excitation phenomenon - harmonics in magnetizing current, switching transients. Autotransformers.

(5 Hours).

MODULE II

Three Phase Transformers:

Labelling and grouping, harmonics in three phase banks of single phase transformers & three phase transformers. Transformer testing, parallel operation and load sharing of single & three phase transformers.

(10 Hours).

Phase conversion - three phase transformers phase conversion – three phase to single phase, two phase and six phase conversion. (4 Hours).

MODULE III

Induction Machines:

Construction of three phase Induction Motor, flux and mmf waves, rotating mmf and torque, development of equivalent circuit model, power across air gap, torque and power output, torque-slip characteristics, condition for maximum power output (motoring and generating mode). (7 Hours).

Starting methods for induction motors, speed control methods for induction motor, deep bar and double cage rotors. (8 Hours).

MODULE IV

Single Phase Induction Motors:

Circle diagram of three phase Induction Motor, testing of three phase induction Motors. Induction generator: Isolated Induction generator, Voltage build up. (9 Hours).

Single phase induction motors: construction, rotating field theory, performance analysis and circuit model for single winding machines, split phase motors- resistance, capacitance split phase motors, capacitor start and two value capacitor motors, shaded pole motors, comparison of single phase and three phase motors.

Text Books

1. Electric machinery- P.S.Bhimbra.; Khanna Publishers
2. Electric Machines -IJ Nagrath and DP Kothari; Tata McGraw Hills
3. Electric Machinery - Dr.S.K.Sen;
4. Perfomance & Design of Alternating current Machines - M.G.Say; CBS Publisher

Reference Books

1. Electrical Machines - S.K.Bhattacharya; Tata McGraw Hills
2. Theory of Alternating Current Machinery- Alexander S. Langsdorf; McGraw Hill

EE 4.5 ANALOG & DIGITAL COMMUNICATION

Lectures per week	3 Hours.
Tutorials per week	1 Hour
Practicals per week	2 Hours
Maximum marks for the paper	100
Maximum marks for Practicals	0
Max marks for sessional	25
Duration of the paper	3 Hours

MODULE I

Modulation Techniques: Basic principles of amplitude modulation (AM), frequency spectrum of AM wave, AM power and current relationships, generation of AM wave using basic transistorized circuits, Envelope DSB and SSB techniques, VSB transmission detection. (9Hours) .

Basic theory of frequency and phase modulation, spectrum of FM, pre emphasis and de emphasis, AFC and AGC principle block diagram. Operation of AM and FM transmitter and Receiver. Frequency Division Multiplexing. (6 Hours).

MODULE II

Sampling Theory: Sampling theorem, recovery of signal from samples. Basic principles of PAM, PWM and PPM, their generation and detection circuits, Quantization, Quantization noise & compounding principles of PCM transmission & Reception, Time division multiplexing. Delta modulation and Adaptive delta modulation. (8 Hours).

Digital Modulation techniques:- ASK, FSK and PSK. Modulator / demodulator circuits of BPSK, QPSK and DPSK. (6Hours).

MODULE III

Data Communication: Components, basic concepts – line configuration point to point, multipoint Topologies Mesh, star, tree, Bus, Ring, hybrid .Access method – Command/ response, interrupt driven, token passing. Line Encoding and error detection and correction (LRC/CRC, Hamming and CRC codes only).

Principles of modems and working of half duplex and full duplex modems.CSMA/CD, Drawbacks of CSMA/CD. (9 Hours).

Principle of Telephony (cross bar Exchange only) DFMT – hand sets, Cellular mobile Telephony (block diagram only), GSM- mobile services, system architecture, security.

Fiber Optic Communication: - Types Mobile Communication – Jochen of fibre such as step and graded index, Principle of Optical Transmission, Optical sources (LED's and ILD's only) optical detectors (PIN diode and APD only). Application in Telecommunication. (6 Hours).

MODULE IV

Satellite orbits and Television: Synchronous orbit, geostationary orbit, Satellite Subsystem (block diagram) Earth station (Block diagram), Telemetry tracking and command. (5 Hours)

Introduction to Television **:** Standards and Principles, Interlaced Scanning, Bandwidth requirements, Compatibility of B & W and Colour TV transmission, Block diagram of a B & W and Colour TV transmission.

Basic principle of antenna used for TV and Satellite reception. Yagi Uda (dipole) and parabolic dish antenna only. (10 hours).

Text books:

1. Electronic communication System- George kennedy;Tata McGraw Hill
2. Telecommunication Switching Systems and Networks – Thyagrajan Vishwanathan;PHI
3. Electronics Communication Systems – W Tomasi;PHI
4. Monochrome & Colour Television – R. R. Gulati; New Age International Ltd.

Reference books:

1. Data communication & Networking – Forouzan; Tata McGraw Hill
2. Satellite Communication – D C Agarwal; Khanna Publishers
3. Optical fiber communication-Keiser ;McGraw Hill
4. Moblile Communication – Jochen Schiller; Education Asia

EE 4.6 ECONOMICS AND MANAGEMENT

Lectures per week	3 Hours
Tutorials per week	-------
Practicals per week	------
Maximum marks for the paper	100
Maximum marks for practicals	0
Maximum marks for sessionals	25
Duration of the paper	3 hours

MODULE I

Demand and supply analysis

Main determinants, Demand and supply schedule, derivation of demand and supply curve, Law of demand and law of supply, Total Revenue and Marginal revenue, Market Equilibrium. (6 hours)

Price, Income and Cross elasticity, Applications of elasticity, Demand forecasting.

National Income terms – GDP, Real vs. Nominal GDP, NNP, GNP, Per Capita Income, Disposable income. (7 hours)

MODULE II

Price index

Construction of price index, Consumer, Wholesale and Labour Price index, Inflation: Causes, Theories, Measures to control inflation (7 hours)

Break-even analysis: Break-even chart, Contribution margin, Break even volume, Break even revenue. Capital budgeting: Importance and need, Steps in preparing a capital budget. Different approaches to drawing up a capital budget, Different methods of evaluation of projects – Payback period, Accounting rate of return, Net Present Value Index, Internal Rate of return. (6 hours)

MODULE III

Science of management:

Definition, Different schools of management; Scientific management, Modern Operational Management, Behavioral Management, Main functions of a manager.

Planning : Importance of managerial planning, Types of plans. (7 hours)

Organisation, Purpose, Structure of organisation, Types of organisation structures, Delegation and Decentralisation, Advantages, Limitations. (4 hours)

MODULE IV

Motivation Theories of motivation :Maslow's theory of needs, Herzberg's theory, Vroom's Expectancy theory

Leadership: Different styles, Theories of leadership (5 hours)

Communication: Nature of communication, Basic communication process, Formal and informal communication, Barriers in communication, Guidelines for improved communication, Principles of effective communication (3 hours)

Text books:

1. Managerial Economics – Varshney and Maheshwari; Sultan Chand & Sons
2. Essentials of management – Harold Koontz and Heinz Weihrich; Tata McGraw Hill
3. Principles of management – Tripathi and Reddy; Tata McGraw Hill

Reference books:

1. Managerial Economics – Petersen and Lewis; PHI
2. Economics – Samuelson and Nordhaus; Tata McGraw Hill
3. Management – James Stoner, Edward Freeman and Daniel Gilbert;PHI

Scheme of Instruction and Examination

Third Year Engineering

(Electrical & Electronics Engineering)

(Revised in 2007-2008)

SCHEME OF INSTRUCTION & EXAMINATION
THIRD YEAR (ELECTRICAL & ELECTRONICS ENGINEERING)

SEMESTER V

Subject Code	Subject	L	T	P	Duration of Theory Exam	Marks Alloted			Total
						TH	S	P	
EE 5.1	Electromagnetic Theory	3	1	--	3 Hrs	100	25	---	125
EE 5.2	Electrical Machines III	3	1	2	3 Hrs	100	25	50	175
EE 5.3	Design of Electronic Circuits	3	1	--	3 Hrs	100	25	---	125
EE 5.4	Control Engineering	3	1	2	3 Hrs	100	25	---	125
EE 5.5	Microprocessor and Interfacing	3	1	2	3 Hrs	100	25	50	175
EE 5.6	Electronic Instrumentation	3	1	2	3 Hrs	100	25	---	125
	Total	18	6	8		600	150	100	850

- Practical examination I shall consist of experiments from subjects EE5.2 and EE5.4.
- Practical examination II shall consist of experiments from subjects EE5.5 and EE5.6.

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Semester VI

Subject Code	Subject	L	T	P	Duration of Theory Exam	Marks Allotted			Total
						TH	S	P	
EE 6.1	Power Electronics	3	1	2	3 Hrs	100	25	50	175
EE 6.2	Digital Signal Processing.	3	1	-	3 Hrs	100	25	--	125
EE 6.3	Electrical Power System I	3	1	-	3 Hrs	100	25	--	125
EE 6.4	Electrical Drives and Control	3	1	2	3 Hrs	100	25	50	175
EE 6.5	Embedded Systems	3	1	2	3 Hrs	100	25	--	125
EE 6.6	Electrical Machine Design	3	1	2	3 Hrs	100	25	--	125
	Total	18	6	8		600	150	100	850

- Practical examination shall I consist of experiments from subjects EE6.1 and EE6.5
- Practical examination shall II consist of experiments from subjects EE6.4 and EE6.6

EE 5.1 ELECTROMAGNETIC THEORY

Lectures per week	3 Hours
Tutorials per week	1 Hour
Maximum marks for the paper	100
Max. Marks for sessionals	25
Duration of Paper	3 Hours

MODULE I

Electrostatics (Part I)

Vector Algebra, Dot product, Cross product of vectors. Gradient, Curl, Divergence as applied to Vector fields. Rectangular, Cylindrical, Spherical coordinate systems. [5 hrs]

Coulomb's law in vector form, Electric Field Intensity (E), Electric Field due to Line charge, surface charge, volume charge. Electric Flux density (D), Gauss law and its applications.

Electric field and potential correlation, Laplace's and Poisson's Equation and its solution in all above coordinate systems. [10 hrs]

MODULE II

Electrostatics (Part II)

Electric dipole, Electric Field of Dipole, Polarization in Dielectric, Capacitance, Energy stored in Electric Field, Boundary relation between E and D at the dielectric interface. [9 hrs]

Method of Images and its applications, Maxwell's equation in electrostatics. Electrostatic shielding.[6 hrs]

MODULE III

Steady Magnetic Field

Steady current, Current density, Continuity equation, Biot-Savart law, Magnetic Flux density (B) for line, ring, current elements. Magnetic Intensity (H), Magnetic Intensity due to solenoid, Ampere's Circuital law and its applications, Magnetic circuits. [10 hrs]

Lorentz–force equation, Force and Torque experienced by current element and closed loops. [5 hrs]

MODULE IV

Time changing Magnetic fields

Inductance and Mutual inductance, Energy stored in Magnetic field, Faraday's Laws and application. Maxwell's Equation for time varying Magnetic Field, Displacement current. [10 hrs]

Introduction to Transverse Electromagnetic Waves, Wave equation and Poynting Vector. [5 hrs]

Text Books

1) Electromagnetics (Second Edition) John D. Kraus, Keith R. Carver. McGraw- Hill Book Company.
2) Fundamentals of Electromagnetics with Matlab Karl E. Lonngren, Sava V. Savov Prentice -Hall of India.
3) Elements of Electromagnetics: - Matthew N. O. Sadiku. Oxford University Press,

Reference Books

1) Engineering Electromagnetics William H. Hayt Jr., John A. Buck. Tata McGraw-Hill.
2) Engineering Electromagnetics Dr. D. Ganesh Rao, C.K. Narayanappa, Sanguine Technical Publisher.
3) Introductory Course in Electromagnetics Fields:-P. V. Gupta, Dhanpat Rai and Sons Publication.

EE 5.2 ELECTRICAL MACHINES III

Lectures per week	3 Hours
Tutorials per week	1 Hour
Practical per week.	2 Hours
Maximum marks for the paper	100
Maximum marks for practicals	50
Max. Marks for sessionals	25
Duration of Paper	3 Hours

MODULE I

Synchronous Machines: Construction, Emf equation and torque equation. Basic synchronous machine model, realistic machine. Synchronous machine on load (generating and motoring action) Circuit model of synchronous machine. Synchronous impedance, determination of synchronous reactance using OCC and SCC. Emf, mmf and Pottier method for determining voltage regulation [7 hrs]
Armature reaction and leakage reactance, nature of armature reaction in synchronous generators and motors. Operating characteristics of generators, and motors, variable excitation with constant load, power angle diagram, synchronous condenser, V-curves and 0-curves. Power flow equations. [8 hrs]

MODULE II

Salient Pole Synchronous Machine: Two-reaction model: analysis and phasor diagram. Determination of X_d and X_q (slip test). Synchronizing the synchronous generators to infinite bus bars. Parallel operation of synchronous generators. [8 hrs]
Hunting in synchronous machines, short circuit transients, I.S.I tests on synchronous machines. Synchronous induction motor, circle diagram, secondary connection, magnitude of D.C. excitation.[7 hrs]

MODULE III

Construction, performance, characteristics and applications of single phase synchronous motors. [3 hrs]
Hysteresis and reluctance motor, stepper motor. Single phase series motor and universal motor. [6 hrs]
Single phase repulsion motor and repulsion start induction motor. PMDC motors. Brushless motors.[6 hrs]

MODULE IV

Introduction to linear induction motor, eddy current slip coupling. [5 hrs]
Linear transformation in Machines**:** transformation from rotational axis to stationary axis. Dynamics of Synchronous machines and dynamics of Induction machines. [10 hrs]

Text Books

1) Electric Machinery – I. J. Nagrath and D. P. Kothari, Tata McGraw-Hill Publications
2) Electrical Machinery - Dr. S. K. Sen, Khanna Publishers, New Delhi
3) Electric Machinery – P.S Bhimbra, Khanna Publishers, New Delhi

Reference Books

1) Generalized theory of Electrical machines - P.S. Bhimbra , Khanna Publishers , New Delhi
2) Performance and Design of Alternating Current Machines - M.G.Say, CBS Publishers, New Delhi.

