

ANDHRA UNIVERSITY

BACHELOR OF ENGINEERING (B.E.)
ELECTRICAL & ELECTRONICS ENGINEERING
DEGREE EXAMINATION

(Syllabus)

(Under Semester System)
(with effect from 2004-05)

THIRD YEAR FIRST SEMESTER

Code	Subject	Instructions period per week	University Examination		Sectional Marks	Total Marks
			Duration Hours	Marks		
EEE 311	Pulse & Digital Circuits (Common with ECE)	4	3	70	30	100
EEE 312	Linear I.C.S & Applications (Common with ECE)	4	3	70	30	100
EEE 313	Logic Design & Microprocessors	4	3	70	30	100
EEE 314	Computer Architecture & Organization (Common with ECE)	4	3	70	30	100
EEE 315	Performance & Design of Electrical Machines – II	4	3	70	30	100
EEE 316	Fluid Mechanics & Hydraulic Machinery	5	3	70	30	100
EEE 317	Electrical Machines Lab – I	3	3	50	50	100
EEE 318	L. I.C.S & Pulse Circuits Lab	3	3	50	50	100
TOTAL		31		520	280	800

**EEE 311 – Pulse and Digital Circuits
(Common with ECE)****Instruction : 4 periods per week**

University Examination	:	3 hours
University Examination Marks	:	70
Sessional Marks	:	30

Linear wave shaping:

High pass and low pass RC circuits and their response for sinusoidal, step voltage, pulse, square wave and ramp inputs. High pass RC circuit as a differentiator. Low pass RC circuit as an integrator. Attenuators and their application as CRO probe. RL and RLC circuits and their response for step input. Ringing circuit

Non Linear wave Shaping:

Diode clippers. Transistor clippers. Clipping at two independent levels. Comparator - applications of voltage comparators - diode comparator. Clamping operation. Clamping circuits using diode with different inputs. Clamping circuit theorem. Practical clamping circuits. Effect of diode characteristics on clamping voltage.

Multivibrators:

Transistor as a switch - switching times of a transistor. Astable, monostable and tristable multivibrators using transistors, resolution time of a binary. Methods of improving resolution time - methods of triggering a binary. Schmitt trigger.

Sweep circuits:

Voltage sweep simple exponential sweep generator. Errors that define deviation from linearity, UJT Relaxation oscillator - methods of linearising a voltage sweep - Bootstrap and Miller circuits – current sweep – linearising a current sweep by adjusting the driving wave form.

Synchronization and Frequency Division:

Principles of synchronization – synchronization of astable multivibrators. Synchronization of sweep circuits with symmetrical signals.

Logic gates:

IC Families, TTL, CMOS, ECL, FFS and circuits.

Blocking Oscillator:

Base timing, Emitter timing and astable blocking oscillator.

Textbooks:

1. Pulse, digital and switching waveforms – Millman & Taub, TMH Pub.
2. Wave generation and shaping – I. Strauss.

EEE 312 – Linear ICS and Applications (Common with ECE)

Instruction	:	4 periods per week
University Examination	:	3 hours
University Examination Marks	:	70
Sessional Marks	:	30

Operational Amplifiers:

Design aspects of monolithic op – amps, ideal characteristics, specifications, offset voltages and currents, frequency compensation techniques, measurement of op- amps parameters, Applications of op – amps, inverting and non-inverting amplifiers, integrators, function generators, logarithmic amplifiers, instrumentation amplifiers, signal conditioning circuits, multivibrators, square wave generators, rectifiers, peak detection and voltage regulation.

555 timers, 556 function generator ICS and their applications. Three terminal IC regulators, IC 1496 (Balanced modulator), IC 565 PLL and its applications.

Active filters:

LPF , HPF, BPF, BEF, all pass filters, higher order filters and their comparison. Op-amp phase shift, Wein - bridge and quadrature oscillator, voltage controlled oscillators, voltage to frequency and frequency to voltage converters, voltage to current and current to voltage converters. Switched capacitance filters, analog multiplexers, sample and hold circuits.

Books:

1. Microelectronics, Jacob millman, tmh inc.
2. Op – amps and linear ICs, Ramakanth Gayakwad, Pearson education.
3. Integrated circuits, Botkar, Khanna Publications.
4. Applications of linear IC's, Clayton.

EEE 313 – Logic Design and Microprocessors

Instruction	:	4 periods per week
University Examination	:	3 hours
University Examination Marks	:	70
Sessional Marks	:	30

Part A - Logic Design

Number systems: Binary, decimal, octal and hexadecimal – binary arithmetic binary codes

Boolean algebra and combinational circuit design: Truth Functions – operators – laws of Boolean algebra – Boolean expressions – logic diagrams – universal building blocks – map method of simplification for POS and SOP forms (only up to four variables) – wired or and wired and gates – pals and plas.

Sequential circuits and design: Sequential logic flip-flops – digital counters – ripple counters design, synchronous counter design with T.D. and J.K. flip-flops. Shift registers and operation modes.

Part B – Microprocessors

Microprocessors: Introduction, internal architecture and functional description of 8085 processor – instruction set and timing diagrams.

Memories: RAM, ROM, PROM, Static and Dynamic memories – memory addressing – interfacing memory to CPU.

Peripheral ICS: PIO – 8255a (PPI) block diagram and operating modes, SIO- 8251 (USART) block diagram and functions of each block, Timer – 8253 block diagram and modes of operation.

Keyboard display device: 8279 block diagram and its operation.

Data converters: Various types of d/a and a/d converters.

