III Year – I SEMESTER	**T**	**P**	**C**
	3+1	**0**	**3**

POWER SYSTEMS–II

Preamble:
This course is an extension of power systems–I course. It deals with basic theory of transmission lines modeling and their performance analysis. Transient in power system, improvement of power factor and voltage control are discussed in detail. It is important for the student to understand the mechanical design aspects of transmission lines, cables, insulators. These aspects are also covered in detail in this course.

Learning Objectives:
- To compute inductance and capacitance of transmission lines and to understand the concepts of GMD, GMR.
- To study short and medium length transmission lines, their models and performance   computation.
- To study the performance and modeling of long transmission lines.
- To study the transient 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 over head insulators.

UNIT–I:
Transmission Line Parameters
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– 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–Numerical Problems.

UNIT–II:
Performance of Short and Medium Length Transmission Lines
Classification of Transmission Lines – Short, medium, long line and their model representations –Nominal-T–Nominal-Pie and A, B, C, D Constants

for symmetrical and Asymmetrical Networks– Numerical Problems–
Mathematical Solutions to estimate regulation and efficiency of all types of
lines – Numerical Problems.

UNIT–III:
Performance of Long Transmission Lines

Long Transmission Line–Rigorous Solution – Evaluation of A,B,C,D
Constants–Interpretation of the Long Line Equations – 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 – 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
(Numerical Problems).

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 – Effect on Regulation of the
Transmission Line–Shunt Compensation –Corona – Description of the
phenomenon–Factors affecting corona–Critical voltages and power loss –
Radio Interference –Power factor improvement methods.

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 parameters of various types of transmission lines
  for using calculation and behavior during different operating
  conditions.

- Able to understand the insight into specific transmission lines short and medium type which would have application in medium and high voltage power transmission systems.

- Student will be able to understand the surge propagation, reflection and refraction in transmission lines. such output will be useful in protecting transmission line insulators and designing level of insulation coordination at various high voltages.

- Will be able to utilize it for understanding the surge behaivour of transmission line for protection of connects equipments,viz.power transformer and system connected shunt reactors.

- Will be able to understand various phenomenon related to charged line transmitting different level of power.

- Will be able to understand physical and geometrical parameters of transmission line for safe and efficient performance during operating condition of voltage and power.

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 Mc Graw Hill, 2nd Edition.
3. Electrical Power Systems by P.S.R. Murthy, B.S. Publications.

Reference Books:

1. Power system Analysis–by John J Grainger William D Stevenson, TMC Companies, 4th edition
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, DhanpatRai& Co Pvt. Ltd.