EE 5.3 DESIGN OF ELECTRONIC CIRCUITS

Lectures per week	3 Hours
Tutorials per week	1 Hour
Maximum marks for the paper	100
Max. Marks for sessionals	25
Duration of Paper	3 Hours

MODULE I

Unregulated Power supplies: Half and full wave rectifiers, ripple factors, filters, design of above filters with half and full wave rectifiers. [7 hrs]
Regulated power supplies: Design of simple Zener diode voltage regulator, transistor shunt and series (emitter follower regulator with and without feedback), modification of series voltage regulator with Darlington pair and current source, IC voltage regulators. [8 hrs]

MODULE II

Voltage amplifiers: design of single stage and two stage voltage amplifiers (BJT and FET). [7 hrs]
Power amplifiers: Heat sink, design of class 'A' power amplifiers (with and without transformer, design of class 'B' push pull amplifier. [8 hrs]

MODULE III

Oscillators: Design of RC phase shift oscillators (BJT, FET), design of Wein bridge oscillator. [8 hrs]
Tuned collector/oscillator, design of Hartley, Colpitts oscillators (BJT, FET). [7 hrs]

MODULE IV

Multivibrators: Design of astable, bistable, monostable multivibrators (symmetrical), Schmitt trigger.[7 hrs]
Design of controlled rectifier using UJT oscillator, RC trigger circuit. Design using IC's and software for above modules. [8 hrs]

Text Books

1) Electronic Circuit Analysis and Design with CD-ROM – 2nd Edition-Donald A Neamen, McGraw Hill.
2) A Monograph on Electronics Design Principles – Khetan and Goyal, Khanna Publisahers New Delhi

Reference Books

1) Transistor circuit Design – Texas instruments.
2) SCR Manual – General Electric.

EE 5.4 CONTROL ENGINEERING

Lectures per week	3 Hours
Tutorials per week	1 Hour
Practical per week.	2 Hours
Maximum marks for the paper	100
Max. Marks for sessionals	25
Duration of Paper	3 Hours

MODULE I

Basic definition and elements of open loop and closed loop control systems. Types of feed back control systems, linear time variant and time invariant systems, non-linear systems, adaptive control systems.

[3 hrs]

Servo systems components: Servo amplifiers, Controllers (PI/PD/PID), DC servomotors, Armature control and field control, AC servomotor, Potentiometers, Synchros, Stepper motors. Mathematical models of systems. Differential equations of physical systems, electrical, mechanical and thermal systems. [12 hrs]

MODULE II

Linearization of non-linear systems, Laplace transforms. Transfer functions of linear systems. Block diagrams, Signal flow graphs, Mason's gain formula. [7 hrs]
Time response of linear first order and linear second order systems. Time domain performance specifications. Steady state error of feed back control systems, error constants and error series. [8 hrs]

MODULE III

Stability of linear feedback systems: Concept of stability, Routh-Hurwitz stability criterion. Root Locus method, Root locus concept, Root locus methods and rules for construction of Root loci. [9 hrs].
Frequency Response methods, Logarithmic plots, Polar plots. Introduction to PID controller, tuning rules for PID controller, two degree freedom control. [6 hrs]

MODULE IV

Frequency response: log magnitude versus phase plots, Nyquist stability criterion, Relative stability, gain margin, phase margin, M and N circles, Nichols chart. [7 hrs]
Preliminary design considerations, Lead compensation, Lag compensation, Lag-lead compensation.
Compensator design in time and frequency domain. [4 hrs]
Analysis of Control system in State Space, State Space representation, solving time invariant state equation.
[4 hrs]

Text Books

1) Modern Control Engineering K. Ogata, PHI Publication
2) Control Systems Engineering I. J. Nagath and M. Copal, New Age Publisher.
3) Control Systems M. Gopal, TMH Publication.

Reference Books:

1) Automatic Control System - B. C. Kuo, PHI.
2) Control System Engineering Norman Nise, Wiley Edition.

EE 5.5 MICROPROCESSOR AND INTERFACING

Lectures per week	3 Hours
Tutorials per week	1 Hour
Practical per week.	2 Hours
Maximum marks for the paper	100
Maximum marks for practicals	50
Max. Marks for sessionals	25
Duration of Paper	3 Hours

MODULE I

Introduction to Mainframe, Mini computers, Microcomputers. Block diagram of a typical microcomputer system – CPU, Address/Data Bus, Control unit, control bus, Memory (RAM / ROM), 8085, 8086, 80186, 80286, 80386, Pentium processors). [2hrs]

8086 architecture: Internal block diagram, Bus interface Unit, Execution Unit, General purpose registers, Flag register, Segment registers, Instruction Pointer, Stack pointer, Index registers. Concept of physical and effective address. Timing diagrams for read and write instructions. Modes of operation – Minimum and Maximum modes, circuit connections for minimum and maximum modes. [6 hrs]

Introduction to programming of 8086 – Concept of Machine language, assembly language (opcode and operand), high level language, addressing modes, Instruction types – Data transfer (Coding templates for MOV instruction, Instruction codes for 8086 registers), Arithmetic, Logic, Input/Output, branching and looping. Counters and delays, assembly language programming examples. [7 hrs]

MODULE II

8086 String instructions, CALL and RET instructions along with their formats, functioning of stack with respect to call and ret instructions, PUSH and POP instructions, procedures, passing parameters to and from procedures (using registers, memory locations, pointers, stack), reentrant and recursive procedures. Macro – Defining and calling a macro, passing parameters to macros. Procedures versus macro. [6 hrs]

Concept of interrupt in a microprocessor, sequence of events when microprocessor is interrupted, 8086 interrupts, interrupt types, software interrupts, hardware interrupts, interrupt priority. [4 hrs]

8259 Priority interrupt controller - Block diagram, Interfacing to 8086, Initialization command words (ICW's), Operational command words (OCW's)**.** [5 hrs]

MODULE III

Interfacing **-** Memory and I/O organization, Memory mapped I/O and I/O mapped I/O, I/O data transfer schemes simple I/O vs. handshaked I/O, synchronous vs. asynchronous data transfer, interrupt driven transfer, DMA transfer.

Programmable peripheral interfaces: 8155 and 8255 PPI – Block diagram, various registers, control and status word formats, various modes in detail, interfacing with 8086 and Programming in various modes. [7 hrs]

Concept of DMA, advantages of DMA, 8257 DMA controller - Block diagram, various registers, working - modes of operation (Master and slave mode), Interface connections, timing diagrams, and applications.

ADC and DAC: Necessity, typical interfacing circuit and programming. Timer: Need for time delay loops, advantages and disadvantages of software timing loops, 8254 programmable timer/counter interface. Block

diagram, Interface connections to 8086, various registers, control word format, modes of operation and applications [8 hrs]

MODULE IV

Keyboard/Display interface**:** Various arrangements of keyboards and displays, various scanning and encoding/decoding schemes, stress on the overheads involved on the processor, necessity of 8279 programmable keyboard/display interface controller, block diagram, working and interfacing 8279 with 8086. [8 hrs]

Serial Communication: Serial / Parallel communication concepts, RS232C standard, Baud rate, Synchronous and asynchronous formats, USART 8251 - Block diagram, Interface connection, operation and applications. [4 hrs]

High level language for system programming a simple C program example program development tools for C. [3 hrs]

Text Books:

1) Microprocessor and Interfacing Douglas Hall, Tata McGraw Hill.
2) Intel Microprocessors Architecture and Programming Brey, PHI.
3) Microcomputer Systems. The 8086/8088 Family Architecture, Programming, Liu and Gibson, PHI.

Reference Books

1) Intel Microprocessors 8086, 80186, 80286, 80386, 80486 Pentium Processor.
2) Microprocessor and Microcomputer based system – M Rafiquazzaman,PHI

EE 5.6 ELECTRONIC INSTRUMENTATION

Lectures per week	3 Hours
Tutorials per week	1 Hour
Practical per week.	2 Hours
Maximum marks for the paper	100
Max. Marks for sessionals	25
Duration of Paper	3 Hours

MODULE I

Electronic Analog Voltmeter: Electronic DC Voltmeter, Electronic AC voltmeter, balanced bridge, peak responsive and RMS responsive voltmeters, logarithmic voltmeters, differential voltmeters. Electronic millimeters, considerations in choosing an analog voltmeter. Vector impedance meter, vector voltmeter, PH meter. [10 hrs]

Digital instruments: Operating principles of DVM using successive approximation, V/F conversion and integrating principles. Digital method for frequency, phase, time and period measurements. Specifications of digital voltmeters. . [5 hrs]

MODULE II

Cathode Ray Oscilloscope: Cathode ray Tube (CRT). Subsystem of a general purpose oscilloscope. Horizontal and vertical positioning controls, time-base generators - free running and trigger mode, synchronization of sweep circuits. Use of CRO for voltage, current, frequency and phase measurement and for study of wave forms. Circular Time base, velocity and intensity, modulation. Dual trace and double beam CRO. Storage and digital CRO. [8 hrs]

Frequency Meters: Introduction, elements of counting and digital display, elements analog frequency meter. Time-base and associated circuits. Electronic counter as frequency, time period and time interval measuring device, universal counter-timer. Heterodyne principle. Analog phase meter (phase detector as phase meter), analog phase meter using Flip-flops. Digital phase meter. [7 hrs]

MODULE III

Q-Meters: Basic concept, measurement methods, direct connection, series and parallel connection, sources of error in measurement of Q.

Signal Generators: AF and RF Oscillators and signal generators. Laboratory type pulse and square wave generators, standard signal generators. Function generators. [8 hrs]

Signal Analysis – Wave Analyzers, Harmonic distortion analyzers, spectrum analyzers. Block diagram of Data Acquisition System. Functional description classification of transducers, selecting transducers, Instrument used in computer controlled Instrumentation. IEEE 488 Electrical Interface (GPIB) specification pin diagram, RS-485/RS-232C standard used for communication with specifications Advantages of using RS-485. [7 hrs]

MODULE IV

Virtual Instrumentation: Historical perspective, advantages, blocks diagram and architecture of a virtual instrument, data-flow techniques, graphical programming comparison with conventional programming. Applications of Virtual Instruments Software used in Creating Virtual Instruments. [5 hrs]

Development of Virtual Instruments, VI programming techniques: VIS and sub-VIS, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string related functions, Express VI, File related operation. Instrument Drivers. Writing Programs to read and write the interface devices and creating Graphical user Interface. [10 hrs]

Text Books

1) Electronic instrumentation and measurement techniques - W.D Cooper, PHI.
2) Electronic Instrumentation- Kalsi H. S, TMH.
3) Lab VIEW Graphical Programming, Gary Johnson, second edition, McGraw Hill.

Reference Books

1) Modem Electronic Instrumentation and Measurement- A.D.Helfrick, Cooper, PHI
2) Electronic Instrumentation Fundamentals - A.P.Malvino, TMH.
3) LABVIEW Express Robert Bishop, PHI

EE 6.1 POWER ELECTRONICS

Lectures per week	3 Hours
Tutorials per week	1 Hour
Practical per week.	2 Hours
Maximum marks for the paper	100
Maximum marks for practicals	50
Max. Marks for sessionals	25
Duration of Paper	3 Hours

MODULE I

Brief Introduction of Power Electronics Components –Schottky diodes, Fast recovery diodes, Power zener diode, Thyristors, DIAC, TRIAC, GTO, Power Transistors (BJT, MOSFET and IGBT). [5 hrs]
Losses and Cooling, Triggering circuits for Thyristors and gate drive circuits for Power Transistors. Snubber design and protection. [5 hrs]
Commutation circuit for Thyristors: Class A, Class B and Class C, Series and Parallel connection of thyristors. [5 hrs]

MODULE II

AC to DC conversion- Single phase controlled converters, half-wave and full-wave controlled converter with R, R-L, R-L-E load. Single-phase dual converter. Effect of freewheeling diode. [4 hrs]
Single-phase half controlled and fully controlled bridge converters, effect of input source impedance.[3 hrs]
Three phase controlled rectifiers: three phase half controlled and fully controlled converter with R, R-L and R-L-E load. Dual converter. [8 hrs]

MODULE III

DC to DC conversion: Principle of chopper operation. Classification and analysis of choppers, Buck, Boost and Buck/Boost regulators. [6 hrs]
Control strategies, commutation in choppers. Impulse commutated, resonant pulse commuted and load commuted thyristor chopper circuits. [5 hrs]
Jones's chopper, Morgan's chopper, AC chopper. [4 hrs]

MODULE IV

DC to AC conversion: Principle of operation of inverter, Classification of inverter, series inverter, parallel inverter, bridge inverter. Self commutated inverter, three phase inverter (120 degree and 180 degree conduction mode), Single phase bridge voltage source inverter, current source inverter. [4 hrs]
Voltage control of single phase inverters: Single PWM, multiple PWM and sinusoidal PWM methods, Basic concept of PWM controlled inverter. [4 hrs]
AC to AC conversion: Single phase AC voltage controllers, Single phase to single phase cycloconverter, centre tap and bridge configuration. Three phase to single phase and three phase to three phase Cycloconverter. [7 hrs]

Text Books

1) Power Electronics - M H Rashid, Pearson Education/PHI publication
2) Power Electronics – M. D. Singh and K. B. Khanchandani, Tata McGraw Hill
3) Power Electronics - P.S. Bhimbra 2nd Edition, Khanna Publishers, 1998

Reference Books

1) Power Electronics - C.Y.Lander, McGraw Hill publishing
2) Power Electronics - M. S. Jamail Asghar, PHI publications

EE 6.2 DIGITAL SIGNAL PROCESSING

Lectures per week	3 Hours
Tutorials per week	1 Hour
Maximum marks for the paper	100
Max. Marks for sessionals	25
Duration of Paper	3 Hours

