

**Faculty of Engineering & Technology**  
**Applications in Protection & Switchgear System**

**Information :**

**Course Code :** EPR 582

**Level :** Undergraduate

**Course Hours :** 3.00- Hours

**Department :** Specialization of Electrical Power Engineering

**Area Of Study :**

1. Enhance the student's knowledge about over-voltages and traveling waves in electrical power systems with the associated suitable protection devices and schemes.
2. Prepare the student to perform system insulation design with adequate reliability at a minimum cost.
3. Enrich the student's knowledge about the protection of different power system components.
4. Train the student to design protective devices against over-voltages and surges.

**Description :**

Item protection: Protection against over-voltages, Protection schemes, Substations, Power stations, Protection of low-voltage systems, Coordination of protective devices. Over-voltage transients and traveling waves, Surge velocity, Surge impedance, Surge power and energy stored. Terminations: Incident reflected and transmitted waves, Applications. Over-voltage protection, Surge divertors, Insulated neutral systems over-voltages protection, Earthing systems, earthing electrodes, Safety and power earthing, Engineering and calculations of systems and equipment earthing resistance.

**Course outcomes :**

**a.Knowledge and Understanding: :**

1 -	Describe the terms and applications related to the protection of over-voltages, traveling waves, lightning surges, and earthing systems.
2 -	Explain the mechanism of lightning stroke generation.
3 -	Describe, with the help of neat sketches, the concepts of generator, line carrier and transformer protection.
4 -	Describe, with the help of neat sketches, the substation equipment and the functions of each equipment, the different bus-bar arrangements and the advantages and disadvantages of each.

**b.Intellectual Skills: :**

1 -	Calculate the voltage rating of a surge arrester.
2 -	Determine the size of the neutral earthing resistance.
3 -	Calculate the transmitted and reflected voltage/current waveforms.
4 -	Deduce the response of protective relays for a given condition.

**c.Professional and Practical Skills: :**

1 -	Practice basic experiments on simulators of substation including SCADA systems.
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**d.General and Transferable Skills: :**

1 -	Collaborate effectively within multidisciplinary team.
2 -	Work in stressful environment and within constraints.

3 -	Communicate effectively
4 -	Effectively manage tasks, time, and resources.

### **Course Topic And Contents :**

Topic	No. of hours	Lecture	Tutorial / Practical
Travelling waves, Surge velocity, Surge impedance, Surge power and energy stored.	10	6	4
Incident reflected and transmitted waves (coefficients), Different termination cases.	10	6	4
Bewley lattice diagram, application to simple cases.	5	3	2
Applications: Over-voltage protection, Surge diverters and Insulation Coordination,	10	6	4
Item Protection: Protection of generators.	10	6	4
Protection of transformers.	10	6	4
Substation busbar arrangements & Protection of bus-bars.	10	6	4
Protection of transmission lines, (carrier protection).	5	3	2
Over-voltage transients (general); Importance, characteristics, types, its control.	5	3	2

### **Teaching And Learning Methodologies :**

Interactive Learning
Discussion / Debate
Problem based Learning
Experiential Learning

### **Course Assessment :**

Methods of assessment	Relative weight %	Week No	Assess What
Experiments	10.00		
Final exam	40.00		
Mid-Term Exam I	15.00		
Mid-Term Exam II	15.00		
Participation	10.00		
Quizzes	10.00		

### **Course Notes :**

No course notes are required

### **Recommended books :**

- 1- Sunil S. Rao, %Switchgear, Protection and Power Systems+Khanhanna Publishers, Thirteenth Edition, 2008.
- 2- Horwitz, S. H. and Phadke, A. G., %Power System Relaying+John Wiley, 1992.