Textbooks:

1. T.C. Bartee: Digital computer Fundamentals, TMH Pub.
2. Microprocessors & its applications by Theagarajan, R., Dhanpal, S & Dhanaseturan, S., New Age India Ltd . 1998.
3. R.S. Gaonkar: Microprocessor architecture, programming and applications with the 8085/8080a. Wiley Eastern Ltd.

EEE 314- Computer Architecture and Organization (Common with ECE)

Instruction	:	4 periods per week
University Examination	:	3 hours
University Examination Marks	:	70
Sessional Marks	:	30

1. Register transfer and micro operations:

Register transfer language, register transfer, bus and memory transfers, arithmetic micro operations logic micro operations shift micro operations arithmetic logic shift unit.

2. Basic computer organization:

Instruction codes, computer registers, computer instructions, timing and control, instruction cycle, memory reference instructions, input – output and interrupt, complete computer description.

3. CPU organization:

Introduction, general register organization instruction formats, addressing modes data transfer and manipulation, program control, reduced instruction set computer (RISC), stack organization.

4. Micro programmed control:

Control memory, address sequencing, micro instruction formats, micro program example, design of control unit.

5. Memory organization :

Memory hierarchy, main memory, auxiliary memory, associative memory, cache memory, virtual memory.

6. Input-output organization:

Peripheral devices, input-output interface, asynchronous data transfer, modes of transfer, priority interrupt, direct memory access (DMA), introduction to multiprocessor system.

Textbook:

1. Computer system architecture, M. Morris mano, pearson education (3rd edition)

References:

1. Computer organization.V.Carl Hamacher, Zvonko g. Vranesic and Safwat G. Zaky, McGraw Hill international, (4th edition) .
2. Digital computer fundamentals, Thomas C.Bartee, TMH

EEE 315 – Performance and Design of Electrical Machines II

Instruction	:	4 periods per week
University Examination	:	3 hours
University Examination Marks	:	70
Sessional Marks	:	30

Transformers: Principles of operation constructional features. Equivalent circuit. Vector diagram, voltage regulation and efficiency parallel operation and load sharing. Three winding transformers, poly phase connections and Scott connection tap changing, cooling methods and transformer oil.

Induction Motor: Principles of operation of three phase induction motor rotating magnetic field types of rotor, torque expression, vector diagram, equivalent circuit and performance equations and calculations, slip-torque characteristic, circle diagram and performance calculations.

Starting of induction motors, crawling and cogging, double squirrel cage induction motor and equivalent circuit, methods of speed control of induction motors induction generator and principle of operation, self excitation of induction generator, charge motor, two phase motors.

Single phase induction motors: Types double revolving field theory, equivalent circuit performance analysis and characteristics of capacitor start motors, shaded pole, repulsion type, reluctance hysteric's and ac series motors.

Design of transformers: Main dimensions, single phase and three phase transformers, Winding and arrangement of coils, no load current estimation for single phase and three phase transformers, Temperature rise and design of tank and cooling tubes. Design of welding transformers.

Text books:

1. Electromechanical energy conversion with dynamics of machines By R. D. Begamudre.
2. Performance and design of alternating current machines by M.G. Say
3. Electrical machines by S k Bhattacharya, TMH, 1998.

Eee 316 – Fluid Mechanics & Hydraulic Machinery

Instruction	:	5 periods per week
University Examination	:	3 hours
University Examination Marks	:	70
Sessional Marks	:	30

I (a) Introduction to fluid mechanics, principle of continuum - fluid properties - mass density, specific weight, specific gravity, viscosity, surface tension, capillarity, compressibility & bulk modulus of electricity, vapor pressure.

(b) Fluid statics - fluid pressure and its measurement, Pascal's law, hydrostatic pressure distribution, manometers – micro manometers – mechanical gauges, hydrostatic forces on plane surfaces, relative equilibrium under translation.

II (a) Fluid kinematics-definition of steady and unsteady, uniform and non uniform, compressible and incompressible, rotational and irrotational, 1-D, 2-D and 3-D, laminar and turbulent flows, stream line, path line, streak line, stream function velocity potential function, local and convective accelerations - flow nets, principle of conservation of mass, 3-D continuity equation in cartesian coordinates, continuity equation for stream tube.

(b) Fluid dynamics - Derivation of Bernoulli's equation from the concepts of work done, total head, limitations of Bernoulli's principle, application of Bernoulli's equation, Venturi meter, Orifice meter, flow nozzle, pitot tube. Momentum principle - impulse momentum equation and its application to pipe bends and reducers, impact of jets on single stationary plates.

III Flow through pipes - laws of friction, Reynolds experiment, Darcy-weibach equation, major and minor losses, pipes in series, pipes in parallel, pipes connecting two reservoirs, siphon, power transmission through pipes and nozzles, concepts of water hammer.

IV (a) Hydraulic machines - Impact of jets on series of stationary and moving vanes, velocity triangles, work done – turbines – hydraulic, mechanical and overall efficiency, classification, component parts and working principles of Pelton, Francis and Kaplan turbines, unit quantities, specific speed, characteristic curves.

(b) Pumps: Classification of pumps, positive displacement and rotodynamic pumps, centrifugal pumps - component parts, working principles, manometric, static and overall efficiency, work done pumps in parallel and series, specific speed and pump characteristic curves.

Reciprocating pumps – working principles, acceleration, friction head, indicator diagrams, workdone, modified indicator diagram considering air vessels.

Textbooks:

1. Fluid mechanics and hydraulic machinery by AK. Jain
2. Fluid mechanics and hydraulic machinery by P. N. Modi & SM Sethi.

