



Punyashlok Ahilyadevi Holkar Solapur University, Solapur

B.Tech Electrical Engineering Semester-II EXTRA HIGH VOLTAGE AC TRANSMISSION

Teaching Scheme	Examination Scheme
Theory: - 3 Hrs/Week, 3 Credits	ESE – 70 Marks
Practical: - 2 Hrs/Week, 1 Credit	ISE- 30Marks
	ICA-25Marks
	OE-50Marks

- **Course Objectives**

1. To provide the students the fundamental concepts of EHVAC system
2. To analyze the accessing techniques for lighting system.
3. To comprehend the different issues related to Power frequency voltage control.

- **Course Outcomes**

1. Student will able to analyze the EHVAC system.
2. Student will able to maintain/ Trouble shoot lightning arrester issues.
3. Student will able to design EHVAC Lines

SECTION-I

Unit 1 Introduction and Calculation of line and ground parameters

(08Hrs.)

- **Prerequisite:**

Transmission line constants and their impacts.

- **Objectives:**

1. To introduce to student Engineering Aspects and Growth of EHVAC Transmission system.
2. To make student understand constants of EHVAC Transmission line with their impact analysis.

- **Outcomes:**

After completing this unit, student -

1. Can able to understand fundamentals of EHVAC transmission system.
2. Can calculate Resistance, inductance and capacitance of EHVAC transmission line.

- **Unit Content:**

Engineering aspects and growth of EHVAC, transmission line trends and preliminaries, Resistance of conductor, temperature rise properties of bundled conductors, inductance and capacitance calculation, sequence inductance and capacitance, line parameters for modes of propagation, resistance and inductance of ground return

- **Content Delivery Methods:**

Chalk and talk, power point presentations

- **Assessment Methods:**

Numerical problems and derivations related Resistance, inductance and capacitance of EHVAC transmission line.

Unit 2– Voltage gradient of conductors and Losses

(06Hrs.)

- **Prerequisite:**

Concepts of electrostatics, potential, potential gradients.

- **Objectives:**

1. To make student understand charge potential relations for transmission lines.
2. To make student analyze impact of potential and voltage gradients.
3. To make student derive I^2R and corona loss.

- **Outcomes:**

After completing this unit, student –

1. Can understand charge potential relations for multi-conductor lines
2. Is able to calculate potential and voltage gradients on conductor lines and sub-conductors.
3. Can evaluate I^2R and corona loss

- **Unit Content:**

Electrostatics, field of sphere gap, charge potential relations for multi-conductor lines, surface voltage gradients on the conductor lines, surface voltage gradients on sub-conductors of bundle conductors, distribution of voltage gradients on sub-conductors of bundle, I^2R and corona loss, corona loss formula, charge voltage diagram with corona, attenuation of travelling waves due to corona loss, audible noise, corona pulses, their generation and properties, limits for radio interference fields

- **Content Delivery Methods:**

Chalk and talk, power point presentations

- **Assessment Methods:**

Numerical problems and derivation related to charge potential relations, voltage gradients, I^2R and corona loss.

Unit 3– Theory of travelling waves and standing waves

(07Hrs.)

- **Prerequisite:**

Concepts of Time varying electromagnetic fields.

- **Objectives:**

1. To make student understand impact of frequency on the performance of EHVAC transmission line.
2. To make student apply concepts of electromagnetic theory and wave propagation.

- **Outcomes:**

After completing this unit, student –

1. Can identify the impact of power frequency and natural frequency on line performance.
2. Is able to apply concepts of electromagnetic theory and wave propagation

- **Unit Content:**

The wave at the power frequencies, differential and solution for general case, standing waves and natural frequencies, open ended line double exponential response, response to sinusoidal,

excitation, line energization with trapped charge voltage, reflection and refraction of travelling waves

- **Content Delivery Methods:**
Chalk and talk, power point presentation, videos
- **Assessment Methods:**
Theory and derivation related to above Content.

SECTION -II

Unit 4 - Over voltage in EHV system covered by switching operations (08 Hrs.)

- **Prerequisite:**
Concept of line switching, voltage surge, switching surge.
- **Objectives:**
 1. To make student understand concept of over voltage with its significance.
 2. To make student capable to calculate switching surges.
- **Outcomes:**
After completing this unit, student –
 1. Can understand over voltage with their types and impacts..
 2. Can analyze the switching surges and its remedies.
- **Unit Content:**
Over voltage, their types, recovery voltage and circuit breaker, Ferro-resonance over voltages and calculation of switching surges- single phase equivalents, reduction of switching surges on EHV systems
- **Content Delivery Methods:**
Chalk and talk, power point presentations
- **Assessment Methods:**
Numerical problems and derivation related to above Content.

Unit 5- Power frequency voltage control and over voltages (07 Hrs.)

- **Prerequisite:**
Power circle diagram, synchronous condenser.
- **Objectives:**
 1. To make student understand application of power circle diagram.
 2. To make student understand need of voltage control and their ways.
 3. To make student understand the requirement of reactive power compensation.
- **Outcomes:**
After completing this unit, student –
 1. Can analyze the performance parameters through circle diagram.
 2. Can give the solution for voltage control under the various power situation.
- **Unit Content:**
Generalized constants, charging currents, power circle diagram and its use, voltage control using synchronous condenser, sub-synchronous resonance in series capacitors compensated lines and static reactive compensating systems

- **Content Delivery Methods:**

Chalk and talk, power point presentation

- **Assessment Methods:**

Theoretical questions and numerical related to above Content.

Unit 6- Design of EHV-AC lines

(06Hrs.)

- **Prerequisite:** basics of line construction

- **Objectives:**

4. To make student understand design procedure and design factors for EHVAC Lines.

- **Outcomes:**

After completing this unit, student –

1. Student will able to design EHVAC Lines

- **Unit Content:**

Introduction, design factors under steady state, design examples: steady state limits, line insulation design based upon transient over voltages

- **Content Delivery Methods:**

Chalk and talk, power point presentations

- **Assessment Methods:**

Theoretical questions and numerical related to above Content.

Text Books

1. Rakosh Das Begamudre,” Extra high voltage AC transmission engineering”, New Age Publication

ICA: -

There should be minimum 6 experiments on the above syllabus but not restricted the following

- 1) Simulation of real and reactive power flow analysis in HVAC transmission line.
- 2) Simulation of VAR compensation for improvement of voltage in EHVAC line
- 3) Simulation for power system stability improvement of AC transmission line.
- 4) Simulation for comparison between Dc & AC transmission line over various performance parameters
- 5) Simulation for design of EHVAC transmission line.
- 6) Simulation for determination transmission line parameters
- 7) Simulation & analysis of power factor controllers for EHVAC line
- 8) Simulation for the study of performance of HVAC line.