MODULE I

Signal and system modeling concepts**:** Examples of systems, Signal Models, Energy and Power signals, Energy and Power Spectral densities. [7 hrs]

Modeling and Analysis in Time domain**:** System modeling concepts, linear time invariant systems, Superposition, Convolution, Step response, Frequency response, stability. [8 hrs]

MODULE II

State variable techniques: State space concepts, State equations, Time domain solution of state equations, Frequency Domain solution, state transition matrix, State equations for Electrical network, state equations from transfer functions. [7 hrs]

Fourier transforms and applications: Fourier integral, Energy spectral density, Fourier transform theorem, System Analysis with Fourier transform, Steady State System response to sinusoidal input, ideal filters, bandwidth rise time. [8 hrs]

MODULE III

Discrete time signals systems**:** A/D Conversion: Sampling, Impulse train sampling model, Data reconstruction, Quantizing and encoding, Z transforms: Definition, Properties of Z-Transforms, Inverse Z transformation by partial fraction, power series and inversion integral methods, difference equations and discrete time systems [7 hrs]

Analysis and design of Digital filters: Structures of digital processors: direct form, cascade and parallel realizations, discrete time integration, rectangular, trapezoid, Infinite impulse response (IIR) filter design synthesis in time domain, frequency domain, bilinear z-transform band pass filters. Finite duration impulse response (FIR) digital filter: design, causal filters [8 hrs]

MODULE IV

The Discrete Fourier Transform**:** Frequency domain sampling and reconstruction of discrete time signals, DFT, relationship with other transforms, properties of DFT, examples illustrating the computation of DFT. [7 hrs]

Mathematical derivation of FFT: decimation in time and decimation in frequency FFT algorithms, applications of FFT (Filtering, Spectral analyzer, Convolution etc.).Windows and their properties, Selection of Parameters for signal processing with DFT, Chirp-z Transform algorithm [8 hrs]

Text Books:

1) Signals and Systems – Zeimer, Tranter, Fannin, IE – Prentice Hall of India
2) Signals and Systems- Oppenheim and Willskay, Hamid Nawab, Prentice Hall of India
3) Digital Signal Processing John G Proakis, Dimitris Manolakis, Prentice Hall of India

Reference Books:

1) Introduction to signals and system – Linder, McGraw Hill
2) Signals and system-Nagrath, Sharan, Rajan and Kumar, McGraw Hill
3) Signals and system-Simon Haykin and Barry Van Veen, John Weily and Sons.

EE 6.3 ELECTRICAL POWER SYSTEMS -I

Lectures per week	3 Hours
Tutorials per week	1 Hour
Maximum marks for the paper	100
Max. Marks for sessionals	25
Duration of Paper	3 Hours

MODULE I

Representation of power system, Single line diagram, equivalent impedance diagram, per unit system. Introduction to symmetrical components, Faults in power systems, symmetrical and unsymmetrical. [7 hrs]
Analysis of faults in power systems by symmetrical components, Sequence networks and their inter connections for different types of faults, short circuit calculation, selection of current limiting reactors. [8 hrs]

MODULE II

Load flow studies – Bus classification, Formation of Y_{BUS} by singular transformation. [2 hrs]
General load flow equations, Gauss-Seidal method – Newton Raphson method – Decoupled load flow method, Fast Decoupled load flow, Comparison of different methods, introduction to power flow studies in system design and operation. [10 hrs]
Control of voltage profile. [3 hrs]

MODULE III

Power system stability – Rotor dynamics and swing equation, power angle equation, synchronizing power coefficients, steady state stability, transient stability and Dynamic stability. [5 hrs]
Equal area criterion, numerical solution of swing equation, multimachine stability, introduction to computer techniques for transient stability studies. Factors affecting transient stability and methods for its improvement. [10 hrs]

MODULE IV

Automatic Generation and Voltage Control. Model of speed governing system, turbine model, generator model. [4 hrs]
Introduction to Load Frequency Control of an isolated system (Single Area case), control area concept, load frequency Control and Economic Dispatch Control, Automatic Voltage Control. Introduction to reactive power control. [8 hrs]
Optimal System operation – Optimum generation scheduling –transmission loss coefficients. [3 hrs]

Text Books

1) Elements of Power System Analysis, Stevenson W.D. Jr and Grainger, Tata McGraw Hill publication.
2) Modern Power System Analysis I. J. Nagrath and D. P. Kothari, Tata McGraw Hill.
3) Electrical Power System -B R Gupta, S. Chand and Company Ltd publications.

Reference Books:

1) Power Generation Operation and Control : Wood and Wollenberg, John Wiley and Sons publication.
2) Electrical Power Systems: B M Weedy, John Wiley and Sons publication.
3) Computer Techniques in power system: M. A. Pai, Tata McGraw Hill Publications.

EE 6.4 ELECTRICAL DRIVES AND CONTROL

Lectures per week	3 Hours
Tutorials per week	1 Hour
Practical per week.	2 Hours
Maximum marks for the paper	100
Maximum marks for practicals	50
Max. Marks for sessionals	25
Duration of Paper	3 Hours

MODULE-I

General concept of Electric drives, Classification of electric drives, Advantages of electric drives, components of electric drives, choice of electric drives, Selection of motor power rating, Thermal model of motor for heating and cooling, calculation of motor rating for various types of duty cycles. [6 hrs]

Dynamics of Electric drives, fundamental torque equation, speed torque equation of DC and AC motors, speed torque conventions, multiquadrant operations, Components of load torques, load equalisation. Types of braking, dynamic braking, counter current braking, Regenerative Braking of DC and AC motors.[7 hrs]

Classification of control schemes, manual control, semiautomatic control, automatic control. [2 hrs]

MODULE-II

Control of DC Drives:- Basic parameters, operating modes, motoring modes, Braking modes, schemes for DC motor speed control, Ward Leonard method, buck boost control, single phase, three phase fully controlled, half controlled DC drives, chopper controlled DC motor drives. [7 hrs]

Control of AC Motor Drives:-Basic parameters, speed control of induction motor drives, pole changing Induction motor drives, stator frequency variation. Speed control of slip ring induction motors, stator voltage variation, rotor resistance variation slip power recovery, eddy current drives, variable voltage variable frequency control. Speed control of Synchronous motor, input frequency variation, starting of large synchronous motor. [8 hrs]

MODULE-III

Motor starters and controllers: DC motor starters, starters using voltage sensing relays, current sensing relays, time delay relays, starters using frequency relays. [5 hrs]

DOL starters with provision for speed reversal Autotransformer starters, Rotor resistance starters, Master controller for wound rotor Induction motors, starting, plugging and speed reversal, starters for two speed pole changing induction motor. [5 hrs]

Starters for two winding two speed pole changing induction motor with provision for speed reversal (constant Torque), starter for single winding two speed pole changing Induction motor with provision for speed reversal, constant horsepower. [5 hrs]

MODULE-IV

Industrial applications:- Layout of electric drives Synchronous motor drives, Induction motor (squirrel cage/ wound rotor) drives, DC motor drives, Rolling mill drives, Reversing mill drives, Screw down mechanism, continuous mills, cold rolling mills, Cement mills, Paper mill drives and control machine tool Drives, Textile mill drives, weaving loom motors, Lathe Machine, Drilling Machine, Milling machine, Shaping Machine, Grinding Machine, Hydraulic Drives. [10 hrs]

Electric traction, tractive effort, requirements of Electric traction, suitability of series motors, coefficient of Adhesion, supply systems and traction motors, train movement, speed control. [5 hrs]

Text Books

1) Electric Drives- Nisit K De, Prashanta K Sen, PHI publication.

2) Electric Drives:- Mohammed A EL-Sharakawi, Vikas Publishing house.

Reference Books

1) Fundamentals of Electric Drives, Second Edition- Gopal K Dubey, Narosa publishing House.

2) Electric Drives-Concepts and applications- V Subramanayam, Tata McGraw Hill publication.

3) Electric Machines and Drive system: Alexander Fransua and others, Technical Press, London.

4) A First course on Electrical Drives S.K.Pillai, New Age International publishers.

EE 6.5 EMBEDDED SYSTEMS

Lectures per week	3 Hours
Tutorials per week	1 Hour
Practical per week.	2 Hours
Maximum marks for the paper	100
Max. Marks for sessionals	25
Duration of Paper	3 Hours

MODULE I

Introduction to embedded systems**:** Definition and Characteristics of Embedded systems, Overview of processors and hardware units in an embedded system, Software embedded into the system, Concept of Real time Systems, Challenges in Embedded System Design. [2 hrs]

Embedded System Architecture: Instruction Set Architecture: CISC and RISC instruction set architecture, Harvard and Princeton architecture. Basic Embedded Processor/Micro controller Architecture. [3 hrs]

Detailed architecture of 8051 - Functional block diagram, Hardware description -Register structure, Memory organization, SFR memory map, Addressing modes, Boolean processing, instruction set, simple programs. I/O ports, Port configuration, Serial port, Timers/Counters, Interrupts and Programming. [10 hrs]

MODULE II

Interfacing and applications of 8051 micro controller: Keypad interfacing, LED interfacing, Seven segment interfacing, LCD interfacing, ADC/DAC interfacing, Stepper motor interfacing, Automobile turn indicator, Small dc motor control, Stepper motor control, AC power control. Software simulations: Writing assembly language and C programs. [8 hrs]

Devices and communication Buses ,: Network I/O devices – Serial I/O devices, UART and HDLC, Parallel port devices. Timers and counters. Need of watchdog timers, BUSES : I^2C, USB, CAN and advanced I/O serial high speed buses, ISA, PCI, PCI-X buses. [7 hrs]

MODULE III

Detailed architecture of ARM 7: Block diagram, Functional diagram with description of various signals, various registers, hardware configurations, and operating modes: User mode, FIQ mode, IRQ mode, Supervisor mode, Abort mode, undefined mode. [5 hrs]

Instruction set - Data processing instructions, branching instructions, arithmetic and logical instructions, and data transfer instructions, coprocessor data operations, data transfers and register transfers, Addressing modes. RTOS: Introduction, scheduling in real time operating systems. [10 hrs]

MODULE IV

Hardware design: Hardware connections, drive and interface levels, analog inputs and outputs, I/O and serial port timings, bus timing and memory interface Expansion methods: I/O port expansion, memory expansion, serial port expansion in a microcontroller system. [5 hrs]

Programmable Logic Devices: Introduction, PLC architecture, PLC programming and programming languages, ladder diagrams, typical applications - Washing machine control, Bottling Plant control. Software simulations. [10 hrs]

Text Books

1) The 8051 Microcontroller and embedded systems using assembly and C, Mazidi, PHI.
2) Embedded Systems – Architecture, Programming and design – Raj Kamal, TMH.
3) Programmable Logic Controller – Hackworth, Pearson Edition.
4) ARM Architecture Reference Manual- David Seal, Second Edition, Addison-Wesley.

Reference Books

1) Programming and customizing 8051 Microcontroller – Predko, Tata McGraw Hill.
2) 8051 Microcontroller Architecture and Programming – Ayala, Penram International Publisher.

EE 6.6 ELECTRICAL MACHINE DESIGN

Lectures per week	3 Hours
Tutorials per week	1 Hour
Practical per week.	2 Hours
Maximum marks for the paper	100
Max. Marks for sessionals	25
Duration of Paper	3 Hours

MODULE-I

General**: -** Basic principles of Electric machine design, General design considerations, specification of machines, Types of Enclosures, Type of Ventilations, Heating cooling curve, estimation of maximum temperature rise, short time rating, overload capacity, cooling mediums. Review of properties of insulating materials used in Electrical machines. [8 hrs]

Classification of magnetic materials, allowable flux densities, calculation of magnetic circuits, magnetising current, coils for given ampere turns, real and apparent flux densities, overhang leakage and zigzag leakage, leakage reactance. General features of armature windings, single layer and double layer winding, winding factors. [7 Hrs]

MODULE-II

Transformers:-Constructional details, core and shell types, Distribution and Power Transformers, types of coils, windings, number of turns, current density, conductor selection, allocation of losses, momentary load limitations, output equation of three phase and single phase transformers, specific loading, leakage reactance calculations, determination of main dimensions. [8 hrs]

Design of low voltage and high voltage windings, cooling system, estimation of core losses and magnetizing current, Regulation and efficiency. Design of Tank and Radiators. Design aspect based on switching surges, voltage surge and mechanical stress under fault condition. Tap changers for Transformers. Salient Features of Energy Efficient Transformers. [7 hrs]

MODULE-III

Three phase Induction Motors:-Constructional details, magnetic circuit calculations, output equation, specific electric and magnetic loadings, efficiency and power factor, main dimensions, D-L determination, winding design of stator, design of stator stampings. [7 hrs]

Rotor design, calculation of air gap length, design of squirrel cage rotor, shape and size of rotor slots, rotor slot insulation, end ring current, design of end ring, design of slip ring rotor winding. [8 hrs]

MODULE –IV

Synchronous Machines:- Constructional details, specific Electric and Magnetic loadings, output equation, main dimensions, types of windings, number of slots and slot design, field winding design, length of air gap and effect of SCR on performance of Machine, cooling of Alternator. [8 hrs]

Introduction to Design of Single phase Induction Motor. [3 hrs]

Design and Estimation of Industrial power supply Installations (Load above 1 MVA, supplied from HT three phase supply). [4 hrs]

Text Books

1) Course in Electrical Machine design:–A.K .Sawhney, Dhanpat Rai and Sons Publication.

Reference books

1) Design and Testing of electrical Machines – M.V.Deshpande, Wheeler Publications.

2) Principles of electrical machine Design - R.K.Agarwal, Esskay publication.

3) Computer aided design o f Electrical equipment-Ramamurthy M, East West Press.

