

VEER NARMAD SOUTH GUJARAT UNIVERSITY

B.E.-II (Electronics & Communication Engg.)

Semester - VIII

Power Systems Protection

Electrical Machine Design

Optimization Methods

ELECTIVES:-

GROUP A

A.1 Power Systems Operation and Controls

A.2 Extra High Voltage AC/DC Transmission

GROUP B

B.1 Operations Research

B.2 Power System Reliability Evaluation

GROUP C

C.1 Industrial Instrumentation

C.2 Advanced Control Systems

GROUP D

D.1 Advanced Microprocessors and Applications to Electrical Engineering

D.2 Advanced Power Electronics

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ELE 801 ELE Power Systems Protection

	Lecture	Tutorial	Practical
Teaching Hours	3	1	2
Examination Scheme Marks	100	25	Continuous Evaluation 20 Examination 30

Introduction : functions and characteristics of protecting relaying, primary and back up relaying.

Relays, basic principles, construction and characteristics : types of relays and actuating structures, instantaneous IDMT, directional and differential relay.

Generator protection: modern methods of protecting generators against faults in stator, rotor and prime movers and other abnormal conditions.

Transformer protection : protection of transformers, basic differential over current relays, restricted earth fault protection, gas relays, overall generator-transformer differential protection, magnetizing inrush protection.

Busbar protection : protection of out door and indoor busbars by current differential, voltage differential and directional comparison principles, linear coupler, high impedance schemes

Distance protection: operating characteristics of impedance, reactance relays on R-X diagram, overreach and memory action, ohm and mho types relays and their characteristics, relay response under power swings and effect of fault resistance, setting of distance relays.

Carrier current protection: phase comparison and directional comparison principles. Testing of protective relays: classification, heavy current test plant, indirect methods of testing

Static protective relays and microprocessor based protective relays: Introduction for the protective relaying schemes discussed above.

References :-

- 1) Power System Protection and switchgear, Badriram & D N Vishwakarma
- 2) Power System Protection and Switchgear, B Ravindranath & M Chander

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E LE 802 ELE Electrical Machine Design

	Lecture	Tutorial	Practical
Teaching Hours	3	0	2
Examination Scheme Marks	100	00	Continuous Evaluation 20 Examination 30

Armature Winding :- Single layer and Double layer Windings; Simple lap and Wave Windings; Multiplex Windings, Equalizer connections; Dummy Coils; Open Windings; Wide spread and Narrow-spread Windings; Fractional Slot Windings; Eddy current Loss in Single and Sectionalised Conductors.

Basic Concept of Design :- Specific Electric and Magnetic Loading; Output Equations of D.C. and A.C. Machines; Significance of output co efficient; Factors affecting Specific Magnetic and Electric Loading; Variation of Output and Losses with Linear Dimensions; Separation of Main Dimensions of Rotating Machines, Computer Aided Design of Rotating Machines.

Design of D. C. Machines :- Choice of Specific Loading; Selection of Number of Poles; Main Dimensions and Air gap Length; Armature Reaction and it's effects; Compensating Winding; Design of Armature Winding; Design of Field System; Commutation; Design of Interpoles.

Design of Three Phase induction Motor :- Specific Loading; Main Dimensions; Design of stator and Rotor Winding; Length of Air Gap; Design of Squirrel Cage Rotor; Harmonic Torque; Magnetizing Current; Resistance and Leakage Reactance; Circle Diagram; Dispersion Co efficient.

Design of Single Phase induction Motor :- Types of Motors; Output Equation and main dimensions; Design of Stator and Rotor; Resistance and Leakage Reactance Calculation; Equivalent Circuit; Design of Auxiliary Winding; Starting Torque; Circle Diagram.

Design of Synchronous Machines :- Types of Synchronous Machines; Round Rotor and Salient Pole Machines; Output Equation; Specific Loading; Main Dimensions; Effect of SCR; Length of Air Gap; Armature Design; Elimination of Harmonics; No load and Full load Field MMF.

