National Institute of Technology, RAIPUR

B.Tech. VIII Semester **Branch: Electrical Engg.**
Code:EL20811

Subject: Flexible AC transmission System
Minimum number of Class tests to be conducted: 2

UNIT I
Introduction:
Introduction of semiconductor devices**,** Flow of power in AC system, Steady state and dynamic problems in AC systems loading capability, controllable parameters, basic types of FACTS controllers, Flexible AC transmission systems (FACTS) Basic realities & roles.

UNIT II
Voltage Source Converters (VSC)
Basic concepts of VSC, single-phase full wave bridge converter operation, single phase-leg operation, three-phase full wave bridge converter and its operation, transformer connections for 12-pulse, 24-pulse and 48-pulse operation.

UNIT III
Current source converters (CSC)
Basic concepts, three-phase CSCs, three-phase full wave rectifier, comparison of VSC and CSC. Static shunt compensators: basic concepts, method of controllable VAR generation, Static VAR compensator, (SVC), application of SVC in power systems.

UNIT IV
Shunt Compensators
Introduction, mathematical model, working of STATCOM, V-I and V-Q characteristics, transient stability enhancement and exchange of real power using STATCOM, comparison of SVC and STATCOM, Merits of hybrid compensators.

UNIT V
Static Series Compensators
Objectives of series compensation, variable impedance type series compensation, GTO thyristor controlled series capacitors (GCSC), thyristor controlled series capacitor (TCSC), basic concepts of GCSC and TCSC, static synchronous series compensator (SSSC). Introduction to Unified Power Flow Controller (UPFC)

Text Books:
1. Understanding FACTS by Hingorani.
2. Thyristor controlled FACTS devices, Mathur
Reference Books:
1. FACTS for Transmission lines, Song, Yu.
2. Recent publications on IEEE Journals.
3. G.T. Heydt, Power Quality, Stars in a Circle Publications, Indiana, 1991.
4. T.J.E. Miller, Static Reactive Power Compensation, John Wiley & Sons, New York, 1982.

National Institute of Technology, RAIPUR

B.Tech. VIII Semester **Branch: Electrical Engg.**

Code: EL20812

Subject: Electrical Drives

Minimum number of Class tests to be conducted: 2

UNIT I: Electric Drives

Basic concept of electric drives, Requirement of electric drives, fundamental torque equation, speed torque converter and multi quadrant operation, equivalent values of drive parameters, concept of load torque, calculation of time and energy loss in transient operation, steady state stability and load equalization

UNIT II: Drives Control

Speed control and drive classification, closed loop control of drives, current limit control, closed loop torque control, closed loop speed control, closed loop speed control of multi motor drives, phase locked loop controller (PLL), closed loop position control.

UNIT III: DC Drives

DC motor drives, Controlled rectifier Fed dc drives, DC motor speed control and their performance.

UNIT IV: AC Drives

Induction motor drives, Review of conventional method of Starting, Braking and Speed control, Dynamic model of induction motor, Cyclo-converter fed drives, Static Kramer & Scherbius drives, vector control of induction motor

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UNIT V: Traction drives

Nature of traction load, Important feature of traction drives, Motors employed in traction, Conventional method for AC and DC traction drives control, Semiconductor converter controlled drives employing DC motors, AC motors for 25 KV AC traction drives.

Text Books:

1. “Fundamentals of electrical drives”,G K Dubey, 2nd edition, Narosa Pb
2. “Electric Drives’’ Vedam Subramanyam, TMH Pbs.
3. “Utilization of electric energy”, Taylor, Orient Longman Pbs.

Reference Books:

1. “Electric drives”, De and Sen, PHI Pbs.
2. “A first course on Electric drives”S K Pillai, University press.
3. “Modern Power Electronics and A C Drives’’ B K Bose, Pearson Education

National Institute of Technology, RAIPUR

B.Tech. VIII Semester **Branch: Electrical Engg.**
Code:EL20813

Subject: Power Apparatus System

Minimum number of Class tests to be conducted: 2

UNIT I: Overhead Line Design

Types of Insulator, String Efficiency, Improvement of voltage distribution, Improvement of String Efficiency, Line Supports, Types of Steel Towers, Cross Arms, Equivalent span, Conductor configurations, Spacing & Clearance, Sag & Tension calculations, Erection conditions, Factors affecting Sag, Sag Template, Catenary, Vibration of conductors & prevention, Selection of conductor size, Cross arm, No. Of circuits, Selection of ground wire