SCHEME OF INSTRUCTION & EXAMINATION

FINAL YEAR (ELECTRICAL & ELECTRONICS ENGINEERING)

Semester VII

Code No	Subject	L	T	P	Duration of Theory Exam	Marks Allotted				Total
						Theory	S	P	O	
7. 1	VLSI Circuit Design	3	1	2	3	100	25	-	50	175
7.2	Electrical Power System II	3	1	-	3	100	25	-	-	125
7.3	Advanced Controlled drives	3	1	2	3	100	25	-	-	125
7.4	Elective I	3	1	2	3	100	25	-	50	175
7.5	Elective II	3	1	2	3	100	25	-	50	175
7.6	Project	-	-	3	-	-	25	-	50	75
	Total	15	5	12	-	500	150	-	200	850

Elective I	Elective II
7.4.1 Power system Deregulation	7.5.1 Engineering Design
7.4.2 Switch Mode Power conversion	7.5.2 Special Electric Machines
7.4.3 Electrical Estimation and costing	7.5.3 Flexible AC Transmission System
7.4.4 Advanced Digital Signal Processing	7.5.4 Data communication and Networking
7.4.5 Neural Networks and Fuzzy logic	7.5.5 Industrial Robotics
7.4.6 Data Base Management Systems	7.5.6 Satellite Communication

EE 7.1 VLSI CIRCUIT DESIGN

Lectures per week	3 Hours
Tutorials per week	1 Hour
Practical per week.	2 Hours

MODULE I

MOS transistor: Structure, MOS system under external bias, operation of MOS transistor (MOSFET), threshold voltage, MOSFET I-V characteristics [4 Hrs]
MOSFET Scaling and small Geometry effects: Full scaling, Constant Voltage scaling, short channel effects, narrow channel effects, MOSFET capacitances. [4 Hrs]
Modeling of MOS transistor circuits using SPICE (level1 model equations) [3 Hrs]
MOS Inverters: Static load MOS inverters, CMOS Inverter Design: DC characteristics, Noise Margin, Power and Area considerations [3 Hrs]

MODULE II

CMOS Design rules, stick diagrams [2 Hrs]
Combinational MOS Logic circuits: CMOS Logic circuits NOR, NAND, Complex logic circuits, Euler's path, Adder circuits, Transmission gates. [4 Hrs]
Sequential MOS Logic Circuits: Latches, flip-flops, registers. [4 Hrs]
Basic CMOS technology: A basic n-well and p-well CMOS process [4 Hrs]

MODULE III

VLSI design methodologies, VLSI design flow [2 Hrs]
VHDL : Introduction, Basic language elements, identifiers, data objects, data types
Behavioral modeling: entity, architectures, signals and variables, sequential processing statements.
Dataflow modeling: concurrent signal assignment statements, conditional signal assignment statements, assertion statement. [5 Hrs]
Structural modeling: component declaration, instantiation, Generics, Attributes, Configuration, Packages, Libraries. [2 Hrs]
Simulation: Simulation delta, transport and inertial delay models, test bench [2 Hrs]
Synthesis: Translation, Boolean optimization, flattening, factoring, mapping to Gates, VHDL Synthesis [3 Hrs]

MODULE IV

FPGA and CPLD: construction, working, features, differences [2 Hrs]
Top down approach location: Partitioning, Floor planning, Placement.
Top down approach Routing: Fundamentals, global routing, and detailed routing. [6 Hrs]
Validation and testing: Test procedure, Design for Testability (DFT), Scan – Based Test, Boundary- Scan Design, Built in self test (BIST), test-pattern generation, fault models, Automatic Test-Pattern generation (ATPG), Fault simulation [6 Hrs]

Text Books:

1. CMOS Digital Integrated Circuits Analysis and design by Sung-Mo Kang Yusuf Leblebici (Tata McGraw Hill Publication)
2. Digital Integrated Circuits – Jan M. Rabaey (Prentice Hall India)
3. VHDL Programming by Example – Douglas Perry (Tata McGraw Hill Publication)

References

1. VHDL Primer by J. Bhaskar
2. An introduction to VLSI Physical Design by Majid Sarrafzadeh (Tata McGraw Hill Publication)
3. Digital Design- Principles and Practices – John F Wakerly PHI
4. Basic VLSI Design- Douglas Pucknell, Kamran Eshraghian, PHI

Practicals will include:

1) VHDL/SPICE simulation
2) Layout editors (Magic/Micro Wind) and circuit extraction

EE 7.2 ELECTRICAL POWER SYSTEM II

Lectures per week	3 Hours
Tutorials per week	1 Hour
Maximum marks for the paper	100
Maximum marks for sessionals	25
Duration of the paper	3 hours

Module I

Protective Relays: Fundamental requirements of protective relaying, Basic relays - Electromagnetic, Induction type over current relays, IDMT relays. [6 Hrs]
Directional relays, Distance or Impedance relay, relay setting and operating time. Salient features of Numerical relays, Numerical protection. [9 Hrs]

Module II

Differential protection of alternator: Earth fault protection, restricted earth fault protection, stator sensitive earth fault protection, leakage to frame protection, protection against unbalanced loads. [5 Hrs]

Protection of transformers: Differential protection, over current and earth fault protection, restricted earth fault protection, gas actuated devices used for protection, thermal protection, over fluxing protection. [6 Hrs]

Protection of motors: Protection of 3 phase motors against over current, protection against single phasing and phase reversals, rotor protection against rotor faults. [4 hrs]

Module III

Protection of transmission lines and bus bars: Time graded protection, current graded protection, distance protection, plain impedance protection, directional impedance relay, reactance relay, mho relay, carrier assisted distance protection, carrier current protection. [7 Hrs]

Protection against lightning: causes of over voltages, mechanism of lightning, insulation coordination, types of lightning arrestors, surge absorbers, neutral earthing, types of neutral earthing, isolator earthing switch. [8 Hrs]

Module IV

Fuses: Desirable characteristics of a fuse element, types of fuses and their constructional features, difference between fuse and circuit breakers. [3 hrs]

Theory of circuit breakers: Fundamental of fault clearing, switching phenomena in circuit breakers, arc formation and arc extinction in circuit breakers, rating of circuit breakers. [6 Hrs]

Types of circuit breakers: construction and principle of arc extinction in air break circuit breakers, air blast circuit breakers, minimum oil circuit breakers, SF6 gas circuit breakers, vacuum circuit breakers. [6 Hrs]

Text Books

1. Fundamentals of Power System Protection - Paithankar YG, Bhide SP - PHI.
2. Switchgear and Protection, Sunil S. Rao, Khanna Publisher

References

1. Switchgear and Protection – M V Deshpande – TMH
2. Power system Protection – S. Badriram -- TMH
3. Power system protection - Ravindranath and Chander, New Age
4. Power system Protection static Relays with microprocessor application, T. S. Rao, TMH

EE 7.3 ADVANCED CONTROLLED DRIVES

Lectures per week	3 Hours
Tutorials per week	1 Hour
Practicals per week	2 Hours
Maximum marks for the paper	100

MODULE I

Introduction to AC motor drives- Induction Motor torque production, speed torque characteristics with variable voltage operation, variable frequency operation, constant voltage /frequency operation. Synchronous Motor power factor control. [10]

Induction motor characteristics in constant torque and field weakening region. [4]

MODULE II

Control of induction motor drive from stator side: Scalar control-voltage fed inverter control –open loop volts/Hertz control. [8]

Speed control with torque and flux control-current controlled voltage fed inverter drive, current fed inverter control, independent current and frequency control, speed and flux control in current fed inverter drive, volts/Hertz control. [6]

MODULE III

Control of induction motor drive from rotor side: Slip power recovery drives, static Kramer drive, phasor diagram, torque expression, speed control of Kramer drive, static scheribus drive, modes of operation [8]

Vector control of Induction motor drive from rotor side: Principles of vector control, vector control methods, direct methods of vector control, indirect methods of vector control. [6]

MODULE IV

Variable reluctance motor drive: Torque production in the variable reluctance motor drive, characteristics and control principles, current control, variable reluctance motor drive. Application of Variable Reluctance motors. [8]

Brushless DC motor drives: Three phase full wave brushless dc motor, sinusoidal type of brushless dc motor, current controlled brushless dc motor drive. [6]

Text books

1) "Modern power electronics and AC drives", Pearson publication, New Delhi
2) "Fundamentals of Electric Drive" , G K Dubey, Narosa publishers
3) "Electric motor drives : Modelling analysis and control ", PHI publications New Delhi

Reference Books

1) "Control of Electric Drives". W Leonard, Springer publications
2) "Power electronic control of AC motors", J M D Murphy and Turnbull, Pergamon press
3) "Sensorless vector and direct torque control" P Vas, Oxford press

7.4.1 POWER SYSTEM DEREGULATION

Lectures per week	3 Hours
Tutorials per week	1 Hour
Maximum marks for the paper	100

MODULE I

Concept of Deregulation, Need and conditions for deregulation. Introduction of Market structure, Market
Architecture, Spot market, forward markets and settlements. Marginal cost of generation, least-cost operation, incremental cost of generation.
Power System Operation: Old vs. New. [14 hrs]

MODULE II

Electricity sector structures and Ownership /management, the forms of Ownership and management. Different structure model like Monopoly model, Purchasing agency model, wholesale competition model, Retail competition model. Salient feature of Indian Electricity Act 2003.
[14 hrs]

MODULE III

Framework and methods for the analysis of Bilateral and pool markets, LMP based Markets. [7 hrs]
Auction models and price formation, price based unit commitment, country practices.
Transmission network and market power. Power wheeling transactions and marginal costing, and transmission costing. [7 hrs]

MODULE IV

Congestion management methods- market splitting, counter-trading; Effect of congestion on LMPs-country practices. Ancillary Services and system security in Deregulation. Classifications and definitions,
Ancillary Services management in various markets- country practices. [7 hrs]
Technical, economic, and regulatory issues involved in the deregulation of the power industry. [7 hrs]

Text Books:

1. Power System Economics: Designing markets for electricity - S. Stoft
2. Operation of restructured power systems - K. Bhattacharya, M.H.J. Bollen and J.E. Daalder
3. Market operations in electric power systems - M. Shahidehpour, H. Yamin and Z. Li
4. Competition and Choice in Electricity - Sally Hunt and Graham

Reference Books:

1. Power generation, operation and control, -J. Wood and B. F. Wollenberg
2. Fundamentals of power system economics - S. Kirschen and G. Strbac
3. Optimization principles: Practical Applications to the Operation and Markets of the Electric Power Industry - N. S. Rau

EE 7.4.2 SWITCHED MODE POWER CONVERSION

Module I

DC-DC Converters without Galvanic Isolation - linear power supplies - overview of switching power supplies - introduction to dc - dc switched mode converters - step down converters – continuous conduction mode - boundary between continuous and discontinuous conduction - discontinuous conduction mode - output voltage ripple [8 Hrs]

Step up converter - continuous conduction mode - boundary between continuous and discontinuous conduction - discontinuous conduction mode - buck boost converter - continuous conduction mode - boundary between continuous and discontinuous conduction - discontinuous conduction mode - output voltage ripple - full bridge dc-dc converter - PWM with bipolar and unipolar voltage switching - dc-dc converter comparison [7 Hrs]

Module II

Switching dc power supplies with isolation - dc-dc converters with electrical isolation - flyback converters - double ended flyback converter - forward converters - double ended forward converter - push pull converters - half bridge converters - full bridge converters [5 Hrs]

Voltage mode control of SMPS - loop gain and stability considerations - shaping the error amp frequency response - error amp transfer function - transconductance error amps - study of popular PWM Control ICs (SG 3525, TL 494, MC34060 etc.) [5 hrs]

Current mode control of SMPS - current mode control advantages - current mode Vs voltage mode - current mode deficiencies - slope compensation - study of a typical current mode PWM control IC UC3842 [5 Hrs]

Module III

Switch mode dc-ac converters - basic concepts of switch mode converters - PWM switching scheme - square wave switching scheme - single phase inverters - half bridge and full bridge inverters - SPWM with bipolar and unipolar voltage switching - push pull inverters - switch utilization in single phase inverters - three phase inverters [7 Hrs]

SPWM in three phase voltage source inverters - square wave operation - switch utilisation - ripple in the inverter output - conduction of switches in three phase inverters - effect of blanking time on voltage in PWM inverters - square wave pulse switching - programmed harmonic elimination switching - current regulated modulation - Single Phase Switched Mode Rectifier and its control [8 Hrs]

Module IV

Introduction to modeling of switched mode power supplies - state space averaging - state space averaged models - equivalent circuits and small signal transfer functions for basic converters [6 hrs]

Introduction to resonant converters - classification of resonant converters - basic resonant circuit concepts - load resonant converter - resonant switch converter - zero voltage switching clamped voltage topologies - resonant DC link inverters with zero voltage switching - high frequency link integral half cycle converter [9 Hrs]

Text Books

1. Pressman A I, Switching Power Supply Design, Mcgraw Hill

2. Mitchell D M, DC –DC Switching Regulator Analysis, Mcgraw Hill

3. Ned Mohan, Power Electronics, John Wiley and Sons

Reference Books

1 Otmar Kilgenstein, Switched Mode Power Supply in Practise, John Wiley

2. Billings K H, Handbook of Switched Mode Power Supplies, McGraw Hill

3. Nave M J, Power Line Filter Design for Switched Mode Power Supples, Van Nostard rheinhold

EE 7.4.3 ELECTRICAL ESTIMATION AND COSTING

Lectures per week	3 Hours
Tutorials per week	1 Hour
Practicals per week	2 Hours

MODULE I

Importance of electrical, costing and specifications, major applicable IE rule

Interior wiring System**:** Different wiring systems, comparison of the various systems. [7 Hrs]

Choice of wiring systems, adequate lighting, earthing, materials used for the electrification, estimation of wiring installations. [8 hrs]

MODULE II

Power Installation:

Load calculations, wire size selection, power circuit wiring materials used and their specifications [8 hrs]

Estimation for motor installation, pump sets, workshops and theatre**.** [7 hrs]

MODULE III

Transmission and distribution Lines:

Planning and surveying, applicable IE rules, materials requires for 400KV, 11KV and 400V lines. [7 hrs]

Estimates of 400 KV, 11 KV and 400 V/230V distribution system. Distribution transformer installation and estimation [8 hrs]

MODULE IV

Specifications: Importance of specifications, ISI specifications of alternators, transformers, induction motors, circuit breakers [7 Hrs].