EEE 317-Electrical Machines Laboratory I

Instruction	:	4 periods per week
University Examination	:	3 hours
University Examination Marks	:	50
Sessional Marks	:	50

(Ten experiments based on EEE-222 and partly based on EEE 315 Syllabus)

EEE 318- L.I.C.S & Pulse Circuits Laboratory

Instruction	:	3 periods per week
University Examination	:	3 hours
University Examination Marks	:	50
Sessional Marks	:	50

(Ten experiments based on EEE-311 & EEE 312 Syllabus)

THIRD YEAR SECOND SEMESTER

Code	Subject	Instructions period per week	University Examination		Sectional Marks	Total Marks
			Duration Hours	Marks		
EEE 321	Control Systems. (Common with ECE)	4	3	70	30	100
EEE 322	Electromagnetic	4	3	70	30	100
EEE 323	Power Electronics	4	3	70	30	100
EEE 324	Electrical Power Generation and Utilization	4	3	70	30	100
EEE 325	Electrical Power Transmission & Distribution	4	3	70	30	100
EEE 326	Performance & Design of Electrical Machines – III	4	3	70	30	100
EEE 327	Digital Electronics & Microprocessors Laboratory	3	3	50	50	100
EEE 328	Fluid Mechanics & Hydraulic Machines Laboratory	3	3	50	50	100
TOTAL		31		520	280	800

EEE 321 – Control Systems (Common with ECE)

Instruction	:	4 periods per week
University Examination	:	3 hours
University Examination Marks	:	70
Sessional Marks	:	30

Mathematical models of control system components: (Electrical networks, mechanical systems, D.C., & A.C. Servo Motors tachogenerators synchros, Stepper motors) using differential equations, transfer function, block diagram and signal flow graphs. Reduction of signal flow graph using mason s formula.

Time response of first and second order standard systems with standard input signals Time and frequency domain specifications and their relation to standard second order system parameters. Steady state error and error constants. Effect of derivative and integral control on transient and steady state performance of feedback systems. Correlation between time and frequency domain specifications.

Concept of stability, Routh- Hurwitz criterion, relative stability analysis, Construction of root loci and analysis of control systems with root locus.

Frequency domain: polar plots- bode plots and nyquist plots determination of stability, phase margin and gain margin.

Textbooks:

1. Control systems engineering by I.J.. Nagrath & M.Gopal New Age imitational publishers.

Reference books:

1. Modern Control Engineering by Ogata, Pearson Education
2. Automatic control systems by Denfamin C. Kuo and Fgoluaraghi, john wiley & Sons, Inc.

EEE 322- Electromagnetics

Instruction	:	4 periods per week
University Examination	:	3 hours
University Examination Marks	:	70
Sessional Marks	:	30

General: Rectangular, cylindrical and spherical coordinate systems.

Electrostatics: Superposition, coulomb's law, electric field of different charge configurations using coulombs law and superposition, flux of a vector field lines, gauss's law in terms of integral form and point form) applications curl of the electric field, electric potential, calculation of electric field through electric potential for given charge configuration, electrostatic energy.

Electrostatic boundary conditions at a charged surface (assuming no dielectric polarization) basic properties of conductors in electrostatic fields, capacitance, Poisson's and Laplace's equations, properties of the solutions of laplace's equations uniqueness theorems, methods of images, electric dipoles, polarization of dielectrics, bound charges and their physical interpretation the displacement vector d , comments about the curl of d in electrostatics, linear dielectrics, determination of electric fields in the presence of linear dielectrics by finding d .

Magnetic Fields and Lorentz Force Law: The magnetic field vector b , steady line, surface and volume currents Biot – savart's law determination of magnetic field due to steady current configuration, the continuity equation, divergence and curl of b , ampere law in integral and differential form, applications the vector magnetic potential and calculation of magnetic field through the vector magnetic potential for given steady currant configurations comparison of electrostatic and magneto static, magneto static boundary conditions (assuming nonmagnetic polarizations)

The Magnetic Dipole: Diamagnetism, Paramagnetic & ferromagnetism, torques and forces on magnetic dipoles magnetization, bound current physic interpretation of bound currents, the h vector the divergence and curl of linear magnetic materials determination of magnetic fields in the presence of magnetic materials by finding h , emf, ohm's law, motional emf, faraday's laws, Lenz's law, quasistatic fields, inductance and energy in magnetic fields.

Time varying fields and Maxwell's equations: Maxwell,s modification of ampere's law, Maxwell's equations in any medium interms of e & b and interms of D, E, B & H , general boundary conditions, the uniform plane wave, Maxwell's equations in free space plane wave propagation, phase velocity and wavelength, intrinsic impedance, perfect dielectrics, attenuation, phase and propagation constants, the pointing vector and power considerations

Text books:

1. Introduction to electro dynamics by D.J..Griffiths,Mc Graw Hill pub
2. Engineering electro magnetic by William h. Hayt jr., McGraw Hill pub.(for wave propagation section only)

EEE 323 - Power Electronics

Instruction	:	4 periods per week
University Examination	:	3 hours
University Examination Marks	:	70
Sessional Marks	:	30

Thyristors: Introduction, principle of operation, two transistor model, gate Characteristics, turn on method, turn off methods, thyristor ratings, measurement of thyristor parameters, protection circuits

Gate triggering circuits: Firing of thyristor, pulse transformers, opto-isolators, gate triggering circuits, resistance firing, resistance capacitor firing, UJT programmable UJT(PUT), UJT as an SCR trigger, synchronized UJT triggering.

Series and parallel operation of thyristors: Equalizing networks triggering, string efficiency, derating.

