

Course Type	Course Code	Name of Course	L	T	P	Credit
DE	EED401	Power System Protection and Switchgear	3	0	0	9

Course Objective

The course will give basic concept on causes and adverse effects of faults on different components of power system. It will cover operating principles, merits-demerits of different types of relays and circuit breakers and their application. The course will also enable modern practices used for power system protection.

Learning Outcomes

- Understanding the fundamentals of different relays and circuit breakers used for protection of different components of the power system.
- Gaining knowledge on the recent developments in protective relays, circuit breakers and their application for protection of modern power system.
- Gaining knowledge on the renewable energy based distributed generation systems and their impact on distribution system protection schemes and newer solutions.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	Fundamentals of power system protection, Evolution of relays, Fundamental principle, merits and demerits of Overcurrent relays, Directional overcurrent relays, Differential protection, Distance protection (Simple Impedance, Reactance and MHO relay), Protection of Generators, Transformers, Bus bars and Transmission lines. Pilot protection of transmission lines (directional comparison blocking/unblocking, permissive overreaching/underreaching transfer trip), Introduction to digital relays.	18	Understanding the causes of faults in power system and the need and characteristics, advantages and disadvantages of different relays used for protection of different components of the power system.
2	Protection issues of series compensated transmission lines and their solutions, Advanced power transmission network protection using synchronized phasor measurement based Wide Area Measurement Systems.	06	Understanding the need of the installation of series compensation in the existing power transmission networks and how the installation of series compensation affects the performance of commonly used distance protection for power networks and possible solutions using WAMS data.
3	Introduction to renewable energy based distributed generation (DG) systems, their protection issues and possible newer solutions.	04	Understating the importance of power generation using renewable based DGs and their impact on existing overcurrent relaying based protection scheme and possible solutions.
4	Formation of electric arc. Arc built-up and quenching theory. Natures of transient short circuit current, recovery voltage and RRRV. Arc restriking phenomena. Problems of capacitive and low inductive current interruptions. Rating of circuit breakers. Different types of arc quenching media and special devices for arc quenching. Different types of circuit breakers (air, air blast, oil, vacuum & SF6) construction, operating principle, merits and demerits.	14	Understanding the different electrical and mechanical phenomena occur at the opening of circuit breaker for isolating the faulted part from the healthy part. Circuit breaker types and their characteristics and operating principles based on the application.

Text Books

1. B. Ram and D N Vishwakarma, 'Power System Protection and Switchgear', 2nd Edition, McGraw Hill, 2011.

Reference Books

1. S. H. Horowitz and A. G. Phadke, 'Power System Relaying', 4th Edition, Wiley, 2014.
2. C. R. Mason, 'The art and Science of Protective Relaying', GE.