Texts / References:

- 1) A Course in Electrical Machine Design, A. K. Sawhney, Dhanpat Rai and Sons.
- 2) The Performance and Design of Direct Current Machines, A. E. Clayton, Pitman.
- 3) The Performance and Design of Alternating Current Machines, M. G. Say, ELBS.

NOTE : Design, Drawing and Term Work will be based on the course under EE 802 ELE Electrical Machine Design.

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E LE 803 ELE Optimization Methods

	Lecture	Tutorial	Practical
Teaching Hours	3	1	0
Examination Scheme Marks	100	25	Continuous Evaluation 00 Examination 00

Mathematical preliminaries :- convex sets, intersection of convex sets, vertices or extreme points of a convex set, convex polyhedron, hyper-planes, closed and open half space, convex functions.

Linear Programming :- standard form, graphical representation and solution of LP in two-dimensional space. Feasible, Basic Feasible and Optimal solutions, pivotal reduction of a set of linear equations, slack and surplus variables, Simplex method and algorithm, two phase method, degeneracy, simplex multipliers, revised simplex method, duality in linear programming, duality theorems.

Integer Linear programming graphical representation, Gomory's cutting plane method for all Integers programming problem.

Transportation Problem :- description, finding initial basic feasible solution, Vogel approximate method, test for optimality, new Basic solution. Assignment Problem and its solution.

Non Linear Convex Programming :- single variable optimization, multi variable optimization with no constraints, Hessian matrix, multivariable optimization with equality constraints, solution by direct substitution, method of constrained variation, Lagrangian function and Lagranges multipliers, interpretation of Lagranges multipliers, multivariable optimization with inequality constraints, Kuhn-Tucker theorem, Quadratic programming.

Search methods :- One dimensional search methods, unimodal functions, search plans (single variable), Fibonacci, Golden section and Rosenbrock methods.

Methods requiring $f(x)$ to be differentiable :- method of bisection, false position, Newton-Raphson method, and Quadratic interpolation.

Multi-dimensional search :- search along a line, choosing a step length, choosing a direction, axial direction, steepest descent, Newton-Raphson method, Conjugate direction.

Text/ References:-

- 1) Mital K V: Optimization Methods in operational research & system analysis, Wiley Eastern.
- 2) Rao S S: Optimization theory and applications.

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GROUP A:

A.1 Power Systems Operation and Controls (Elective)

	Lecture	Tutorial	Practical
Teaching Hours	3	1	00
Examination Scheme Marks	100	25	00

Load Flow studies :- Network model formulation, Formation of Y bus, Power Flow problem: different types of buses, Approximate power flow, Gauss Siedel method, Newton-Raphson method, Decoupled Power flow studies, Fast Decoupled Power flow studies, Comparison of Power Flow Methods. Control of Voltage Profile.

Optimal System Operation :- Optimal operation of generators on a busbar, Optimal Commitment – dynamic programming technique, Optimal Generation Scheduling, Optimal Power Flow solution, Optimal Scheduling of Hydrothermal system.

Auto generation & voltage Control :- Power Frequency control, Power Frequency control & economic dispatch control, Two area Load frequency control, Auto voltage control.

Texts/References:-

- 1) Nagrath & Kothari : Power System Engineering , 1994 edition, TMH publishers.
- 2) O.L Elgerd : Electric Energy Systems Theory, TMH publishers.

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A.2 Extra High Voltage AC. DC Transmission (Elective)

	Lecture	Tutorial	Practical
Teaching Hours	3	1	00
Examination Scheme Marks	100	25	00

HVDC Power Transmission :- Comparison of AC and DC Transmission,, Application of DC transmission., kind of DC links.

Thyristor Valve :- Device Characteristics: steady state and switching,.

Analysis of HVDC Converters :- Three phase and six phase converter circuits, voltage current waveforms and ratios, apparent power factor and utilization factor, delay angle, transformer rating pulse number, commutation group, Graetz Circuit, Overlap, advance angle and extinction angle. analysis of two and three valve conduction mode, equivalent commutation resistance.

EHV AC Transmission Lines :- Introduction, transmission line trends and preliminaries, calculation of line and ground parameters, bundled conductors, bundle spacing and bundle radius, sequence inductance and capacitance parameters, line parameters for modes of propagation, diagonalization procedure, interpretation of eigen vectors, velocity of propagation for the modes in transposed lines.