Phase controlled rectifiers: Single phase – Half wave, Full wave & bridge controlled rectifiers. Three phase half wave and full wave controlled rectifiers, three phase fully controlled bridge rectifiers.

Inverters: Classification Series and parallel inverters, self commutated inverters, the Mc Murray inverter, the Mc Murray – Bedford inverter, harmonic reduction, current source inverters.

Choppers: Principle of operation, step up choppers, step up/ step down choppers, Jones chopper, and Morgan chopper.

Cycloconverters: Principle of operation, single phase to single phase cycloconverter, cycloconverter circuits for three phase output, control circuits.

Modern power semiconductor devices: Basic structure and static characteristics of power diode, power transistor, power MOSFET, IGBT, GTO basic structure principle of operation and static characteristics of DIAC and TRIAC.

Text Books:

M.D. Singh, K.B.Khanchandani - Power Electronics. Tata McGraw Hill Publishing Company Limited.

Reference Books:

1. Muhammad.h.rashid - Power Electronics , circuits, devices and applications. Pearson education.
2. Ashfeq ahmed - Power Electronics for technology, pearson education.

EEE 324 – Electrical Power Generation & Utilization

Instruction	:	4 periods per week
University Examination	:	3 hours
University Examination Marks	:	70
Sessional Marks	:	30

Introduction: Power generation, comparison of different sources of energy.

Thermal power stations: Line diagram, location, coal handling, drought, condensers, cooling water systems.

Hydro Electric Plants: Choice of site hydrology Classification of plants, general arrangement, functions of different components of a hydro plant.

Nuclear Power Plants: Schematic arrangement, components of nuclear reactor, classification of reactors different power reactors.

Gas turbine plants: Layout components of a gas turbine plant, open cycle and closed cycle plants.

Magneto Hydro Dynamic (Mhd) Power Generation: Basic concepts, principle, classification, coal MHD steam power plant, gas cooled nuclear mhd power, liquid metal MHD generator.

Operational Aspects Of Generating Stations: Load curves and associated definitions, selection of units, load duration curves.

Economic Considerations: Capital and running costs of generating stations, different tariffs, comparison of costs.

Heating and Welding: introduction, power frequency and high frequency methods of electric heating, ARC furnace. Resistance welding, ARC welding, modern welding techniques.

Illumination: Definitions, laws of illumination, polar curves, photometry, the electric lamps, cold cathode lamps, light fittings, illumination for different purposes, requirements of good lighting.

Textbook :

1. A textbook on power System Engineering by Soni, Gupta, Bhatnagar & Chakradarti, Dhanpat Rai & Co 1998

Reference books:

1. Generation & utilization by C.L. Wadhwa
2. Electrics power by S. L. UPPAL, Khanna publishers

EEE 325 – Electrical Power Transmission & Distribution

Instruction	:	4 periods per week
University Examination	:	3 hours
University Examination Marks	:	70
Sessional Marks	:	30

Single line diagram of a .c. power supply system, comparisons of A.C. & D.C. Transmission.

EHVAC Transmission: Necessity & problems involved,

HVDC Transmission: Single line diagram, principles of HVDC operation & control types of H. V. D. C. Links.

Power supply systems: Comparisons between various systems and copper efficiencies, effect of system voltage on transmission efficiency, choice of transmission voltage, conductor size and Kelvin s law

Power distribution systems: Radial and ring main systems, different types of a.c. Distributors.

Transmission line modeling: Inductance and capacitance of single phase and three phase lines, concept pf self GMD & Mutual GMD, transposition, skin effect and proximity effect,

Transmission line: modeling: Generalized network constants, modeling of short, medium and long transmission lines, rigorous line modeling, circle diagrams.

Mechanical design of transmission lines: Sag and tension calculations, line supports, conductor materials, OVER HEADLINES Vs UNDERGROUND CABLES,

Overhead line insulators: Types of insulators, potential distribution over a string of insulators and methods of equalizing potential.

Underground cables: Types of cables, insulation in cables, armoring & covering of cable, insulation resistance of cables, stress in insulation, sheathing in cables, use of inter sheaths, capacitance grading, capacitance in 3- core cables,

Corona: phenomenon of corona, critical, voltages, power loss due to corona factors affecting corona loss, radio interference

Textbooks:

1. A textbook on power system engineering by soni, gupta, bhatnagar & chakrabarti, bhanpatrai & co., 1998
2. Electrical power systems by C.L. Wadhwa, 3rd edition new – age international(p) Ltd.

Reference books :

1. Principles of power Systems by V.K. Mehata, S. Chand & Company Ltd, 2000.

EEE 326 – Performance and Design of Electrical Machines III

Instruction	:	4 periods per week
University Examination	:	3 hours
University Examination Marks	:	70
Sessional Marks	:	30

(Synchronous machines and design of synchronous machines and induction machines)

Synchronous generators: Basic concepts, types of machines and construction, armature windings, emf equation, effect of chording and winding distribution, armature reaction, regulation by synchronous impedance, MMF and Potter triangle methods, parallel operation Synchronous generators, Synchronizing current and Synchronizing power. Synchronizing to infinite bus-bars and operation of infinite bus power transfer equations, capability curve, two reaction model of salient pole synchronous machines and power angle characteristics, determination of X_d & X_q by slip test short circuit transients in synchronous machine.

Synchronous motor: principle of operation, methods starting, power flow, power developed by Synchronous motors, effects of changing load at constant excitation and changing excitation at constant load, excitation and power circles for synchronous machine. V – and inverted v curves, hunting and damper windings.

Design of Induction motors: Output equation, main dimensions air gap length, selection of starter and rotor slots. Design of windings.

