TRANSMISSION AND DISTRIBUTION SYSTEMS

V Semester: EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEE011	Core	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

COURSE OBJECTIVES:

The course should enable the students to:

I. Determine the performance parameters of transmission lines.
II. Evaluate the voltage regulation and efficiency of short, medium and long transmissions lines.
III. Demonstrate the mechanical design of overhead line insulators and cables.
IV. Illustrate the importance of sag in the design of overhead transmission lines.
V. Discuss the operation of different distribution schemes and design of feeders.

COURSE OUTCOMES (COs):

CO 1: Determine the value of Resistance, inductance and capacitance of transmission lines and study the effect of corona.
CO 2: Model the short, medium and long transmission lines and study the Ferranti effect and surge impedance loading.
CO 3: Demonstrate the working of different types of insulators, calculate the string efficiency and also illustrate the importance of underground cables.
CO 4: Estimate the Sag and tension in overhead transmission lines in different conditions.
CO 5: Discuss the different types of distribution systems, its economic considerations along with the Indian electricity rules and present grid scenario.

COURSE LEARNING OUTCOMES (CLOs):

1. Formulate the transmission line parameters(resistance, inductance and capacitance)
2. Estimate the value of inductance and capacitance of different configurations so as to compensate it
3. Illustrate the effect of ground on the capacitance calculations
4. Explain corona, effects of corona in power system, power loss due to corona, advantages and disadvantages
5. Classify the transmission line based on the length of the conductor and voltage levels.
6. Analyze the nominal T model, nominal-π models and end capacitor models of medium transmission lines and long length transmission lines
7. Evaluate the efficiency and regulation of short, medium and long length transmission lines.
8. Describe Ferranti effect in long transmission lines.
9. Differentiate different insulators used in overhead and underground transmission lines
10. Deduce the string efficiency of suspension type insulators, voltage distribution across string of insulators and methods to improve string efficiency.
11. Construct single core and three core underground cables for transmission of power in highly populated areas.
12. Calculate the sag and tension with equal and unequal heights of towers
13. Illustrate the effect of wind and ice on weight of the conductors for the calculation of sag.
14. Compare different distribution systems (AC Vs DC distribution, Ring main Vs Radial).
15. Evaluate the voltage drops in AC distributors and DC distributors. Design of substation
16. Discuss Indian electricity rules, various voltage levels of transmission and distribution systems, Indian grid scenario.

UNIT-I	TRANSMISSION LINE PARAMETERS	Classes: 09

Transmission line parameters: Types of conductors, simple diagrams of typical towers and conductors for 400, 220 and 132 kV operations, 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, capacitance calculations for symmetrical and asymmetrical single and three phase lines, single and double circuit lines, effect of ground on capacitance, numerical problems; Corona: Types, critical disruptive voltages, factors affecting corona, methods for reducing corona power loss, charge voltage diagram, audible noise, radio interference.

UNIT-II	MODELING AND PERFORMANCE OF TRANSMISSION LINES	Classes: 08

Classification of transmission lines: Short, medium and long line and their model representations, nominal T, nominal π 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; Long transmission line: Rigorous solution, evaluation of A, B, C, D constants, interpretation of the long line equations, methods of voltage control, Ferranti effect, incident, reflected and refracted waves, surge impedance and surge impedance loading of long lines, wave length and velocity of propagation of waves, representation of long lines, equivalent T and equivalent π network model, numerical problems.

UNIT-III	OVERHEAD INSULATORS AND UNDERGROUND CABLES	Classes: 09

Overhead insulators: Types of insulators, voltage distribution, string efficiency and methods for improvement, capacitance grading and static shielding, numerical problems.

Underground cables: Types of cables, construction, types of insulating materials, calculations of insulation resistance and stress in insulation, capacitance of single and three core belted cables, grading of cables, capacitance grading, description of inter sheath grading, numerical problems.

UNIT-IV	MECHANICAL DESIGN OF TRANSMISSION LINES	Classes: 04

Sag and tension calculations: Sag and tension calculations with equal and unequal heights of towers, effect of wind and ice on weight of conductor, stringing chart and sag template and its applications, numerical problems.

UNIT-V	DISTRIBUTION SYSTEMS	Classes: 15

Distribution systems: Classification, comparison of DC vs AC and underground vs overhead, radial and ring main system, requirements and design features, Substation: Substation design, equipments, types of substations, bus bar arrangement layout, bus schemes, location, Kelvin's law for the design of feeders and its limitations; voltage drop calculations in DC distributors: Radial DC distributor fed at one end and at both the ends (equal / unequal voltages) and ring main distributor, voltage drop calculations in AC distributors, power factors referred to receiving end voltage and with respect to respective load voltages, numerical problems; Basic concept of interconnected systems: Indian electricity rules, various voltage levels of transmission and distribution systems, Indian grid scenario.

Text Books:

1. C L Wadhwa, "Electric Power Systems", New age publications, New Delhi, 9th Edition, 2007.
2. Singh S N, "Electric Power Generation, Transmission and Distribution", Prentice Hall of India Pvt. Ltd., New Delhi, 2nd Edition, 2002.
3. Turan Gonen, "Electrical Power Distribution System Engineering", CRC Press, 3rd Edition, 2014.
4. V Kamaraju, "Electrical Power Distribution Systems", TMH, Publication, Edition 2009.

Reference Books:

1. J B Gupta, “A Course in Power Systems”, S K Kataria and Sons, 2013 Edition, 2013
2. D Kothari and I J Nagrath, “Power System Engineering”, McGraw-Hill Education, 2nd Edition, 2007.
3. V K Mehta and Rohit Mehta, “Principles of Power System”, S Chand, 3rd revised Edition, 2015.
4. M L Soni, P V Gupta, U S Bhatnagar and A Chakrabarthy, “A Text Book on Power System
5. Engineering”, Dhanpat Rai and Co Pvt. Ltd., revised Edition, 2009.

Web References:

1. https://www.en.wikipedia.org/wiki/Electric_power_transmission
2. https://www.iec.ch/about/brochures/pdf/technology/transmission.pdf
3. https://www.teriin.org/upfiles/pub/papers/ft33.pdf

E-Text Books:

1. https://www.jfgieras.com/Grigsby_Chapter_34_LEM.pdf
2. https://www.personal.psu.edu/sab51/vls/vonmeier.pdf
3. https://www.edsonjosen.dominiotemporario.com/doc/Livro_Electric_Power_Distribution_Sy stem_En gineering_-_Turan_Gonen.pdf