III Year I Semester 17EE504

POWER SYSTEMS – II

Preamble:

This course deals with modelling of transmission lines and evaluation their performance. Also, Transient in power system, improvement of power factor and voltage control techniques discussed in detail. It is important for the student to understand the mechanical design aspects of transmission lines, cable and insulators.

Learning Objectives:

- To compute inductance/capacitance of network lines and to understand the concept of GMD/GMR.
- To study the length of transmission lines, their models and performance.
- To study the different types of cables and their performance.
- To study the effect of travelling waves on transmission lines.
- To study the factors affecting the performance of transmission lines and power factor improvement methods.
- To discuss sag and tension computation of transmission lines as well as to study the performance of overhead insulators.

UNIT-I:

Transmission Line Parameters

Conductor materials - Types of conductors – Calculation of resistance for solid conductors – Calculation of inductance for single phase and three phase– Single and double circuit lines– Concept of GMR and GMD–Symmetrical and asymmetrical conductor configuration with and without transposition–Bundled conductors-Numerical Problems–Calculation of capacitance for 2 wire and 3 wire systems – Effect of ground on capacitance – Capacitance calculations for symmetrical and asymmetrical single and three phase–Single and double circuit lines-Bundled conductors-Numerical Problems.

UNIT-II:

Performance of Transmission Lines

Classification of Transmission Lines – Short, medium, long line and their model representations –Nominal-T–Nominal-Pie and A, B, C, D Constants–Rigorous Solution - Interpretation of the Long Line Equations, regulation and efficiency– Incident, Reflected and Refracted Waves – Surge Impedance and SIL of Long Lines–Wave Length and Velocity of Propagation of Waves – Representation of Long Lines – Equivalent-T and Equivalent Pie network models (Numerical Problems).

UNIT-III:

Underground Cables

Types of Cables, Construction, Types of insulating materials, Calculation of insulation resistance, stress in insulation and power factor of cable. Capacitance of single and 3-Core belted Cables: Grading of Cables-Capacitance grading and Inter sheath grading.

UNIT – IV:

Power System Transients

Types of System Transients – Travelling or Propagation of Surges – Attenuation–Distortion– Reflection and Refraction Coefficients – Termination of lines with different types of conditions – Open Circuited Line–Short Circuited Line – T-Junction– Lumped Reactive Junctions.

UNIT-V:

Various Factors governing the Performance of Transmission line

Skin and Proximity effects – Description and effect on Resistance of Solid Conductors – Ferranti effect – Charging Current –Shunt Compensation –Corona – Description of the phenomenon–Factors affecting corona–Critical voltages and power loss – Radio Interference.

UNIT-VI:

Sag and Tension Calculations and Overhead Line Insulators

Sag and Tension calculations with equal and unequal heights of towers–Effect of Wind and Ice on weight of Conductor–Numerical Problems – Stringing chart and sag template and its applications–Types of Insulators – String efficiency and Methods for improvement– Numerical Problems – Voltage distribution–Calculation of string efficiency–Capacitance grading and Static Shielding.

Learning Outcomes:

- Able to understand the different parameters of several transmission lines under various scenarios.
- Able to evaluate the efficiency, regulation and other performance parameters of the network lines.
- Able to evaluate the complete performance of the underground high and low power cables.
- Able to understand transients and the concepts related to travelling waves on transmission lines.
- Will be able to understand various factors related to charged transmission lines.
- Will be able to understand sag/tension of transmission lines and performance of line insulators.

Text Books:

- 1. Electrical power systems by C. L. Wadhwa, New Age International (P) Limited, Publishers, 1998.
- 2. Modern Power System Analysis by I. J. Nagarath and D. P. Kothari, Tata McGraw Hill, 2nd Edition.

Reference Books:

- 1. Power system Analysis-by John J Grainger William D Stevenson, TMC Companies, 4thedition
- 2. Power System Analysis and Design by B. R. Gupta, Wheeler Publishing.
- 3. A Text Book on Power System Engineering by M. L. Soni, P. V. Gupta, U.S. Bhatnagar, A. Chakrabarthy, Dhanpat Rai & Co Pvt. Ltd.
- 4. Electrical Power Systems by P.S.R. Murthy, B. S. Publications.