Voltage gradient of Conductors :- field of a point charge and its properties, field of a sphere gap, method of image charges, field of line charges and their properties, corona inception gradient, charge potential relations for multi-conductor lines, maximum charge condition on a three phase line, surface voltage gradients on conductors : single conductor, 2 conductor and multi conductor bundle, maximum surface voltage gradient, Mangoldt (Markt-Mengle) formula, design of cylindrical cage for corona experiments, single conductor concentric as well with eccentricity inside a cylinder,

AC Power frequency Voltage Control and Over-voltages :- No load voltage conditions and charging current, voltage control using synchronous condensers, shunt reactor compensation of very long line with intermediate switching stations, series capacitor compensation at line centre., sub-synchronous resonance in series- capacitor compensated line. sub synchronous resonance problem, induction generator effect, torsional interaction , transient torque problem.

Text / References:-

- 1) Padiyar : "HVDC Power Transmission Systems" Wiley Eastern Ltd. 1993
- 2) Begamudre " Extra High Voltage AC Transmission Engineering" Wiley Eastern Ltd. 1990.

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GROUP B

B.1 OPERATIONS RESEARCH (Elective)

	Lecture	Tutorial	Practical
Teaching Hours	3	1	00
Examination Scheme Marks	100	25	00

Probabilities and Statistics for Operations Research :- Distribution; Random (Stochastic) Process, Markov Process, Markov Anal

Review of Probability Theory: Concept of Probability; Frequency Interpretation; Conditional Probability; Probability Distribution of a Random Variable; Mean Variable and Standard Deviations.

Probability Distributions and Markov Analysis: Bernoulli Distribution; Binomial Distribution; Poission Distribution; Normal analysis.

Simulation (Monte-Carlo Technique): Types and use of Simulation; Monte-Carlo Simulation; Applications to Inventory Control; Queuing Problems and Capital Budgeting.

Operations Research Models :-

Game Theory: Introduction; Basic Principal and Applications.

Inventory and Production Management: Introduction; Deterministic Inventory Models; The EOQ Model with No Storage, with storage and with Constraints; Simple Probabilistic Inventory Models; Inventory Models with price Breaks.

Replacement Models and System Reliability: Introduction; Replacement of items that Deteriorate; Replacement of items that fail Completely; Other Replacement Problems; System Reliability.

Queuing Models: Queuing Problem; Distribution in Queuing Systems.

Job Sequencing: Introduction, Solution of Sequencing Problem.

Dynamic Programming: Introduction; Concept of Dynamic Programming; Mathematical Formulation of Multistage Model.

Project Management by PERT-CPM: Introduction; Basic Steps in PERT/CPM Technique; Resource Allocation; Application Aries of PERT/CPM for Management.

Information Theory: Introduction; Fundamental Theorems; Applications.

Texts / References:-

- 1) S. D. Sharma, Operations Research, Khedarnath Ramnath and Co., Meerut.
- 2) J. K. Sharma, Mathematical Models in Operation Research, Tata Mc Graw Hill Publications Ltd., New Delhi.
- 3) Harvey M. Wagner, Principles of Operations Research, Prentice-Hall of India.

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B.2 POWER SYSTEM RELIABILITY EVALUATION (Elective)

	Lecture	Tutorial	Practical
Teaching Hours	3	1	00
Examination Scheme Marks	100	25	00

Basic Reliability Concepts :- Reliability definition, failure data analysis, failure data, mean time to failure, hazard model, distribution functions and reliability analysis, conditional probabilities and multiplication rules, probability calculations by VENN diagrams, system reliability, series-parallel and mixed configuration, applications to specific hazard models, methods of solving complex problems, reliability improvements, unit redundancy, optimization, reliability allocation, maintainability and availability.

Static generating capacity reliability evaluation :- Introduction, capacity outage probability tables, loss of load probability method, load-forecast uncertainty, loss of energy probability, frequency and duration approach.

Spinning generating capacity reliability evaluation :- Introduction, spinning capacity evaluation, load forecast uncertainty, derated capacity levels.