Panels for transformers, overhead line conductors, insulators, underground cables, storage batteries and earthing electrodes. [8 Hrs].

Text books

1. Dhanpat Rai and K. R. Gangadhar Rao, Electrical Estimating and Energy Management Sapna Publications, 2006

Reference books:

1. S.K. Raina and Bhattacharya, Electrical Design Estimation and Costing, Wiley Eastern limited 2007

EE 7.4.4 ADVANCED DIGITAL SIGNAL PROCESSING

Lectures per week	3 Hours
Tutorials per week	1 Hour
Practical per week.	2 Hours

MODULE I

Design of IIR Filters: IIR Filter Design by impulse invariance, bilinear transformation, Butterworth Filter, chebyshev Filters [7 Hrs]

Design of FIR Filters: Linear phase FIR systems, symmetric FIR Filters, design of linear phase FIR filters using windows (Rectangular, Hann, hamming, Kaiser), frequency sampling method [7 Hrs]

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MODULE II

Multirate Digital Signal Processing: Introduction, Decimation by factor D, interpolation by factor I, sampling, sampling rate conversion by a rational factor I/D. [4 Hrs]

Applications of Multirate Signal processing: Design of phase shifters, Interfacing of Digital systems with different sampling rates, sub band coding of speech signals, [3 Hrs]

Introduction to programmable Digital Signal Processor: Architecture of TMS 320C6X, bus structure, Central arithmetic logic unit (CALU), register structure, Flags, on chip memory, on chip peripherals. [7 Hrs]

MODULE III

Discrete time Random Processes: Introduction, Random variables, Random processes, special types of random processes: autoregressive moving average processes, autoregressive processes, moving average processes. [7 Hrs]

FIR adaptive filters: steepest descent adaptive filter, LMS algorithm, convergence of LMS algorithms, Application: noise cancellation, channel equalization . [7 Hrs]

MODULE IV

Spectrum estimation: Nonparametric methods: Periodogram, performance, modified periodogram, Bartlett Method, Welch Method, Blackman-Tukey approach, performance comparisons [7 Hrs]

Parametric Methods: Relationship between the auto correlation and the model parameters, The Yule – Walker method for the AR Model Parameters, The Burg Method for the AR Model parameters, selection of AR Model order. MA model and ARMA model for power spectrum estimation [7 Hrs]

Text Books:

1) Digital Signal processing principles, algorithms and applications- John Proakis, Dimitris Manolakis (Prentice Hall of India)
2) Statistical Digital signal Processing and Modelling- Monson H. Hayes (Wiley)
3) Digital signal processing-Sanjit K. Mitra (TMH)

References

1) Discrete Time Signal Processing – Alan V. Oppenheim, Ronald W. Shafer (PHI)
2) Introduction to Digital signal Processing- Johnny R. Johnson
3) Digital signal Processing- S Salivahanan, Vallavaraj, Gnanapriya

EE 7.4.5 NEURAL NETWORKS AND FUZZY LOGIC

Lectures per week	3 Hours
Tutorials per week	1 Hour
Practical per week.	2 Hours

Module- I

Fuzzy set theory: Fuzzy sets-properties, basic operations, Fuzziness-measure of fuzziness, membership functions, extension principle, fuzzy relations-operations on fuzzy relations. (7 Hrs)

Fuzzy logic: Introduction- Fuzzification and defuzzification methods, fuzzy rule base, fuzzy inference, Mamdani and Sugeno types-design parameters-linguistic hedges, developing membership functions, fuzzy controllers-applications (8 Hrs)

Module –II

Introduction to neural networks: Basic concepts-structure of biological neuron, Mc Culloch Pitts neuron model, logic network realization by using Mc Culloch Pitts neuron model, modeling for artificial learning. (5 Hrs)

Learning process: Supervised learning, unsupervised learning, competitive learning-Hebbian learning rule, Perceptron learning rule, Delta learning rule, Widrow Hoff learning rule, Corelation learning rules, winners take all and outstar learning rules. (5 Hrs)

Single layer networks: Perceptrons-concept of linear separability- perceptron training algorithm, concept of nonlinear separability-pocket algorithm, LMS algorithm, ADALINE. (5 Hrs)

Module –III

Multilayer networks: Back propagation algorithm, setting parameter values and design considerations (initialization of weights, frequency of weight updates, choice of learning rate, momentum, generalizability, network size, sample size, non-numeric inputs, cover algorithm, quick prop algorithm, Prediction networks-recurrent networks, radial basis function. (7 Hrs)

Associative models: Non iterative procedures for association, matrix association memories, least square procedure, optimal linear association memory, Hopfield networks-discrete and continuous, energy functions, energy minimization, storage capacity, Boltzman machines, Mean field annealing. (8Hrs)

Module- IV

Bidirectional Associative Memory (BAM)-application, Adaptive Resonance Theory (ART)-application. (5 Hrs)

Neuro fuzzy hybrid: Introduction to neuro fuzzy hybrids, Implementing fuzzy IF-THEN rules by trainable neural networks, Fuzzy back propagation, fuzzy ART map, Fuzzy associate memory(FAM),application of neuro fuzzy concept. (10 Hrs)

Text Books:

1. Fuzzy logic with Engineering Applications by Timothy Ross,Mc Graw Hill
2. Introduction to Artificial Neural systems by J. M. Zurada, Jaico Publishers
3. Elements of Artificial Neural Network by Malhotra, Mohan, Ranka, Penram Publications

Reference:

1. Neural Network and fuzzy systems by Bart Kosko Prentice Hall,Inc, Englewood Cliffs
2. Introduction to neural system by Patterson

EE 7.4.6 DATA BASE MANAGEMENT SYSTEMS

Module I

Introduction to Database System Concept: Data, Information and Information Processing, Purpose of Data base System. Secondary (Auxiliary) Storage Devices, Files, Files Organization and File Structures, Indexing and Hashing. Data models (5 hrs)

Introduction to Database Management Systems (DBMS), Software Development Life Cycle (SDLC) and Database Development Life Cycle (DDLC) (5 hrs)
Introduction to Relational Database Management Systems (RDBMS). (3 hrs)

Module II

Database Architecture, Design and Data Modeling, Entry-Relationship (E-R) Modeling, Enhanced Entity-Relationship (EER) Model. Data Normalization. Query Languages, Relational Algebra and Relational Calculus. (8 hrs)

Introduction to Structured Query Language (SQL), Tables, Views and Indexes, Nulls, Queries and Sub queries, Aggregate Functions, Insert, Update and Delete Operations, Cursors, Joins and Unions, Programming with SQL, Query-by-Example (QBE), QUEL, Triggers, Query Processing and Optimization. (8 hrs)

Module III

Database Implementation Issues, Database Security, Data Integrity, Transaction Management and

Concurrency Control, Backup and Recovery. (4 hrs)

Database Technologies, Evolution of Computing Models, Client/Server Technology and Client/Server Database, Distributed Databases, Multidimensional Data and Databases, Parallel Processing and Parallel Databases, Spatial and Multimedia Databases, Mobile Computing and Mobile Databases, Web Databases. (10 hrs)

Module IV

Database Applications, Knowledge Discovery in Databases (KDD), Data Warehouses and Data Marts, Data Mining, On-line Transaction Processing (OLTP), On-line Analytical Processing (OLAP). (7 hrs)

Customer Relationship Management (CRM), Supply Chain Management (SCM), Geographic Information System (GIS). (6 hrs)

TEXT BOOKS

1. Fundamentals of Database System – Elmasri, Navathi – Pearson Education Asia

2. Data base Systems Concepts, Abraham Silberschatz, Henry F Korth, S Sudarshan Mc Graw Hill

REFERENCE BOOKS

1. Data Base Management Systems Raghu Ramkrishan Mc Graw Hill International Edition

2. Data Base Management Systems – Dr. Arun Kumar Pujari, ISTE Learning Materials Centre.

3 Computer database Organization, James Martin PHI

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EE 7.5.1 ENGINEERING DESIGN

Lectures per week	3 Hours
Tutorials per week	1 Hour
Practicals per week	2 Hours
Maximum marks for the paper	100

Module I

Transmission line design: Choice of voltage level, number of circuits, phase and shield conductors, tower configuration.
Parameters: Determination of series impedance and shunt admittance matrices and electric field strength profile at ground level. [7Hrs]
Characteristics: Plotting of power circle diagram, load ability characteristics, and voltage profile for no load, short circuit and rated load conditions at various power factors. PF improvement schemes.[7Hrs]

Module II

Compensations: Determination of appropriate size of series and shunt compensations. [4Hrs]
Circuit loading modeling, voltage profile and out-of-service contingency, Large HT motor starting and the transient voltage drop. [6 Hrs]
HT and LV cables under fault conditions. [4Hrs]

Module III

Design of a 33/11/0.4 kV network for an industrial processing plant fed by the utility and partially fed by the in-plant 11 kV generators. The scope of the design to include Load estimation, Cable and breaker sizing, System Earthing and fault level analysis [9 Hrs]
Protection requirements and over current and earth fault relays co-ordination [5 Hrs]

Module IV

Design of Protection Schemes for Industrial Power Systems. Design of protective relaying schemes for the power transformers in the given industrial power system network. Design a simple bus bar protection scheme for the primary distribution substations in the network. [7 Hrs]
Design an appropriate relaying scheme for the protection of a sizable power factor correction capacitor bank. Design an automatic switching scheme to cater for load transfer in the case of faults affecting the confirm capacity of the distribution system. [7Hrs]

Text Books

1. Least Cost Electric Utility Planning, Stoll H G, John Wiley and Sons Inc.
2. Power System Protection IEE Electricity Council, vols. 1-3, 2nd Edition
3. Protection of Electricity Distribution Networks -J.M. Gers, IEE, U.K
4. Teo C Y, Principles and Design of Low Voltage Systems, 2nd Edition, Byte Power Publications, 1997.

Reference Books

1. Protective Relays Application Guide - GEC Alstom, U.K., 3rd Edition
2. IEEE Standard 141-1993, IEEE Recommended Practice for Electric Power Distribution for Industrial
Plants, IEEE, 1993.
3. W.L. Weeks, "Transmission and distribution of electrical energy", Harper and Row Publisher, 1981.
4. Debs A, Modern Power Systems Control and Operation, Kluwer Academic Publishers, 1988.

EE 7.5.2 SPECIAL ELECTRICAL MACHINES

Lectures per week	3 Hours
Tutorials per week	1 Hour
Practicals per week	2 Hours
Maximum marks for the paper	100

Module I

Synchronous Reluctance Motors: Constructional features, axial and radial air gap Motors. Operating principle, reluctance torque, phasor diagram, motor characteristics. [7 Hrs]

SWITCHED RELUCTANCE MOTORS: Constructional features, principle of operation. Torque equation, Power controllers, Characteristics and control, Microprocessor based controller. [8 Hrs]

Module II

Permanent Magnet Synchronous Motors: Principle of operation, EMF, power input and torque expressions, Phasor diagram, [7 Hrs]

Power controllers, Torque speed characteristics, Self control, Vector control, Current control schemes. [8Hrs]

Module III

Permanent Magnet Brushless Dc Motors: Constructional features, principle of operation, Commutation in DC motors, Difference between mechanical and electronic commutators, Hall sensors, Optical sensors [8 Hrs]

Multiphase Brushless motor, Square wave permanent magnet brushless motor drives, Torque and emf equation, Torque-speed characteristics, and Controllers-Microprocessor based controller. [7 Hrs]

Module IV

Stepping Motors: Principle of operation, modes of excitation, torque production in stepping motors, dynamic characteristics. [7 Hrs]

Drive systems and circuit for open loop control, closed loop control of stepping motor. [8 Hrs]

TEXT BOOKS:-

1. R. Krishnan, “Electric Motor Drives – Modeling, Analysis and Control”, Prentice-Hall of India Pvt. Ltd., New Delhi, 2003.
2. Kenjo, T, “Stepping motors and their microprocessor control ", Clarendon Press, Oxford, 1989.

REFERENCE BOOKS:

1. Miller, T.J.E. "Brushless permanent magnet and reluctance motor drives ",Clarendon Press, Oxford, 1989.
2. Kenjo, T and Naganori, S “Permanent Magnet and brushless DC motors ", Clarendon Press, Oxford, 1989.
3. B.K. Bose, “Modern Power Electronics and AC drives”, Prentice-Hall of India Pvt. Ltd., New Delhi

EE 7.5.3 FLEXIBLE AC TRANSMISSION SYSTEM

Lectures per week	3 Hours
Tutorials per week	1 Hour
Practicals per week	2 Hours

Module I

Power flow in an AC system, loading capability of transmission line, power flow and dynamic stability considerations in a interconnected system [7 Hrs]

Emergence of FACTS, FACTS control considerations, basic types and brief descriptions of FACTS controllers. [8 Hrs]

Module II

Objectives of shunt compensation, methods of controllable VAR generation [5 Hrs]

Static VAR compensators SVC and Synchronous Compensator (STATCOM), characteristics and control [10 hrs]

Module III

Objectives of static series compensation, variable impedance type series compensators, GCSC, TCSC and TSSC [8 Hrs]

Switching converter type series compensators, Static Synchronous Series Compensator (SSSC). [7 Hrs]

Module IV

Principles of operation-Steady state model and characteristics of a static voltage regulators and phase shifters- power circuit configurations. [7 Hrs]

UPFC -Principles of operation and characteristics, independent active and reactive power flow control, comparison of UPFC with the controlled series compensators and phase shifters. [8 hrs]

Text books

1. Song, Y.H. and Allan T. John, Flexible ac transmission systems (FACTS)', Institution of Electrical Engineers Press, London, 1999.
2. Hingorani, L.Gyugyi, 'Concepts and Technology of flexible ac transmission system', IEEE Press New York, 2000 ISBN –078033 4588.