Design of synchronous machine: Output equation, main dimensions for salient pole and non salient pole machines. Armature windings and design selection of starter slots, air gap length, design of rotor for salient pole and turbo alternator.

Textbooks:

1. “ Electromechanical energy conversion and dynamics of machines by R.D.Begamudre. New age international publishers. New Delhi.
2. Electrical machines by S.K. Bhattacharya. Tata McGraw Hill Co 1998.

EEE 327 – Logic Design and Microprocessors

Instruction	:	3 periods per week
University Examination	:	3 hours
University Examination Marks	:	50
Sessional Marks	:	50

(Ten experiments based on EEE 313 syllabus)

EEE 328 - Fluid Mechanics & Hydraulic Machines Laboratory

Instruction	:	3 periods per week
University Examination	:	3 hours
University Examination Marks	:	50
Sessional Marks	:	50

(Ten experiments based on EEE 316 syllabus)

FOURTH YEAR FIRST SEMESTER :

Code	Subject	Instructions period per week	University Examination		Sectional Marks	Total Marks
			Duration Hours	Marks		
EEE 411	Elective- (Digital signal processing (common with ECE411) or operations Research)	4	3	70	30	100
EEE 412	Power System Analysis & Stability	4	3	70	30	100
EEE 413	Electric Electric Drives & Traction	4	3	70	30	100
EEE 414	Switch Gear Protection & Relaying	4	3	70	30	100
EEE 415	Digital Control Systems	4	3	70	30	100
EEE 416	Power Electrical LAB.	4	3	70	30	100
EEE 417	Electrical Machines Lad- II	3	3	50	50	100
EEE 418	Project work	3	-	-	50	50
TOTAL		29	500	200	200	750

ELECTIVE-I

EEE 411 – Instrumentation

Instruction	:	3 periods per week
University Examination	:	3 hours
University Examination Marks	:	70
Sessional Marks	:	30

Introduction to Instrumentation: Typical applications of instrument system functional elements of measuring system classification of instruments, definitions of accuracy precision fidelity, resolution, linearity, digital computers, standards and calibration.

Static and dynamic characteristics of instruments: Introduction errors and uncertainties in performance parameters, propagation of uncertainties in compound quantities Static performance parameters, impedance loading and matching specification of static characteristics, selection of the instrument. Formulation of the system dynamic equations, dynamic response compensation.

Transducers and intermediate elements: Introduction, classification of analog digital, active passive, intermediate elements like amplifiers compensators, differentiating and integrating elements, fillers, A-D and D-A converters data transmission elements.

Indicating and recording elements: Introduction, digital voltmeters, cathode ray oscilloscopes, galvanometric records, servo type potentiometer records magnetic tape recording, digital recorder, memory type data acquisition systems, data display and storage.

Measurement of non- electrical quantities with electrical transducers: Velocity acceleration, force, torque, pressure, flow, temperature and acoustics.

Biomedical measurements and biometrics: Introduction, measurement of blood pressure and bio electric potentials, ECG recording, physiological effects of electric current, shock hazards methods of accident prevention.

Textbook:

1. Instrumentation, measurement and analysis by B.C. Nakra and K.K Chaudary.

Reference Books:

1. Biomedical Instrumentation and measurement by I.Cromwell, F.J. Weibali, and E.A.Pfeiffer.
2. Electrical and electronic measurement and Instrumentation by A.K. Sawhaney
3. Electronic Instrumentation by H.S. Kalsi.

ELECTIVE-I
EEE 411 – Operations Research

Instruction	:	4 periods per week
University Examination	:	3 hours
University Examination Marks	:	70
Sessional Marks	:	30

Introduction to optimization, engineering applications of optimization, statement of problem, classification of optimization problem techniques.

Linear programming: Introduction, requirements for a LP problem, examples on the application of LP, graphical solution of 2-variable LP problems, some exceptional cases, general mathematical formulation for LPP, canonical and standard forms of LP problem, simplex method, examples on the application of simplex techniques.

Artificial variable technique: Big- method and two phase techniques.

Transportation problem: Matrix terminology, definition and mathematical representation of transportation model, formulation and solution of transportation models (basic feasible solution by north-west corner method, inspection method, Vogell's approximation method)

Assignment problem: Matrix terminology, definition of assignment model, comparison with transportation model, mathematical representation of assignment model, formulation and solution of assignment models.

Pert network: Introduction, phases of project scheduling, network logic, numbering the events (Fulkerson's rule), measure of activity.

Pert network computations: Forward pass and backward pass computations, slack critical path, probability of meeting the scheduled dates.

Inventory models: Introduction, necessity for maintaining inventory, classification of inventory models, inventory models with deterministic demand, demand rate uniform-production rate infinite, demand rate non-uniform production rate finite, demand rate uniform-production rate finite.

Game theory: Useful terminology, rules for game theory, saddle point, pure strategy, reduce game by dominance, mixed strategies, 2x2 games without saddle point.

Text books :

1. Operations research- an introduction by H. TAHA, Prentice Hall of India Pvt. Ltd.
2. Engineering optimization- theory & practice by S.S. Rao, New Age international (p) Ltd.
3. Operations research – an introduction by P.K. Gupta & D.S. Hira, S. Chand & Co.Ltd.

ELECTIVE 1
EEE 411 – Digital Signal processing
(Common with ECE- 411)

Instruction	:	4 periods per week
University Examination	:	3 hours
University Examination Marks	:	70
Sessional Marks	:	30

1. Discrete – time signals and systems :

Discrete time signals – sequences linear shift – invariant systems stability and causality, linear constants – coefficient difference equations, frequency domain representation of discrete –time signals and systems .