Transmission system reliability evaluation :- Average interruption rate method, frequency and duration method, the Markove process approach.

Composite system reliability evaluation :- Introduction, The conditional probability approach, simple system application, two plant and single load system, two plant two-load system.

Interconnected system generating capacity reliability evaluation :- Probability array for two systems, loss of load approach, reliability evaluation in more than two systems.

DC system reliability evaluation :- System models of failure, los of load approach, frequency and duration approach, multiple bridge equivalents.

Texts / References :-

- 1) R. Billinton, Power system reliability evaluation, Gordon and Breach Science Publications.
- 2) R. Billinton and R.N. Allan, Reliability evaluation of power systems, Plenum Press.
- 3) J. Endrenyi, Reliability Modelling in Electric power systems, Jhon Wiely.
- 4) Robert N. Sullivan, Power system planning, McGrow Hill International Book Co.
- 5) L.S. Srinath, Concepts in reliability Engg., Affiliated East-West Press Pvt. Ltd.
- 6) Balagurusamy, Reliability in Engg., Tata McGraw Hill.

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GROUP C

C.1 Industrial Instrumentation (Elective)

	Lecture	Tutorial	Practical 00
Teaching Hours	3	1	00
Examination Scheme Marks	100	25	00

(I) TRANSDUCER INSTRUMENTATION :

Transducers for Industrial measurements :- Working principle and characteristics of transducers used for measuring weight, density, vibration, distance, thickness, torque and shaft power.

Transducers for process measurements :- Working principle and characteristics of transducers used for measuring pressure, level, temperature, flow, moisture, humidity and pH value.

Analytical systems :- Classification of analytical instruments, sampling for on line analyzers, pH measurements, electrical conductivity measurements, thermal conductivity gases analyzers, process chromatography. Oxygen determination, gas and process analyzers, refractometers.

Control elements :- Actuators, driving units and control valves - classification and working principle of pneumatic and electrical types.

(II) PROGRAMMABLE LOGIC CONTROLLERS :

Introduction :- Introduction to PLC relays in control application, ladder diagram, advantages and disadvantages of programmable controller.

PLC system description :- Overall system description, central processing unit, the programmer/monitor, input-output modules, discrete and analog modules, program recording devices.

Programming of PLC :- Elements of ladder diagram: registers, timers, input contacts, output coils, creating a ladder diagram for a process problem, general-programming procedures.

Basic programmable controller functions :- Programming on-off inputs-outputs, arithmetic and logic functions, bit-wise manipulation and computer interface, industrial process timing examples.

(III) DISTRIBUTED PROCESS CONTROL INSTRUMENTATION :

Introduction to real time system, concept of computer control, protocols for communication, computer hardware required for real time applications, DDC algorithms and their implementation.

Texts/Reference:-

- 1) Doebelin E. O., Measurement systems, McGraw-Hill international editions, fourth edition, 1990.
- 2) Ranga, sarma, Mani, Instrumentation Devices and Systems, TMH, second edition 1997.
- 3) Considine D. M., Process/Industrial instruments and control handbook, McGraw Hill, fourth edition.
- 4) D. Patranabis, Principles of Process Control, TMH, 1981.
- 5) Webb J.w., programmable controllers, Merrill publishing company, 1988.
- 6) Batten G. L., programmable controllers, McGraw Hill Inc., second edition.
- 7) Bennett stuart, Real time Computer Control, Prentice Hall, 1988.

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C.2 ADVANCED CONTROL SYSTEMS (Elective)

	Lecture	Tutorial	Practical
Teaching Hours	3	1	00
Examination Scheme Marks	100	25	00

Describing Function Analysis of Nonlinear Control System :

Introduction to Nonlinear Systems Describing Functions for Common Types of Nonlinearities Describing Function Analysis, Stability and Limit Cycles.

Phase-Plane Analysis :-

Introduction; Analytical Methods for constructing Trajectories, Graphical Methods for constructing Trajectories; Isocline Method; Delta Method; Pell's Method; Lienard's Method; Classification of Singular Points; Limit Cycles; Phase-Plane Analysis of Linear control systems; Phase-Plane Analysis of Non-linear control systems, Minimum Time Trajectory; Optimum Switching Curve.

