ELECTRICAL POWER TRANSMISSION SYSTEMS

V Semester: EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEC15	Core	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

Prerequisites: Network Analysis (AEEC05), Electrical Power Generation Systems (AEEC10)

I. COURSEOVERVIEW:

Electrical Power Transmission Systems deals with the modeling, analysis and design of electrical power transmission lines. It gives an emphasis on overhead line insulators, underground cables, transient behavior ofthe lines, corona phenomena, Extra High Voltage Alternating Current (EHVAC) and High Voltage Direct Current (HVDC) transmission systems.

II. COURSEOBJECTIVES:

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 overhead transmission lines, the use of insulators and underground cables inelectrical 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.

III. COURSE OUTCOMES:

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

CO 1	**Compute** the line parameters of a single phase and three phase transmission lines using the concepts of Geometric Mean Radius (GMR) and Geometric Mean Distance (GMD).	Apply
CO 2	**Discuss** about ovehead line insulators, string efficiency, sag andtesion parameters which are used in the mechanical design of transmission lines.	Understand
CO 3	**Classify** the transmission lines and model them using ABCD constants to evalutate the performance of tranmission system.	Apply
CO 4	**Discuss** the concepts of skin effect, proximity effect, Ferranti effect, surge impedance and corona effect in electrical power transmission inorder to improve the performance of lines.	Understand
CO 5	**Analyze** the power system transients under different loding conditions of tranmission line using circuit concepts and Bewley'slattice diagram method.	Analyze
CO 6	**Describe** the EHV, HVDC and Underground transmission systems along with its parameters which affects the efficiency and quality operation of power system.	Understand

IV. COURSESYLLABUS:

MODULE-I: TRANSMISSION LINE PARAMETERS (08)

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: MECHNAICAL DESIGN OF TRANSMISSION LINES (10)

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 (09)

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 (10)

Power systems transients: Incident reflected and refracted waves, 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), Bewley"s lattice diagrams (for all the cases mentioned with numerical examples); Corona, description of the phenomenon, factors affecting corona, critical voltages and power loss, radio interference, Electrostatic and electromagnetic interference with communication lines.

MODULE-V: UNDERGROUND CBALES, EHV TRANSMISSION AND HVDC TRANSMISSION (08)

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.

V. TEXTBOOKS:

1. D P Kothari and I J Nagrath, "Power System Engineering", McGraw-Hill Education, 2nd Edition, 2007.
2. V K Mehta and Rohit Mehta, "Principles of Power System", S Chand, 3rd revised Edition, 2015.
3. D Das, "Electrical Power systems", New age international publishers, 2nd Edition, 2006.
4. K R Padiyar, "HVDC transmission Systems", New age international publishers, 2nd Edition, 2005.
5. B R Guptha, "Power system analysis and Design" S. Chand Publishing, 2nd Edition, 1998.

VI. REFERENCEBOOKS:

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

VII. WEBREFERENCES:

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

VIII. E-TEXTBOOKS:

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