2. Applications of Z transformers :

Systems functions $H(Z)$ of digital systems, stability analysis, structure and realization of digital filters, finite word length effects

3. Discrete fourier transformer (DFT) :

Properties of the DFT, DFT representation of periodic sequences, properties of DFT convolution of sequences

4. Fast fourier transforms (FFT) :

Radix – 2 decimation – in – time (DIT) and decimation – in – frequency (DIF) FFT algorithms, inverse FFT

5. IIR digital filters design techniques :

design of IIR filters from analog filters, analog filters approximations (Butterworth and chebyshev approximations) frequency transformations general considerations in digital filter design, bilinear transformation method step and impulse invariance technique .

6 .design of filters: Fourier series method window function techniques comparison of IIR and FIR filters.

7. applications : Applications of FFT in spectrum analysis and filtering application of DSP in speech processing .

Text books :

1. Alan V. Oppenheim & Ronald W. Schaffer: digital signal processing Pearson Education.

References:

1. Sanjit K Mitra, digital signal processing “ a –computer based approach” TATA McGraw Hill
2. Raddae & Rabiner application of digital signal processing
3. S.P. Eugene Xavier ,signals systems and signal processing S chand &co Ltd.
4. Antonio :Analysis and design of digital filters, TATA Mc Graw Hill

EEE 412 – Power System Analysis & Stability

Instruction	:	4 periods per week
University Examination	:	3 hours
University Examination Marks	:	70
Sessional Marks	:	30

P.U. Representation: single line diagram, per unit quantities, P.U impedance of 3-winding transformers, P.U impedance diagram of power systems.

Load flow studies: Formulations of network matrices, load flow problem, gauss-seidel method Newton-raphson method & fast decoupled method of solving load flow problem.

Symmetrical fault analysis: 3phase short circuit currents and reactance of a synchronous machine, fault limiting reactors.

Symmetrical components: the Symmetrical components, phase shift in delta / star transformers, 3phase power interms of Symmetrical components.

Un- Symmetrical faults: Various types of faults – LG, LL, LLG on an unloaded alternator, sequence impedances and sequence networks .

Power systems stability: Concepts of stability (steady state and transient) swing equation, equal area criterion, critical clearing angle and time for transient stability, step by step method of solution factors affecting transient stability .

Textbooks:

1. Power system analysis by Hadi Sadat, McGraw Hill, 1999.
2. Elements of power system analysis by William D.Stevenson, JR McGraw Hill

Reference:

1. Power system engineering by the I.J.Nagarath &D.P.Kothari, TMH Pub.

EEE 413- Electric Drives and Traction

Instruction	:	4 periods per week
University Examination	:	3 hours
University Examination Marks	:	70
Sessional Marks	:	30

Electric drive: concept and classification of Electric drives, four quadrant operation, types of load dynamics of motor combination, steady- state and transient stability of drive.

Characteristics of motors: Basic relations and characteristics and modified speed – torque characteristics of DC shunt and series motors, characteristics of 3phase induction and synchronous motors and modifications of their speed of torque characteristics.

Starting: Effect of starting on power supply, motor and load, methods of starting, acceleration time, energy relation during starting and methods to reduce energy loss during starting.

Electric braking : Types of braking, braking of DC motors during lowering of loads, braking while stopping, braking of induction and synchronous motors, energy relations during braking.

Rating and heating of motor: Heating effects, loading conditions and classes of duty, determination of power ratings of motors for different applications, effect of load inertia, load equalization and fly- wheel, calculation, environmental factors.

General factory drive, paper mill drive, steel mill drive, coal mining drive.

Electrical Traction : General features and systems of track electrification, traction motors, loco wheel arrangement and riding qualities, transmission of drive traction motor control (series- parallel control), trac equipment and collection gear, train movement, speed-time curve and speed distance curve, specific energy consumption (sec) and factors affecting it.

Textbooks:

1. A first course on electric drive by S.K. Pillai, wiley Eastern Ltd.
2. Utilisation of electrical energy (S.I.units) by E. open shaw Taylor and V.V.I.Rao Orient long man.

Reference:

1. Modern electric traction by H. Partab. Dhanpat roy &co
2. Electric drives by vedam subramanyam, TMH pub.

EEE 414 – Switch Gear, Protection & Relaying

Instruction	:	4 periods per week
University Examination	:	3 hours
University Examination Marks	:	70
Sessional Marks	:	30

Fuses: Types, high voltage HRC fuses, applications, selection. Fundamentals of fault clearance and circuit breakers; Transient recovery voltage, single and double frequency transients, resistance switching, current chopping, switching of capacitor banks and unloaded lines, rating and characteristic of circuit breakers, formation of arc, methods arc extinction.

Circuit breakers: classification, principle of operation, constructional features of air circuit breakers, air blast circuit breakers, SF₆ circuit breakers and Vacuum circuit breakers, testing of circuit breakers.

Relaying: Different types, principle of operation and characteristics, over current, earth fault differential and distance protection with simple applications to alternators, transformers, single and parallel feeders, introductions to solid state relaying, static relays for time lag over current and differential protection.

Traveling waves in the transmission lines: traveling wave phenomena, surge impedance incidence and reflected waves, voltage and current distributions open circuited line; short circuit line, line terminated through a resistance, capacitance; line connected to a cable, t. junction respected relations –bewley`s lattice diagram.

