

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:** 4.0 and 5
3. **Text book, title, author, and year**

Text Books / Reference Books

- *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, duties of switchgear, various power system elements that needs protection.

Fuses: Types, ratings and characteristics, construction and application of HRC fuses, limitations and application of fuses, Introduction to MCBs.

Circuit Breakers: Theory of arc formation and its extinction (AC and DC), re-striking and recovery voltage, Current chopping, 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, Microprocessor based relays.

Protection Schemes: Over-current and Over-voltage protection of transmission lines, differential protection, transformer protection, Bus bar protection, distance protection of transmission line, carrier aided protection of transmission lines, generator protection, induction motor protection.

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 of 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:

- Explain various protection strategies applied for power system protection.
- Select the protection elements namely fuse, circuit breakers and relays 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 equipment.

6. Brief list of topics to be covered

- Introduction of switchgear protection.
- Fuses
- Circuit Breakers
- Earthing
- Protective Relays
- Protection Schemes