References

1. IEE Tutorials on 'Flexible ac transmission systems', published in Power Engineering Journal, IEE Press, 1995.

EE 7.5.4 DATA COMMUNICATION AND NETWORKING

Lectures per week	3 Hours
Tutorials per week	1 Hour
Practical per week.	2 Hours

Module I

Introduction to Data communication Model, Need for Networking, Classification of Network based on topology, size, media, architecture. Applications and advantages of Networking. (2 Hrs)
Design Issues for the layers, Connection Oriented Vs Connection less services. Relationship of services and Protocol. Protocol Characteristics, Network Reference Models OSI, TCP/IP Model. Comparison of OSI and TCP/IP Reference Model. (6 Hrs)
Physical layer and Media: Signals and data. Data Transmission via Guided and unguided media. Data encoding methods, Digital data Digital signals, Digital data analog signal, analog data Digital signal and analog data analog signals. Bandwidth Utilization. (6 Hrs)

Module II

Data Link Control: Functions of data link layer, Error detection and correction methods, Framing Flow control methods- Stop and wait protocol and Sliding window protocol. Media access control sub layer -Channel allocation problem, Static and Dynamic channel allocation. MAC layer protocol. ALOHA, Slotted ALOHA. Carrier sense multiple access protocol, characteristics. Channelization using FDMA, CDMA techniques. (8 Hrs)
IEEE 802 Standards, protocol performance of Ethernet, Token bus, Token ring. (3 hrs)
Networking devices: Hubs, Switches, Bridges, Routers and Gateways. Types of Bridges. Data Link layer Protocol HDLC, PPP. (3 Hrs)

Module III

Network layer Design issues, Circuit switching and packet Switching methods. Connection less vs. Connection Oriented services virtual Circuit switching and Data gram Switching.
Routing algorithms static/dynamic merits of shortest path, distance vector algorithm. Link state routing. Congestion control prevention/detection mechanism in the Network. (5Hrs)
IP protocol format, Address mapping protocol ARP, RARP, Error reporting protocol ICMP.
IP addressing: IPV4 and IPV6. Subnet mask and IP address calculation of given network. (6 Hrs)
Functions of Transport layers as Process to process delivery, Concept of sockets, TCP protocol UDP protocol format TCP connection management, Performance of TCP over UDP. Wireless TCP and UDP. (3 Hrs)

Module IV

Need of Domain Name System. Application layer protocol:- Remote login service (TELNET), FTP protocol. Function of Email Server, SMTP and POP Server. (6 Hrs)
Architecture of Network Management system, Performance-Fault-Configuration-Security –Fault management. SNMP protocol. Network Security-Cryptography, Symmetric Key and asymmetric key Cryptography. (8 Hrs)

Text Books:

1. Data Communication and Networking - Behrouz A Forouzan (TMH).
2. Computer Networks - Andrew Tannenbaum.(PHI)
3. Computer Networking - James Kurose Keith w Ross (PHI)

References

1. Data and Computer Communications - Willam Stallings (PHI)
2. Computer Network and Internets Douglas Corner (PHI)
3. Data Communication and Networking Achut Godbole (TMH)

EE 7.5.5 INDUSTRIAL ROBOTICS

Lectures per week	3 Hours
Tutorials per week	1 Hour
Maximum marks for the paper	100
Maximum marks for sessionals	25
Duration of the paper	3 hours

Module I

Introduction: Definition of a Robot - Basic Concepts - Robot configurations - Types of Robot drives - Basic robot motions -Point to point control - Continuous path control. [6 Hrs]

Components and Operations: Basic control system concepts - control system analysis - robot actuation and feedback, Manipulators –director and inverse kinematics, Coordinate transformation - Brief Robot dynamics. Types of Robot and effectors - Grippers - Tools as end effectors - Robot/End - effort interface. [8 Hrs]

Module II

Sensing and machine Vision: Range sensing - Proximity sensing - Touch sensing - Force and Torque sensing. [7 Hrs]

Introduction to Machine vision: Sensing and digitizing - Image processing and analysis. [7 Hrs]

Module III

Robot Programming: Methods - languages - Capabilities and limitation [7 Hrs]

Artificial intelligence - Knowledge representation – Search techniques - AI and Robotics. [7 Hrs]

Module IV

Industrial Application: Application of robots in machining - Welding, Assembly, Material handling - Loading and unloading –CIM Hostile and remote environments. [8 Hrs]

Case studies. Robot in assembly (Puma), Mobile robot (Nataraj) [6 Hrs]

Text Book:

1. “Robotics Control sensing ", Vision and Intelligence, K.S. Fu., R.C.Gonalez, C.S.G.Lee, McGraw Hill International Edition, 1987.

References:

1. " Industrial robotics, technology, Programming and Applications ", Mikell P. Groover, Mitchell Weiss, McGraw Hill International Editions, 1986.

2. . “Robotic engineering - An Integrated Approach ", Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, Prentice Hall Inc, Eaglewoods Cliffs, NJ, USA, 1989.

EE 7.5.6 SATELLITE COMMUNICATION

MODULE I

Overview of satellite systems, orbits and launching methods: Introduction – Frequency Allocations for Satellite Services – Intelsat – U. S. Domsats – Polar Orbiting Satellites – Problems – Kepler's First – Second and Third Law – Definitions of Terms for Earth-orbiting Satellites – Orbital Elements – Apogee and Perigee Heights – Orbital Perturbations – Effects of a Nonspherical Earth – Atmospheric Drag – Inclined Orbits – Calendars – Universal Time – Julian Dates – Sidereal Time – The Orbital Plane – The Geocentric-Equatorial Coordinate System – Earth Station Referred to the IJK Frame – The Topcentric-Horizon Co-ordinate System – The Sub-satellite Point – Predicting Satellite Position.

MODULE II

Geostationary orbit and space segment : Introduction – Antenna Look Angels – The Polar Mount Antenna – Limits of Visibility – Near Geostationary Orbits – Earth Eclipse of Satellite – Sun Transit Outage – Launching Orbits – Problems – Power Supply – Attitude Control – Spinning Satellite Stabilization – Momentum Wheel Stabilization – Station Keeping – Thermal Control – TT&C Subsystem – Transponders – Wideband Receiver – Input Demultiplexer – Power Amplifier – Antenna Subsystem – Morelos – Anik-E – Advanced Tiros-N Spacecraft

MODULE III

Earth segment and space link: Introduction – Receive-Only Home TV Systems – Outdoor Unit – Indoor Unit for Analog (FM) TV – Master Antenna TV System – Community Antenna TV System – Transmit-Receive Earth Stations – Problems – Equivalent Isotropic Radiated Power – Transmission Losses – Free-Space Transmission – Feeder Losses – Antenna Misalignment Losses – Fixed Atmospheric and Ionospheric Losses – Link Power Budget Equation – System Noise – Antenna Noise – Amplifier Noise Temperature – Amplifiers in Cascade – Noise Factor – Noise Temperature of Absorptive Networks – Overall System Noise Temperature – Carrier-to-Noise Ratio – Uplink – Saturation Flux Density – Input Back Off – The Earth Station HPA – Downlink – Output Back off – Satellite TWTA Output – Effects of Rain – Uplink rain-fade margin – Downlink rain-fade margin – Combined Uplink and Downlink C/N Ratio – Inter modulation Noise.

MODULE IV

Satellite access: Single Access – Preassigned FDMA, Demand-Assigned FDMA, SPADE System. Bandwidth-limited a Power-limited TWT amplifier operation, FDMA downlink analysis. TDMA : Reference Burst; Preamble and Postamble, Carrier recovery, Network synchronization, unique word detection, Traffic Date, Frame Efficiency and Channel capacity, preassigned TDMA, Demand assigned TDMA, Speech Interpolation and Prediction, Downlink analysis for Digital transmission. Companion of uplink Power requirements for FDMA & TDMA. On-board signal Processing for TDMA / FDMA operation, Satellite switched TDMA.

Code-Division Multiple Access – Direct-Sequence spread spectrum – code signal c(t) – autocorrelation function for c(t) – Acquisition and trackling – Spectrum spreading and dispreading – CDMA throughput – Problems – Network Layers – TCP Link – Satellite Links and TCP – Enhancing TCP Over Satellite Channels Using Standard Mechanisms (RFC-2488) – Requests for comments – Split TCP connections – Asymmetric Channels – Proposed Systems.

TEXT BOOK

1. Dennis Roddy, Satellite Communications, McGraw-Hill Publication Third edition 2001

2. Sattellite communication, Agarwal

REFERENCES

1. Timothy Pratt – Charles Bostian and Jeremy Allmuti, Satellite Communications, John Willy and Sons (Asia) Pvt. Ltd. 2004

2. Wilbur L. Pritchars Henri G.Suyder Hond Robert A.Nelson, Satellite Communication Systems Engineering, Pearson Education Ltd., Second edition 2003.

3. M. Richharia : Satellite Communication Systems (Design Principles Macmillan Press Ltd. Second Edition 2003.

SCHEME OF INSTRUCTION & EXAMINATION

B. E. FOURTH YEAR (ELECTRICAL & ELECTRONICS ENGINEERING)

Semester VIII

Code No	Subject	L	T	P	Duration of Theory Exam	Marks Allotted				Total
						Theory	S	R	O	
8.1	High Voltage Engineering	3	1	2	3	100	25	-	50	175
8.2	Principles of Industrial Engineering	3	-	-	3	100	25	-	-	125
8.3	Elective III	3	1	2	3	100	25	-	50	175
8.4	Elective IV	3	1	2	3	100	25	-	50	175
8.5	Project	-	-	10	-	-	50	50	100	200
	Total	9	3	16	-	400	150	50	250	850

L-Lecture T-Tutorial P-Practical S-Sessional R-Report O-Oral

Elective III	Elective IV
8.3.1 Transient over voltages in Power system	8.4.1 Power Quality
8.3.2 Energy Engineering and Management	8.4.2 Image Processing and machine vision
8.3.3 Testing & Commissioning of Electrical equipment	8.4.3 Wind and PV Electrical Energy Systems
8.3.4 Protective Static Relays	8.4.4 Biomedical Instrumentation
8.3.5 Cryptography And Network Security	8.4.5 Optimization Techniques
8.3.6 Optical fiber Communications	8.4.6 Illumination Engineering

8. 1 HIGH VOLTAGE ENGINEERING

Lectures per week	3 Hours
Tutorials per week	1 Hour
Practicals per week	2 Hours

Module I

Generation and measurement of High voltage:

Generation of AC HV: Cascade transformer, resonant transformer, Tesla coil. (2 hrs)
Generation of HV DC: Half wave and full wave circuits, voltage doubler circuits, Crockroft Walton circuit, Van de Graff generator (4 hrs)
Measurement of HV: Sphere gap, Rod gap, Electrostatic Voltmeter. (2 hrs)
Generation and measurement of Impulse HV and Current: Generation of Impulse HV: Standard impulse wave shape, Marx circuit, generators, impulse wave shape control, Impulse current generator, multistage impulse generators, (3 hrs)
Measurement of impulse voltage using Voltage dividers, Resistive potential dividers, capacitive potential dividers. (2 hrs)

Module II

HV Solid, Liquid and gaseous insulation:

Mechanism of breakdown of gas: Townsend's Ionization Coefficient, Townsend breakdown Mechanism, Paschen's law, Penning effect, corona discharge, time lag. (6 hrs)
HV Liquid and solid insulation and its breakdown mechanism, HV breakdown in vacuum.(7 hrs)

Module III

Insulation coordination and Protection: Principle of insulation coordination, over voltages and their significance, standard impulse lightning and switching impulse waveforms, insulation coordination of substation, insulation coordination of EHV systems. (7 hrs)
Protection: Protective devices against lightning, overhead ground wires, Thyrite and ZnO Arrestors, switching over voltages in EHV systems. Methods of reducing switching over voltages. (6 hrs)

Module IV

HV Application and Testing:

HV Application: Transmission, Need for HV transmission, types of transmission conductors, GMR, Mechanical Aspects of Transmission lines, Traveling wave theory ,surge impedance, Transmission line parameters, charging current, reflection and refraction on transmission line, power circle diagram, Bewely Lattice diagrams. (6 hrs)
High Voltage cables and their electrical parameters. (2 hrs)
HV testing: HV testing of electrical apparatus, tests on insulators, bushings, cables, surge arrestor. (5 hrs)

Text books

4) "High voltage Eng ineering", M. S. Naidu, Tata McGraw Hills
5) "High Voltage Engineering".Kuffel Ea Zaengal, Pergam Press
6) "High voltage Transmission" , R. Begamudre, Tata Mc Graw Hills

Reference

1) "High Voltage Engineering ". C. L. Wadwa,New Age International
2) " High Voltage Engineering and Testing ", Edited by Huge Ryan, IEE, London publication

EE 8.2 PRINCIPLES OF INDUSTRIAL ENGINEERING

Lectures per week	3 Hours
Tutorials per week	-----
Practicals per week	------

Module-I

Productivity-Scope and Measurement. Partial and Total Productivity. Dynamics of Productivity change. Efficiency and Effectiveness. Means of Improving Productivity. (4 hrs)

Job Evaluation-Objectives and Procedures. Job Description and Job Specification. Methods of Job Evaluation –Ranking ,Job classification or grading, point system and factor comparison. (4 hrs)

Incentives-Need and Characteristics. Types of Incentives Plans. (2 hrs)

Module-II

Work Study-Objectives and Procedures. Work content Analysis. Work study as a means of improving productivity. Human Factor in the application of work study. (3 hrs)

Method Study-Objectives and Procedures .Selection of a job .Recording Techniques-Charts and Diagrams(Charts-Outline, flow process, two handed, multiple activity and Travel chart. Diagrams-Flow and String diagram) (4 hrs)

Ergonomics-Objectives of Human Factor Engineering .Ergonomics, Productivity and work Environment. Workplace Design. (3 hrs)

Module-III

Work Measurement-Objectives and Techniques of Work Measurement. (5 hrs)

Time Study-Procedure. Job Selection ,Elemental breakup of a job.

