

Course Syllabi: UEE603 Switchgear and Protection (L : T : P :: 3 : 0 : 2)

1. **Course number and name:** UEE603; Switchgear and Protection

2. **Credits and contact hours:** Credits: 4.0; Hours: 5

3. **Text book, title, author, and year**

- *Chakraborti, A., Soni, M.L., Gupta, P.V. and Bhatnagar, U.S., a Text Book on Power System Engineering, DhanpatRai and Co. (P) Ltd. (2008).*
- *Pathinkar, Y.G. and Bhide, S.R., Fundamentals of Power System Protection, PHI Learning Pvt. Limited (2008).*
- *Rao, S.S., Switchgear and Protection, Khanna Publishers (2007).*
- *Deshpande, M.V., Switchgear and Protection, Tata McGraw–Hill (2005).*
- *Elmore, W.A., Protective Relaying Theory and Applications, ABB Power T and D Company Inc. (2003).*

a. Other supplemental materials

- Nil

4. **Specific course information**

a. Brief description of the content of the course (catalog description)

Introduction: A protection system and its attributes, System transducers, various power system elements that needs protection.

Fuses: Types, Ratings and characteristics, Construction and application of HRC fuses, Limitations, Introduction to MCBs, Application of fuses.

Circuit Breakers: Theory of arc formation and its extinction (AC and DC), Re-striking and recovery voltage, Current chopping, Duties of switchgear, Circuit Breakers: Specifications of circuit breakers, Different types of circuit breakers like oil, Air, Vacuum and SF₆, Comparative merits and demerits. HVDC circuit breaker system.

Earthing: Earthing requirements, Earthing practices, Earth resistivity and earth gradient, Neutral shift.

Protective Relays: Functions, Constructional and operating principles of electromagnetic type like over-current, Directional, Differential and distance relays, Characteristics, General equation, Basic principles of static relaying, Phase and amplitude comparator, Static Relays.

Protection Schemes: Over–current protection of transmission lines, Differential protection, Transformer protection, Busbar protection, Distance protection of transmission line, Carrier aided protection of transmission lines, Generator protection, Induction motor protection, over–voltage protection.

Recent Trends in Relays: Numerical relays, under frequency relay.

Laboratory Work

Sequence impedance and their calculations, Symmetrical fault level measurement on a D.C. network analyzer, Unsymmetrical fault level measurement on a D.C. network analyzer for various types of faults, Measurement of ground resistivity and resistance of a ground electrode, Plotting of characteristics of different types of relays, Performance or different types of protection schemes, ABCD constants of an artificial transmission line, String efficiency of insulator string. Use of standard software package for Short Circuit studies and relay co-ordination.

5. **Specific goals for the course**

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

- Select the protection elements such as fuse, circuit breakers and relays etc. for a given configuration.
- Design the basic earthing requirement for residential and other purposes.
- Select required protection measures against overcurrent, overvoltage in transmission lines.
- Select suitable protection scheme for different power system equipments.

6. **Brief list of topics to be covered**

- Fuses
- Circuit Breakers
- Earthing
- Protective Relays
- Protection schemes