ELECTRICAL POWER TRANSMISSION SYSTEMS

V Semester: EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB19	Core	2	1	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

OBJECTIVES:

The students will try to learn:

I The mathematical solutions for transmission line parameters of a single phase and three phase system.

II The mechanical design of over head transmission lines, the use of insulators and underground cables in electrical power transmission system.

III The mathematical modeling of short, medium and long transmission lines along with the transient behavior.

IV The Extra High Voltage Alternating Current (EHVAC) and High Voltage Direct Current (HVDC) transmission systems used for transmitting electrical power to consumers.

COURSE OUTCOMES:

After successful completion of the course, students will be able to:

CO 1 **Compute the line parameters of a single phase, three phase symmetrical and asymmetrical transmission lines using the concepts of Geometric Mean Radius (GMR) and Geometric Mean Distance (GMD).**

CO 2 **Discuss the operation of different types of insulators and underground cables used in electrical power transmission system**

CO 3 **List the methods to improve the string efficiency in overhead transmission system to get the quality operation of insulators.**

CO 4 **Compute the Sag and tension of overhead lines under different weather conditions using sag template and stringing chart to get the economical design of transmission towers and lines.**

CO 5 **Interpret the performance of short, medium and long transmission lines using ABCD constants.**

CO 6 **Discuss the concepts of skin effect, proximity effect, Ferranti effect, surge impedance and surge impedance loading in electrical power transmission to improve the performance of lines.**

CO 7 **Use the Bewley's lattice diagram in travelling wave analysis under different loading conditions to design the protective equipments for lines.**

CO 8 **Describe the formation of corona and its effect on overhead transmission and communication lines to suggest the methods to reduce the corona.**

CO 9 **Calculate the insulation resistance, capacitance and dielectric stress in a single core cable to propose the methods for achieving uniform dielectric stress over the cable.**

CO 10 **Recognize the importance of EHVAC, HVDC transmission systems to improve efficiency, flexibility and quality operation of existing power system network.**

MODULE-I	TRANSMISSION LINE PARAMETERS	Classes: 09

Transmission line parameters: Types of conductors, calculation of resistance for solid conductors, description and effect of resistance on solid conductors, calculation of inductance for single phase and three phase, single and double circuit lines, concept of GMR, GMD, symmetrical and asymmetrical conductor configuration with and without transposition, Skin and Proximity effect ; 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.

MODULE-II	MECHANICAL DESIGN OF TRANSMISSION LINES	Classes: 08

Overhead line insulators: Types of insulators, string efficiency and methods for improvement, numerical problems, voltage distribution, calculation of string efficiency, capacitance grading and static shielding, testing of insulators; Sag and tension calculations: 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; mechanical design of typical towers and conductors for 400KV, 220KV and 132KV operations

MODULE-III	PERFORMANCE OF TRANSMISSION LINES	Classes: 10

Performance of short and medium length transmission lines: Classification of transmission lines, short, medium and 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.

Performance of long transmission lines: Long transmission line, rigorous solution, evaluation of A, B, C, D constants, representation of long lines, equivalent-T and equivalent Pie network models (numerical problems); Ferranti effect, charging current, effect on regulation of the transmission line, surge impedance and SIL of long lines, wave length and velocity of propagation of waves.

MODULE-IV	POWER SYSTEM TRANSIENTS AND FACTORS GOVERNING PERFORMANCE OF TRANSMISSION LINES	Classes: 09

Moving charges in a magnetic field, Lorentz force equation, force on a current element in a magnetic field, force on a straight and a long current carrying conductor in a magnetic field, force between two straight long and parallel current carrying conductors, magnetic dipole and dipole moment, a differential current loop as a magnetic dipole, torque on a current loop placed in a magnetic field;

Vector magnetic potential and its properties, vector magnetic potential due to simple configurations, Poisson's equations, self and mutual inductance, Neumann's formula, determination of self-inductance of a solenoid, toroid and determination of mutual inductance between a straight long wire and a square loop of wire in the same plane, energy stored and density in a magnetic field, characteristics and applications of permanent magnets.

MODULE-V	UNDERGROUND CABLES, EHV TRANSMISSION AND HVDC TRANSMISSION	Classes: 09

Underground cables: Types of cables, construction, types of insulating materials, calculation of insulation resistance and stress in insulation, numerical problems, capacitance of single and 3core belted cables, numerical problems, grading of cables, capacitance grading, numerical problems, description of inter-sheath grading, HV cables. Need of EHV transmission systems, types of DC links, comparison of AC and DC transmission, advantage of DC transmission, HVDC systems in India.

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 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_System_En gineering_-_Turan_Gonen.pdf