Work Sampling-Procedure. Determination of Sample size

Standard Data

Predetermined Motion Time System. (5 hrs)

Module-IV

Value Engineering-Principle, Methodology and Scope. (5 hrs)

T P M-Introduction. Types of Maintenance.TPM Targets-O P E, O E E. Steps in introduction of TPM in an Organization. Pillars of TPM (5 hrs)

Text Books:

1) Introduction to work study by ILO
2) Martand Telsang, Industrial Engineering and Production Management, S. Chand
3) Kumar B., Industrial Engineering, Khanna Publishers

Reference:

1) A. P. Verma, Industrial Engineering, S. K. Kataria&Sons
2) Benjamin W. Niebel, Motion and Time Study, Mc Graw Hill
3) Ralph M. Barnes, Motion & Time Study, Design and Measurement of work, Wiley

EE 8.3.1 TRANSIENT OVER VOLTAGES IN POWER SYSTEMS

Lectures per week	3 Hours
Tutorials per week	1 Hour
Practicals per week	2 Hours

Module I

Transients in electric power systems – Internal and external causes of over voltages- Lightning strokes Mathematical model to represent lightning. [6 Hrs]

Travelling waves in transmission lines – Circuits with distributed constants – Wave equations – Reflection and refraction of travelling waves – Travelling waves at different line terminations. [7 Hrs]

Module II

Switching transients –double frequency transients – abnormal switching transients [6 Hrs]

Transients in switching a three phase reactor- three phase capacitor banks [7 Hrs]

Module III

Voltage distribution in transformer winding under transient condition, winding models, – voltage surges-transformers [6 hrs]

Generators and motors. Transient parameter values for transformers, reactors, generators and transmission lines. [7 Hrs]

Module IV

Basic ideas about protection –surge diverters-surge absorbers-protection of lines and stations Modern lighting arrestors. Insulation coordination. [6 hrs]

Protection of alternators and industrial drive systems. Generation of high AC and DC –impulse voltages, currents- measurement using sphere gaps – peak voltmeters – potential dividers and CRO. [7 hrs]

Text Books

1. Allen Greenwood, 'Electrical transients in power systems', Wiley Interscience,
2. Bewley, L.W., 'Traveling waves and transmission systems', Dover publications, New York

Reference Books

1. Gallaghar, P.J. and Pearmain, A.J., 'High voltage measurement, Testing and Design', John Wiley and sons, New York, 1982.

EE 8.3.2 ENERGY ENGINEERING AND MANAGEMENT

Lectures per week	3 Hours
Tutorials per week	1 Hour
Practicals per week	2 Hours

MODULE-I

General Aspects of Energy Management: Energy scenario, Forms of Energy, Primary & secondary Energy, Commercial and non-commercial Energy, Renewable and non-renewable Energy, Energy pricing, energy sector reforms, Energy Security.

[7 hrs]

Energy Conservation and its importance, EC act 2001, Definition and objectives of Energy Management, Energy Audit, Types and methodologies, Energy Audit Instruments, Benchmarking and Energy performance, Energy and Environment, Sustainable development.

[7 hrs]

MODULE-II

Energy efficiency in thermal utilities: Fuels and combustion, Boiler systems, Boiler types and classification, performance evaluation of Boilers, Boiler blowdown, energy conservation opportunities.

[7 hrs]

Steam system, Furnaces, Insulation, Refractories, Cogeneration, waste heat recovery. [7 hrs]

MODULE-III

Energy efficiency in electrical utilities: Electrical system, Electric motors, Compressed air system, HVAC and refrigeration system, Pumps, pumping system. [7 hrs]

Lighting system, DG set system, Energy efficient technologies in Electrical system. [7 hrs]

MODULE –IV

Economics and Finance: Project management, steps in project management, project planning techniques [7 hrs].

Financial management, investment need, Appraisal and criteria, financial analysis techniques, Sensitivity and risk analysis, financing options, costing techniques.

[7 hrs].

Text Books

1) Energy Management by W.R .Murphy, Gmckay Butterworths, London

2) Guide books on Energy Management by Bureau of Energy Efficiency, New Delhi.

Reference Books

1) Energy Auditing made simple by P. Balasubrimanian, Separation Engineers ltd. (Chennai)

2) Energy Auditing-TERI Publication

EE 8.3.3 TESTING AND COMMISSIONING OF ELECTRICAL EQUIPMENTS

Lectures per week	3 Hours
Tutorials per week	1 Hour
Practicals per week	2 Hours

MODULE-I

Classification of Test : Type Test, routine test, Acceptance test, pre commissioning test/ commissioning test, methods of measurements of Temperature rise of various parts of machines, concept of direct and indirect , Regenerative testing (Phantom loading). [7 Hrs]

DC Machines Testing:- Classification of various losses in DC Machines as per IS and separation of various losses, Calculation of mechanical ,Electrical and overall efficiency, Determination of Efficiency by direct, Indirect and Regenerative methods. (Brake test, Swinburn test and Hopkinson test) [7 Hrs]

MODULE-II

Transformers: Location and sites, selection and design of foundation details (like bolts size, their sequence number, etc.) code of practice for terminal plates, polarity and phase sequence, oil tanks, drying of windings with and without oil, general inspection. [5 Hrs]

Commissioning Tests: Following tests as per NATIONAL and International standards, volts ratio test, earth resistance oil strength, Bochlholz and other relays, tap changing gear, fan and pumps, insulation test, impulse test, polarizing index, load and temperature raise test. [4 hrs]

Specific Tests: Determination of performance curves like efficiency, regulation, etc, det of mechanical stress under normal and abnormal conditions. Maintenance Schedule. [4 hrs]

Module-III

Induction Motors: Specifications for different types of motors. Duty el L. P. protection. [2 Hrs]
Installation & Commisioning: Location of the motors (including the foundation details) and its control apparatus, shaft and alignment for various couplings, fitting of pulleys and couplings, drying of windings. Mechanical test for alignment, airgap symmetry, tests for bearings, vibrations and balancing. [6 Hrs]

Performance Tests and Maintenance Schedule: Insulation test, earth resistance, high voltage test, starting up failure to speed up to take the load type of test, routine test, factory tests and site tests (in accordance with ISI code). Performance and temperature raise tests, stray load losses, shaft elements, re-ratings and special duty capability. Maintenance Schedule. Ac machine testing and loss estimation. [5 hrs]

MODULE -IV

Synchronous Machines:-Installation and Commissioning Tests: Physical inspection, rating name plate details, foundation details, alignments, excitation systems, cooling and control gear, drying out. Insulation, resistance measurement of armature and field windings, waveform and telephone interference factors, line charging capacity. [6 hrs]

Performance tests: Various tests tp estimate the performance for generator and motor operations, slip maximum lagging currents, maximum reluctance power tests, sudden short circuit tests, transient and sub-transient parameters, measurements of sequence impedances, capacitive reactance, separation of losses, temperature raise tests, and retardation tests. Factory tests- Gap length, magnetic centrity balancing vibration, bearing performance. [7 hrs]

Text Books:

1. S Rao, Testing and Commissioning of Electrical Equipments**.** Khanna Publ, 2006

EE 8.3.4 PROTECTIVE STATIC RELAYS

Lectures per week	3 Hours
Tutorials per week	1 Hour
Practicals per week	-----

MODULE I

Introduction: Basic of static relay development, classification of static relays, microprocessor based relays, Digital protection, advantages of digital protection. Basic protection scheme using microcomputer. [4 hrs]

Static Relay Components: Semi conductor devices, static switching, logic circuits and relay logic. Integrated circuits, transducers and interface devices, replica impedances, time delay devices, sequence filters, voltage regulators. [4 hrs]

Static Comparators: Single input multi-input comparators. Amplitude comparator – integrating, instantaneous and sampling techniques; phase comparators – Vector product and coincidence techniques. Direct phase comparison, phase splitting technique, integrating phase comparison. Duality of amplitude and phase comparison. [5 hrs]

MODULE II

Static Relays: Over current relays, directional over current relays using Hall crystal, Rectifier Bridge, instantaneous since comparator. [6 hrs]

Distance relay, impendence. Reactance, admittance, offset mho, trapezoidal and elliptical characteristics. Differential relays. [7 hrs]

MODULE III

Schemes of Protection: Static switching scheme of distance relays. Polyphase distance relays. [6 hrs]

Static differential protection for generators, transformer and Bus zone. Static protection for motors, single-phase preventer. [7 hrs]

MODULE IV

Modern Trends In Power System Protection: Auto recolsing, frequency relay-under frequency, over frequency and rate of change of frequency relay, static ultra high speed directional comparison line protection [6 hrs]

Reliability-dependability, security, redundancy, factors affecting the performance of relays, design reliability of complete protection schemes; improving technical reliability; routine tests, type tests and reliability tests of relays. [7 hrs]

TEXT BOOKS:

1. TMS Rao – Static Relays, TMH
2. M. Chander – Switchgear and Protection, New Age

RFERENCE BOOKS

1. S.S. Rao – Switchgear and Protection, Khanna

EE 8.3.5. CRYPTOGRAPHY AND NETWORK SECURITY

Lectures per week	3 Hours
Tutorials per week	1 Hour
Practicals per week	2 Hours

MODULE I

Introduction to Cryptography : Attacks, Services, and Mechanisms, Security Attacks, Security Services, OSI security architecture, A model of Internetwork Security. [3 hrs]

Classical Encryption Techniques, Substitution and transposition techniques, Simplified DES, Block Cipher Principles the Data Encryption Standard, The strength of DES, Differential and Linear Cryptanalysis. Algorithms: Triple DES, Advanced Encryption standard. International Data Encryption Algorithm [8 hrs]

Confidentiality Using Conventional Encryption: Placement of Encryption Function, Traffic Confidentiality, Key Distribution, Random Number Generation. [2 hrs]

MODULE II

Cryptography: Public key cryptography: Principles of Public-Key Cryptosystems, The RSA Algorithm, Key Management, Diffie-Hellman Key Exchange [4 hrs]

Number Theory: Prime and Relatively Prime Numbers, Modular Arithmetic, Fermat's and Euler's Theorems, Euclid's theorem. Testing for Primality, The Chinese Remainder Theorem, Discrete Logarithms. [4 hrs]

Message Authentication and Hash functions: Authentication Requirements, Authentication Functions, Message Authentication Codes, MDs Message Digest Algorithm, Digital Signatures and Authentication Protocols: Digital Signatures, Authentication Protocols, Digital Signature Standard. [5 hrs]

MODULE III

Network Security-I Authentication Applications: Kerberos, X.509 Directory Authentication Service, Electronic Mail Security: Pretty Good Privacy, S/MIME. [6 hrs]

IP Security: IP Security Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations, Key Management. [7 hrs]

MODULE IV

Network Security-II Web Security: Web security Requirements, Secure Sockets Layer and Transport Layer Security, Secure Electronic Transaction. [7 hrs]

Intruders: Intruder Detection, Password management. Malicious software: Viruses and related Threats, Viruses Counter measures . Firewall design Principles Trusted systems. [6 hrs]

TEXT BOOKS:

1. Cryptography and Network security 2nd ed.—William Stallings PEA
2. Network Security, Private Communication in a Public World, PTR Prentice Hall, 1995: Charlie Kaufman, Radia Perlman, Mike Speciner

REFERENCES:

1.Cryptography and Network security - BEHROUZ A FOROUZAN TMH
2. Cryptography and Network security, ATUL KAHATE, TMH
3. Security in Computing, Charles Pfleeger, Shari Lawrence Pfleeger, PHI

EE 8.3.6 OPTICAL FIBER COMMUNICATION

Lectures per week	3 Hours
Tutorials per week	1 Hour
Practicals per week	2 Hours

MODULE I

Overview: The Electromagnetic Spectrum, Properties of Light, Dual Nature of Light Concept of a photon, Wave Model, Characteristics of light waves. Concepts of information, general communication systems, evolution of Basic Fiber Optic Communication System, Benefits and disadvantages of Fiber Optics. [6 hrs]

Transmission Windows. Transmission Through Optical Fiber, The Laws of Reflection and Refraction, Light rays and light waves, Reflection of light from optical surfaces, Refraction of light from optical interfaces, The Numerical Aperture (NA), The Optical Fiber, Types of Fiber, optical transmitter. [7 hrs]

MODULE II

Optical sources and detectors: Sources: Basic principle of surface emitter LED and edge emitter LED- material used, structure, internal quantum efficiency and characteristics, LASER Diode - material used, structure, internal quantum efficiency and characteristics, working Principle and characteristics of Distributed feedback (DFB) laser. [7 hrs]

Detectors: PIN photodiode - material used, working principle and characteristics, Avalanche Photodiode: - material used, working principle and characteristics. [6 hrs]

MODULE III

Losses in optical fibre: Attenuation, Material absorption losses, linear and non linear scattering losses, fiber bend loss, dispersion viz inter modal dispersion and intra modal dispersion, overall fiber dispersion and polarization, Dispersion shifted and dispersion flattened fibers, attenuation and dispersion limits in fibers, Kerr nonlinearity, self phase modulation, combined effect of dispersion and self phase modulation. [8 hrs]

Fibre material, couplers and connectors: Preparation of optical fiber: liquid-phase techniques, vapor phase deposition techniques. Connector Principles, Fiber End Preparation, splices, connectors. [5 hrs]

MODULE IV

Optical amplifiers: Optical receiver, semiconductor amplifier, rare earth doped fiber amplifier (with special reference to erbium doped fibers), Raman amplifier, Brillouin amplifier – principles of operation, amplifier noise, signal to noise ratio, gain, gain bandwidth, gain and noise dependencies, inter modulation effects, saturation induced crosstalk, wavelength range of operation. Fiber Optic Networks, Transreceivers for Fiber-Optic Networks, Semiconductor Optical Amplifiers [8 hrs]

Optical fiber sensors: Intensity modulated sensor - general features, intensity modulation through light interruption, shutter multimode fiber sensors and reflective fiber optic sensors. [5 hrs]

Text Books

1. Optical Fiber Communication Principles and Practice by John M. Senior, PHI Publication
2. Optical Communication Systems by John Gowar, PHI Publications.