UNIT II: Electrical Substation & Earthing:

Types of Substation, Layout and Bus Bar schemes, Voltage level, Substation equipments Protection & Control Substation Earthing, Tolerance limits of body currents, Soil resistivity, Earth resistance, Tolerable & Actual Step & Touch Voltages, Design of Earthing Grid, Tower Footing Resistance, Measurement of soil & earth resistivity

UNIT III: Power System Earthing:

Ground versus isolated neutral, Solidly and effectively grounded system Resistance and Impedance Grounding, Resonant Grounding, Reactance Grounding, Voltage Transformer Grounding, Zigzag Transformer Grounding, Grounding practice, Effect of grounding on system over voltages & protection over voltage and over voltage phenomenon in isolated and grounded neutral system.

UNIT IV: Surge Protection& Insulation Co-ordination:

External and Internal over voltages mechanism of lighting discharge, wave shapes of stroke current line design based on direct stroke, over voltage protection, earth wire Rod gap T.F.R., Expulsion tube, surge diverter. General idea, Selection of B.I.L., International recommendation, Selection of arrester rating, Co-ordination of protector devices with apparatus insulation

UNIT V: Reliability of Transmission & Distribution Systems:

Definition, Outage, Bath Tub Curve, Two State Model, Failure & Repair Rate, Probability Density Function, Probabilities of Survival & Failure, Mean Time to Failure, Mean Down Time,

Reliability of Series & Parallel Systems, Two-State Fluctuating Enviornment, Approximate Method, Reliability Planning, Preparation of Reliability Models.

Textbook:

1. Power System Analysis & Design by B.R. Gupta –S.Chand
2. Sub Station Design and Equipment - Gupta & Satnam (Dhanpat Rai & Sons)

Reference books:

1. Transmission & Distribution – Westinghouse
2. A Course in Electrical Power – J.B. Gupta, Kataria

National Institute of Technology, RAIPUR

B.Tech. VIII Semester **Branch: Electrical Engg.**

Code: EL20814

Subject: Modern Control Systems Engg.

Minimum number of Class tests to be conducted: 2

UNIT-I: Non-Liner Control System

Introduction, some common types of nonlinearities, comparison of linear and non-linear systems, properties of non-linear control systems, describing functions, stability analysis using describing functions, limit cycle, liapunov Stability Analysis of Linear and Non-linear Systems, Second method of Liapunov with four stability theorems.

Unit-II: State Space Analysis

Basics: State and its nonuniqueness, eigen values and its invariance, Diagonalization and Jordan canonical form, Caylay- Hamilton theorem, Computation of state transition matrix by **(a)**Inverse Laplace method **(b)**Caylay Hamilton method and **(c)** other methods. Controllability and observability of time invariant systems, State equations in CCF, OCF and Diagonal Canonical form, Decompositions of Transfer Functions, Effect of Pole-Zero cancellation in Transfer Function.

UNIT-III: Control System Design by State Space

Pole placement design, Ackermann's Formula for pole placement, Design of full and reduced order state observers, Design of Servo system.

UNIT-IV: Discrete System Control

Introduction, Impulse sampling and Data Hold, Reconstructing original signals from sampled signals, Pulse Transfer Function, Mapping between the s-plane and the z-plane, Dominant pole, Characteristic equation, Roots, Stability Analysis using Bilinear transformation Method of Jury's stability test, Solution of discrete time state equations.

UNIT-V: Optimal Control Systems

A. Parametric optimization problem using second method of Lyapunov, Quadratic optimal control problems, Matrix Riccati equation, Alternate approach to determine optimal feedback gain matrix.
B. Solving optimal control problems using Hamiltonian and Pontrygin's Maximum Principle.

Test Books:

1. Modern Control Systems Engineering; by Ogata, PHI.
2. Digital Control Systems; Benjamin. C Kuo; Oxford University Press, Second edition.

Reference Books:

1. Modern control Engineering, Roy Choudhary, PHI.
2. Control System Analysis and Design by K K Agrawal.
3. Control Engineering Theory and Practice by M N Bandhopadhyay, PHI.
4. Introduction to Control Engg. Model, Analysis and Design by Ajit K Mandal, New Age International Publishers.
5. I J Nagrath and M Gopal; New Age international Publishers, Forth Edition