Sampled-Data Control Systems:-

Introduction; the Z-Transformation; Properties of Z-Transform; Solving Differential Equations by the Z-Transform Method; The Inverse Z-Transformation; sampling Theorem Frequency Response Characteristics of Zero-order Holding Devices; Pulse transfer Function; Pulse Transfer Functions of Closed-Loop systems; Stability Analysis in the Z-plane; Bi-linear transformation; Jury's Stability test; Root Locus technique; Steady state error and error constants; Frequency response and Nyquist Stability criterion in the Z-plane; Time Domain and Frequency Domain Technique for Designing Compensators in the Z-plane; State space Representation of Discrete time Systems; Decomposition of Discrete Transfer Functions – Direct, Cascade and Parallel Decomposition; Solution of Discrete time state equations; Evaluation of state transition Matrix; Discretisation of Continuous Time-state Equations.

Optimal Control System:-

Introduction; Calculus of Variation Fixed-End-Point Problem; Free-End-Point Problem and constrained variational problem; Optimal Control Problems; The Hamiltonian Formulation; A Linear Regulator Problem; pontryagin's Minimum Principle; Minimum Time problems; Fuel optimal problem.

Texts / References :-

- 1) Katsuhiko Ogata, Modern Control Engineering, Prentice-Hall of India Pvt. Ltd.
- 2) I. C. Nagrath and M. Gopal, Control system Engineering, wiley Eastern Ltd.
- 3) K. K. Aggarwal, Control system analysis and Design, Khanna Publishers. 1
- 4) John E. Gibson, Non-linear Automatic Control, Mc Graw Hill Book Co. (ISE).
- 5) Andrew P. Sage, Optimum System Control, Prentice-Hall Inc.

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GROUP D

D.1 Advanced Microprocessors & Applications to Electrical Engineering (Elective)

	Lecture	Tutorial	Practical
Teaching Hours	3	1	0
Examination Scheme Marks	100	25	00

Introduction to Advanced Microprocessor :-

8086/8088 architecture, batch processing, multi-programming, time sharing and multi-tasking systems, Machine language instructions, Internal operations, Addressing modes, System bus timing and timing diagram.

8086/8088 Family Assembly Language Programming :-

Program development with assembler and other development tools like compilers, debuggers etc., Data transfer instructions, branch instructions, NOP, HLT and flag manipulation instructions, string instructions, stack-manipulations, Use of PC interrupts, Using 'C' with assembly language programming.

Peripheral Interfacing :-

8086 hardware overview of min mode systems, memory and I/O addressing for micro computer systems, Review of interfacing of peripheral devices 8251, 8254, 8255, 8259, 8279.

Interrupt Management:-

Intel 8086 interrupts, acknowledgment cycle, typical 8086 response, Interrupt service routines, Block transfer and Interfacing DMA controller – IC 8237.

Interfacing Typical PC Peripherals and their Programming :-

Printer Interfacing, PC-KeyBoard interfacing, CRT Terminals.

Introduction to Micro controller:-

8031/8051 architecture, instruction set, addressing modes, programming of 8031/8051, Introduction to 16-bit micro-controllers.

Application of Microprocessors/Micro-controllers in Electrical Engineering:-

Electrical Drives, Microprocessor based protection system, study of different relays like over-current relay, under and over frequency relay, impedance and mho relay, differential relay.

Text /References:-

- 1) Douglas V. Hall, Microprocessor and interfacing, McGraw Hill, 2nd Edition, Reprint 1995.
- 2) Yu Cheng Liu and Glenn A. Gibson, Microcomputer Systems – The 8086/8088 Family Architecture, Programming and Design, Prentice Hall of India, Reprint 1997.
- 3) Govind Rajalu – IBM PC and its clones, TMH Publication, 1994.
- 4) Kenneth J. Ayala, The 8051 Microcontrollers, Architecture, Programming and Applications, Second Edition, Penram International Publishing (India), 1996.

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- 3) Govind Rajalu – IBM PC and its clones, TMH Publication, 1994.
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