Reference Books

1. Optical Fiber Communication by Gerd Keiser, Mc Graw Hill International Publications.
2. Fundamentals of Fibre Optics in Telecommunication and sensor systems by Bishnu P. Pal,

New Age International (P) Ltd.

EE 8.4.1 POWER QUALITY

Lectures per week	3 Hours
Tutorials per week	1 Hour
Practicals per week	2 Hours

Module I

Introduction of the Power Quality (PQ) problem, Terms used in PQ: Sags, Swells, Surges, Harmonics, Interruptions. Assessing PQ; Remedies: Customer side of meter, utility side of the meter. [8 Hrs]

Power Quality Data: Data collection, Data analysis, Database structure, Creating PQ databases, Processing PQ data [7 hrs]

Module II

Voltage sag characteristics; methodology for computation of voltage sag magnitude and occurrence; accuracy of sag analysis; duration and frequency of sags. [7 Hrs]
Effect of transformer connections, effect of pre-fault voltage, simple examples. Voltage dip problems. Fast assessment methods for voltage sags in distribution systems. [7 hrs]

Module III

Adjustable speed drives (ASD) systems and applications, sources of power system harmonics, mitigation of harmonics. Characterization of voltage sags experienced by three-phase ASD Systems [7 Hrs].

Types of sags and phase – angle jumps. Effects of momentary voltage dip on the operation of induction and synchronous motors. Voltage sag coordination for reliable plant operation. [7 Hrs]

Module IV

Harmonic analysis of industrial customers; technical barriers in ASDs. Methods of evaluation of harmonic levels in industrial distribution systems. Harmonic effects on transformers. Impact of distribution system capacitor banks on PQ. [7 hrs]

Guidelines for limiting voltage harmonics. General plant description, monitoring strategy, equipment selection and testing. Design philosophy of filters to reduce harmonic distortion. Power conditioners. Voltage flicker measurement and analysis System. Industry standards and general guidelines.

Global quality standards: IEEE standards framework for quality. [7 hrs]

TEXT BOOKS

1. Power Quality by C. Sankaran, YesDee Publishing
2. Understanding Power quality problems by Bollen M. J. Standard Publishers and Distributors.

REFERENCE BOOKS

1. Handbook of power quality by Angelo Baggini John Wiley publication

2. Recent Technical Papers Published in IEEE on ‘Power Quality’

EE 8.4.2 IMAGE PROCESSING AND MACHINE VISION

Lectures per week	3 Hours
Tutorials per week	1 Hour
Practical per week.	2 Hours

Module I

Fundamentals of Images: Digital Image representation, Elements of Image Processing systems and simple image model. Image functions, Sampling and Quantization, Basic relationship between pixels, image Geometry. Image transforms Fourier transforms and other separable transforms. (8 Hrs)

Digital Image Properties: Metric and topological properties of digital images. Histograms. Visual perception of the Image, Image quality, Noises in the Image. (6 Hrs).

Module II

Data structure for Image analysis: Levels of image data representation, Image data structure using Matrices, Chains, Topological data structure, Relational structure. (7 hrs)

Image preprocessing: Pixel brightness transformation, Geometrical transformation. Local preprocessing: Image smoothing, Edge detectors, zero crossings of second derivatives.

Image restoration methods algebraic approach to restoration problem, Inverse Filtering. (7 Hrs)

Module III

Image segmentation: Thresholding Edge based Segmentation, Regional oriented segmentation detection of discontinuity, linking and boundary detection. (7 Hrs)

Image Compression Fundamentals of Image Compression, Compression models, error free compression, lossy compression. (7 Hrs)

Module IV

Motion analysis: Motion detection, Differential motion analysis methods, Optical flow in motion analysis. Analysis based on correspondence of interest points. Object tracking. (Case Studies on any automated Image analysis) (8 Hrs)

Geometry for 3D vision: projective geometry, calibration of one camera. Geometry of Two cameras: the Fundamental matrix, fundamentals matrix estimation from image point correspondences. Basic morphological concepts of images. Four morphological principles. (6 Hrs)

Text Books

1. Image processing, analysis and Machine Vision Sonka Milan Hlavac, Boyle Roger-Vikas Publishing.
2. Fundamentals of Digital Image Processing - By A.K.Jain, PHI

Reference Books

1. Digital image processing William K Pratt –Mc Graw Hill
2. Digital image processing – A Rosenfield and A.C.Kak Academic press.
3. Digital Image Processing - By R.C. Gonzalez and R.E. Woods, Addision Wesley

EE 8.4.3 WIND AND PV ELECTRICAL ENERGY SYSTEMS

Lectures per week	3 Hours
Tutorials per week	1 Hour
Practicals per week	2 Hours

MODULE-I

Introduction to Wind Energy Systems:-Historical development of wind power, types of wind turbines, power in the wind. [3 Hrs]

Wind Turbine generators:-Impact of tower height, maximum rotor efficiency, wind turbine generators, importance of variable rotor speeds, pole changing induction generators, multiple gear boxes, variable slip induction generators, indirect grid connection systems. [7 Hrs]

Average power in the wind:- Discrete wind histogram, wind power probability density functions, Weibull and Rayleigh statistics, average power in the wind with Rayleigh statistics [4 Hrs]

MODULE-II

Simple estimates of wind turbine energy:-Annual energy using average turbine efficiency, wind farms. [3 Hrs]

Specific wind turbine performance calculations:-Aerodynamics, idealized wind turbine power curve, optimizing rotor diameter, and generator rated power, wind speed cumulative distribution function, using real power curves with Weibull statistics, using capacity factor to estimate energy produced [7 Hrs]
Wind turbine economics:-Capital costs and annual costs, annualized cost of electricity from wind turbines. [4 Hrs]

MODULE-III

Solar resource:-Solar spectrum, earth's orbit, altitude angle o the sun, solar position at any time of day, sun path diagrams, solar time and civil time, sun rise and sun set, clear sky direct beam radiation, total insolation on a solar collecting surface, monthly clear sky insolation, solar radiation measurements, average monthly insolation [7 Hrs]

PV materials and electrical characteristics:-Introduction, generic PV cell, cells to modules to arrays, PV I-V curve at STC, impacts of temperature and insolation on I-V curve, shading impacts on I-V curve [7 Hrs]

MODULE-IV

PV systems**:** Introduction, current-voltage curves for loads, grid connected systems [7 Hrs]

Grid connected PV economics, stand-alone PV systems, PV power water pumping. [7 Hrs]

Text Books:

1. Gilbert M Masters., Renewable and Efficient Electric Power Systems, Wiley Interscience, New Jersey, 2004

Reference Books:

1. B.H. Khan, Non-Conventional Energy Resources, THM Publishers, New-Delhi, 2006.

8.4.4 BIOMEDICAL INSTRUMENTATION

Lectures per week	3 Hours
Tutorials per week	1 Hour
Practical per week.	2 Hours

Module I

Introduction to Man-Instrument System: Components of Man-Instrument system, Physiological systems of body, Problems encountered in measuring a living system. [3 Hrs]

Sources of Bio Electric Potential: Resting and Action potential, Propagation of action potential. Cardio Vascular System and Measurements; Heart and Cardiovascular system, Blood pressure, Systolic and Diastolic Heart sounds. [3 Hrs]

Electro cardiograph: ECG Electrodes and leads, Block diagram of ECG, Types of ECG Recorders. [2 Hrs]

Measurement of Blood Pressure: Indirect methods, direct methods. [3 hrs]

Measurement of Blood Flow and Cardiac Output: Magnetic blood flow meters, Ultrasonic blood flow meters, Indicator Dilution method. [3 Hrs]

Module II

Plethismography. Measurement of Heart sounds - PCG. [2 Hrs]

Nervous System Measurements: Anatomy of Nervous system, Neuronal communication, EPSP and IPSP, Neuronal firing measurements, EEG - block diagram, Various Rhythms, EEG in diagnostics, EMG and Applications. [5 Hrs]

Ophthalmology Instruments: Electro Retinogram, Electroculogram, Ophthalmoscope, Tubometer for eye pressure measurement. [3 Hrs]

Instruments in Clinical Laboratory: Blood gas analysers, Measurement of blood parameters, A complete blood gas analyzer, Blood cell counters. [4 Hrs]

Module III

Therapeutic Instruments: Cardiac pace makers, Different types and power sources, Defibrillators. Kidney Assist, Artificial Kidney, Dialysers, Hemodialysis Machines, Diathermy- S.W. Microwave, Surgical Diathermy, Apparatus. [8 Hrs]

Bio-Medical Telemetry: Physiological parameters adaptable to bio-telemetry, Components of a biotelemetry system, Implantable units. [5 Hrs]

Module IV

Electrical Safety of Medical Equipment: Physio effects of Electric current, shock hazards from electrical equipments, Methods of accident prevention. [7 Hrs]

Patient Maintaining Systems: System concepts, Bedside monitors, Central monitors. [3 Hrs]

Basic Principles: Basic principles of X-ray Machines and CAT and MRI Scanners. [3 Hrs]

Text Books

1. Handbook of Bio-Medical Instrumentation: R.S. Khandpur (Tata McGraw Hill)

Reference Books:

1. Bio Medical Instruments and Measurements: Crombell, Weibell, Pfeitter (Pearson education)
2. Cormwell/Biomedical Instrumentation and Measurements /PHI
3. Medical Instrumentation Application and Design- John G. Webster (John Wiley and sons, New York, 1998)

EE 8.4.5: OPTIMISATION TECHNIQUES

Lectures per week	3 Hours
Tutorials per week	1 Hour
Practical per week.	2 Hours

MODULE I

Linear Programming:-Introduction-Formulation of LP, Solution to LP-Graphical method (4 Hrs)
Simplex method-Big M method-Two phase method (4 Hrs)
Dual Simplex method-Revised simplex method, Duality (3 Hrs)
Transportation models, Assignment models.
(3Hrs)

MODULE II

Dynamic Programming:-Introduction-Formulation of DP, Principle of optimality, System reliability, Solution of LPP by DP.
(5 Hrs)
Application of DP in shortest route-cargo handling-allocation-scheduling problem (5 Hrs)
Network models: - CPM and PERT. (3 Hrs)

Module III

Nonlinear programming:-Introduction-Formulation of NLP, local and global optimum, concave and convex functions, types of NLP (3 Hrs)
Unconstrained one –d optimization: - Necessary and sufficient conditions, unrestricted search methods-Region elimination methods-Dichotomous search-Interval halving method, Fibonacci method-Golden section method, Gradient search methods-Bisection method-Secant method-Newton Raphson method-Quadratic interpolation method. (11 Hrs)

MODULE IV

Multivariable NLP without constraints:-Classical methods-limitations, Numerical methods-Univariant method-Conjugate direction method-Steepest descend method-Newtons method.
(7 Hrs)

Multivariable NLP with constraints:-Necessary and sufficient conditions-Equality and inequality constraints, Kuhn Tucker conditions, Gradient projection method-cutting plane method-penalty function method. (6 Hrs)

TEXT BOOKS:

1) Optimization: Theory and Applications by S. S. Rao, Wiley Eastern Press, 1978

2) Operations Research-An Introduction by Taha, H. A. , Prentice Hall of India

3) Introduction to Optimum Design by Jasbir S. Arora, McGraw Hill

REFERENCE BOOKS:

1) Operations Research by J.K.Sharma, Macmillan

2) Operations Research by Premkumar Gupta and D.S.Hira, S.Chand and Co.

EE 8.4.6 ILLUMINATION ENGINEERING

Lectures per week	3 Hours
Tutorials per week	1 Hour
Practicals per week	2 Hours

Module I

Introduction of light: Radiation, color, eye and vision; different entities of illuminating systems; light sources, daylight, incandescent, electric discharge, fluorescent, arc lamps and lasers; Luminaries, wiring switching and control circuits. [5Hrs]

Laws of illumination, Illumination from point, line and surface sources. Photometry and spectrometry; photocells. Environment and glare. [4Hrs]

Quality of good lighting, Methods of artificial lighting, lighting system, direct, indirect, semi direct, semi indirect, lighting scheme, generalized, localized. [5Hrs}

Module II

Design of Interior lighting: Illumination required for various work planes (as per BIS).Terms related to interior lighting. Standard practice for illumination levels in various areas. [3Hrs]

Design of industrial, residential, office, departmental stores, indoor stadium, theater and hospitals. [10 Hrs]

Module III

Design of Exterior lighting: Terms related to exterior lighting standard practice for illumination levels. [3Hrs]

Design of Street lighting, flood, aviation and transport lighting [6 Hrs]

Lighting for displays and signaling, neon signs, LED, LCD displays beacons and lighting for surveillance. [4Hrs]

Module IV

Utility services for large building/office complex and layout of different meters and protection units. Diferent type of loads and their individual protections. [7 Hrs]

Selection of cable/wire sizes; potential sources of fire hazards and precautions. Emergency supply – stand by and UPS. A specific design problem on this aspect. [6 Hrs]

Text Books

1) Lighting By D C Pitchard
2) Lamps and Lighting M A Cayles and Marsden

Reference Books

1) Applied Illumination Engineering Jack L Lindsay