Protection against over voltage: causes of over voltages, over voltages due to lightning. Protections against lightning and traveling waves –earth wire, effects of series inductances, shunt capacitance, spark gap, surge arresters, lightning arresters etc, insulation co-ordination

Substation layout & bus bars: Schemes of layout and bus bar design

Test books :

1. Electrical power systems by C.I. wadhwa
2. Electrical power systems by S.L. Uppal
3. Power system productions & switch gears by Ravindranath & M.Chanda, New Age Pub

EEE 415- Digital Control Systems

Instruction	:	4 periods per week
University Examination	:	3 hours
University Examination Marks	:	70
Sessional Marks	:	30

Signal conversion and processing: Introduction, block diagram representation of s/h device, mathematical modeling of the sampling process, finite-pulse width sampler, folding frequency. The sampling theorem, mathematical modeling of the sampling, ideal sampler, sample and hold devices, expressions of $f^*(s)$, s plane properties of $f^*(s)$, zero-order hold, frequency-domain characteristics of ZOH, first order hold, fractional hold device.

The Z transform: The Z-transform definition, relationship with Laplace transform, alternate expression for $f(z)$, evaluation of z-transform, relationship between s-plane and z-plane, inverse z-transform, non uniqueness of the z-transform, defining equations of the z-transform, theorems of the z-transform, limitations of the z-transform.

Transfer function, Block Diagrams & Signal Flow Graphs: Transfer functions, block diagrams, signal flow graphs the pulse transfer function and z-transform function, systems with cascaded elements separated by a sampler & not separated by a sampler, pulse transform function of zoh and relation between $g(s)$ and $g(z)$, closed loop systems characteristic equation, physical reliability.

The state variable techniques: The state variable techniques, state equation and state transition equations of continuous data systems. State transitions matrix solutions, properties of state transition matrix, solution of non-homogeneous state equations, state equations of discrete systems with sample and hold devices, state transition equations, the recursive method, the z-transform method, state equations and transfer function, characteristic equation, eigen values eigen vectors, diagonalization of the 'A' matrix, Jordan canonical form computing state transition matrix.

Controllability, Observability, Stability: Definition of controllability, theorem on controllability, definition of observability, theorem on observability, relationships between controllability and observability and transfer function, stability of linear digital control systems, definition & theorem, stability tests, bilinear transformation method, Jury's stability test.

Text book:

1. Digital control system by B.C. Kuo, Second edition, Oxford University press, 2003.

Reference book:

1. Digital control systems by K. Ogata, Pearson education.

EEE 416-Power Electronics Laboratory

Instruction	:	3 periods per week
University Examination	:	3 hours
University Examination Marks	:	50
Sessional Marks	:	50

EEE 417- Electrical Machines Laboratory

Instruction	:	3 periods per week
University Examination	:	3 hours
University Examination Marks	:	50
Sessional Marks	:	50

EEE-418-Project work

Instruction	:	3 periods per week
University Examination	:	
University Examination Marks	:	
Sessional Marks	:	50

FOURTH YEAR SECOND SEMESTER :

Code	Subject	Instructions period per week	University Examination		Sectional Marks	Total Marks
			Duration Hours	Marks		
EEE 421	Engineering Economics & Management (Common with ECE)	3	3	70	30	100
EEE 423	Elective- II (non Conventional Energy Sources or Data Structures or Advanced Topics in Control Systems)	4	3	70	30	100
EEE 424	Power System Operation & Control	4	3	70	30	100
EEE 425	Control Systems Lab.	3	3	50	50	100
EEE 426	Project work	3	3	100	50	150
EEE 427	Power Systems & Simulation Laboratory	3	3	50	50	100
TOTAL		20		410	240	650

EEE 421-Engineering Economics & Management (Common with ECE)

Instruction	:	3 periods per week
University Examination	:	3 hours
University Examination Marks	:	70
Sessional Marks	:	30

1. Fundamentals of economics: scarce definition of economics: Engineering Economics and its definition utility and types of utility; demand- law of demand, elasticity of demand, factors affecting the elasticity of demand.

2. Types of business ownership: private ownership – individual, partner-ship, joint stock companies, and cooperative societies; state ownership – government departmental organization, public corporations, government companies the joint sector management.

3. Types of industrial organization: purchasing organization, sales organization store keeping, materials management and control policies.

4. Plant location- location economics ; production planning and control; principles and functions of management; balance sheet.

5. Wages: Methods of wage payment, industrial disputes and their settlement industrial disputes Act.

Textbook:

1. S.C. Sharma and T.R. Bangs, Industrial Organization and Engineering Economics.

Reference Book:

1. K.K. Ddewett, Modern Economic Theory.

EEE 422- Principles of Environmental Studies
(Common with all Engineering Branch)
(Non-credit audit course)

Instruction	:	3 periods per week
University Examination	:	-
University Examination Marks	:	-
Sessional Marks	:	-

Unit 1 : Introduction to environmental sciences- importance – types of ecosystems – lake – river – marine – forest – desert – bio – diversity.

Unit 2: Resources natural – water – mineral – food – forest – energy- land – use and exploitation- environmental degradation- remedial measures.

Unit 3: Environmental pollution causes, effects, standards and control of (a) air pollution; (b) water pollution; (c) soil pollution;(d) marine pollution; (e)noise pollution.

Unit 4: Legal aspects of pollution

- (A) Air (prevention and control of pollution) act.
- (B) Water (prevention and control of pollution) act.
- (C) Forest conservation act.
- (D) Forest conservation act.

Unit 5: Role of people to protect environment – role of NGOs

- A. Global issues.
- B. Green house effect
- C. Global warming
- D. Nuclear accidents
- E. local issues .Causes and action
- F. Air pollution due to industries
- G. Automobiles
- H. Public interest litigation case studies – success stories

Leather industries:

Taaj & Mathura Refinery; Silent valley

Recommended textbook:

- (A) Introduction to environmental science – Turk &Turk and Witties &Wittes
- (B) Environmental sciences –P.D. Sarma.

