NIRMA UNIVERSITY

Institute:	**Institute of Technology**
Name of Programme:	**BTech in Electrical Engineering**
Semester:	**VI**
Course Code:	**3EE209ME24**
Course Title:	**EHV Transmission and FACTS**
Course Type:	**Department Elective-II**
Year of Introduction:	**2024-25**

L	T	Practical component				C
		LPW	PW	W	S	
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Course Learning Outcomes (CLOs):

At the end of the course, the students will be able to -

1. appraise the importance of EHV AC transmission lines **(BL2)**
2. estimate of electrostatic field of AC lines and able to understand their effect on voltage gradient **(BL5)**
3. conceptualise the design of EHV lines **(BL6)**
4. analyse different types of FACTS controllers and their role in improving power system performance **(BL3)**

Contents: **Teaching Hours: 45**

Unit-I **Introduction to EHV AC Transmission**

Necessity of EHV AC transmission, advantages and problems, power handling capacity and line losses, mechanical considerations – resistance of conductors, properties of bundled conductors, bundle spacing and bundle radius, line and ground reactive parameters: line inductance and capacitances, sequence inductances and capacitances, ground return **06**

Unit-II **Voltage Gradients of Conductors**

Electrostatics, field of sphere gap, field of line changes and properties, potential relations for multi-conductors, surface voltage gradient on conductors, distribution of voltage gradient on sub-conductors of bundle **03**

Unit-III **Corona Effects** **06**

Power loss and audible noise (AN), corona loss formulae, charge voltage diagram – generation, characteristics – limits and measurements of AN – relation between 1-phase and 3-phase AN levels

Radio interference (RI) – corona pulses generation, properties, limits, frequency spectrum – modes of propagation, excitation function, measurement of RI, RIV and excitation functions

Unit-IV **Electrostatic Field on EHV AC lines** **06**

Calculation of electrostatic field of EHV/AC lines, effect on humans, animals and plants, electrostatic induction in un-energised circuit of double-circuit line, electromagnetic interference, traveling wave theory: traveling wave expression and solution- source of excitation- terminal conditions, open circuited and short-circuited end- reflection and refraction coefficients, lumped parameters of distributed lines-generalized constants, no load voltage conditions and charging current

Unit-V	**Design of EHV AC Transmission line** Electrical design philosophy and criteria, electrical design parameters: bundled conductors, phase spacing, minimum height, air clearances and insulator length selection of shield angle and overhead ground wire size, lightning back flashover outages, mechanical design philosophy and criteria: structure design, sags, tensions and span lengths, mechanical design parameters: structural loading, mechanical selection of conductor sizes, vibration protection, new conductor design, structure heights	**09**
Unit-VI	**FACTS Controllers** Conventional reactive power compensation, basic theory of line compensation, theory of power transmission control, basic principle of FACTS (flexible AC transmission system), basic series and shunt FACTS devices, basic principle of thyristor-controlled series compensation (TCSC), principle of static var compensation (SVC), static compensator (STATCOM), principle of operation of unified power flow controller (UPFC), locations of facts devices, transient and dynamic stability enhancement using FACTS components, introduction to UHV transmission	**15**

Self-Study:
The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Laboratory Work:
This shall consist of at least 08 practical / simulations based on the above syllabus.

Suggested Readings:

1. Narain G. Hingorani, Laszlo Gyugyi, Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems, IEEE Press
2. Padiyar K R, FACTS Controllers in Power Transmission & Distribution, Anshan Publishers
3. Rakosh Das Begamudre, Extra High Voltage AC Transmission Engineering, Wiley Estern Limited.
4. E.W. Kimbark. EHV-AC and HVDC Transmission Engineering & Practice, Khanna Publishers.
5. Math H. J. Bollen, Understanding Power Quality Problems: Voltage Sags and Interruptions, Wiley-IEEE Press.
6. Yong-Hua Song, Allan T. Johns, Flexible AC Transmission Systems, IEE publication

Suggested List of Experiments:

S. No.	Title of Experiments	Hrs.
1.	To build an EHV transmission line model in PSCAD	2
2.	To analyse the corona effects on transmission line and to write a program to determine the corona loss	4
3.	To determine voltage gradient on the surface of conductor using FE tool	2
4.	To study of effect of EHV field on human, animals & plants	2
5.	To perform the mechanical design of EHV transmission line.	2
6.	To implement TCSC for power flow enhancement	4
7.	To simulate STATCOM for reactive power compensation	4
8.	To simulate of unified power flow controller	4

L = Lecture, T = Tutorial, P = Practical, C = Credit

w.e.f. academic year 2024 – 25 and onwards