ELECTIVE II

EEE 423 Non- Conventional Energy sources

Instruction	:	4 periods per week
University Examination	:	3 hours
University Examination Marks	:	70
Sessional Marks	:	30

Introduction to energy sources: Conventional, non –Conventional renewable energy sources advantages prospects

Solar energy: Basic principles components of wind energy conversion system (wecs) classification of wecs, applications.

Bio-energy: Introduction, biomass-energy conversion wet & dry processes, classification of biogas plants, constructional details of few main digesters, biogas form wastes, applications.

Geo-thermal energy: Introduction, sources, prime movers, for Geo-thermal energy, applications.

Energy from the oceans: Introduction, ocean –thermal electrical conversion (otec) open and closed cycles. Tidal energy principles, single and double basin arrangements, wave energy conversion devices.

Fuel Cells: Introduction, classification, types, conversion efficiency, applications.

Text Books:

1. Non-Conventional Energy sources, by G.D. Rai, Khanna pub.

References Books:

Energy technology Non- Conventional, Renewable & Convectional By S. Rao
Khanna pub.

Future sources of electrical power by M.P. Agarwal First ed. S. Chand & Co, 1999.

ELECTIVE II
EEE 423 – Data structures

Instruction	:	4 periods per week
University Examination	:	3 hours
University Examination Marks	:	70
Sessional Marks	:	30

Revision of C language: Over- view only (no questions to de set on this)

Arrays and functions: Organization and use of one dimensional two dimensional and multi dimensional arrays, handling of character strings , string operations concept of function, parameter passing, recursion.

Structures, pointers & Files: Definition of structure and union programming examples, pointer, pointer expressions, programming examples file operations and preprocess.

Linear Data Structure: Stack representation, operation queue representation, operations, circular queues, list representation operations double linked and circular list.

Non linear data structure: Trees, binary tree representation, tree transversals, conversion of general tree to binary tree, representation of graphs.

Search techniques: Basic search techniques, tree searching graphics linked representation of graphs, graph transversal and spanning trees.

Textbooks:

1. Programming in ANSI C by E. Balaguruswamy
2. Data structures using C by A.M. Tanenbaum and others.

Reference Books:

1. An introduction to data structures with applications by trmbly & Sorenson
2. the C Programming language by Kernigan & Wretch

ELECTIVE II

EEE 423 – Advanced Topics in control Systems

Instruction	:	4 periods per week
University Examination	:	3 hours
University Examination Marks	:	70
Sessional Marks	:	30

Types of compensation and controllers, design on cascade compensators, lead and lag, using riotous and bode plot techniques, pole placement of single input, single output systems with state variable feedback.

Nonlinear systems: Common physical nonlinearities, classification of nonlinearities, general response of nonlinear components.

Definition of describing function and significance. Describing function of on- off relay, on – off relay with dead – zone, saturation, saturation with dead zone and relay with hysteretic non linearities , determination of amplitude and frequency of limit cycles.

Phase plane analysis: Basic concept of stability analysis with single on- off relay phase plane method, singular points. Construction of phase trajectory using isoclines method for linear systems.

Liapunov stability: Definition of slipknot stability theorems, direct met hob of Liapunov and its application to linear system stability study.

Textbook:

Control System Engineering by U Nagarath & M. Gopal, New Age International Publications, 1999.

References Books:

1. Control Engineering Theory & Practice by N.Bandhopadhyay, PH, 1 , 2003.
2. Control System Engineering by S.N. Sivanandam, Vlkas publishing House Pvt.
3. Control Systems by R. C. Sukla, Dhanpet Rai & Sons, New Delhi.

EEE 424 – Power System Operation & Control

Instruction	:	4 periods per week
University Examination	:	3 hours
University Examination Marks	:	70
Sessional Marks	:	30

Optimal System Operation: Optimal Operation of generators on a bus bar, operating cost and incremental fuel cost characteristics, optimum generation scheduling, derivation of transmission loss formula, optimal load flow solution, optimal scheduling of hydro thermal system.

Automatic generation & voltage controlled – frequency control, concepts, load frequency control of a single area system, load frequency control of a two area system, load frequency control and economic dispatch control, speed governor dead – band and its effect on automatic generation control

Power system security: Introduction, system states, security analysis contingency analysis sensitivity factors, voltage stability.

Emergency control: concepts, preventive and emergency control, coherent area dynamics, stability enhancement methods, long term frequency dynamics, average system frequency, center of inertia.

Text books:

1. Modern power system analysis, D.P. Kothari and I.J.Nagarath – revised edition, T.M.H.Publications
2. Electric energy systems theory- an introduction by OLLEI. Elgerd (TMH Edition)

References Books:

1. Advanced power system analysis and dynamics by L.P; Singh, Wiley eastern limited, third edition,
2. Power System Analysis by Hadi Sadat, MGraw Hill Pub.

EEE 425 – Control Systems Laboratory

Instruction	:	3 periods per week
University Examination	:	3 hours
University Examination Marks	:	50
Sessional Marks	:	50

(Ten experiments based on EEE -321 & EEE- 415 Syllabi)

EEE 426 –Project work

Instruction	:	3 periods per week
University Examination	:	Viva Voice
University Examination Marks	:	100
Sessional Marks	:	50

EEE 427 – Power Systems & Simulation Laboratory

Instruction	:	3 periods per week
University Examination	:	3 hours
University Examination Marks	:	50
Sessional Marks	:	50