EEPE3009 POWER SYSTEM PROTECTION (3-0-0)

Course Learning Objectives: This course will enable students to:

1. To understand the significance of protection, protection schemes and role of earthing.
2. To study the characteristics, functions and application areas of various relays.
3. To acquire practical knowledge about common faults in power system apparatus and applying suitable protective schemes.
4. To understand the functioning of static relays and Numerical protection concepts.
5. To understand the problems associated with circuit breaking and to discuss about various circuit breakers.

Module I (5 Hours)

Protection Schemes: Significance and need for protective schemes – nature and causes of faults – types of faults Effects of faults - Zones of protection and essential qualities of protection – Types of Protection schemes - Power system Grounding and Methods of Grounding.

Module II (8 Hours)

Basics of Relays: Operating Principles and Relay Construction: Relay design and construction, Relay classification, Types of Electromagnetic relays, Theory of Induction relay torque, General Equations of Comparators and Electromagnetic Relays, Over Current relays, Directional relays, Distance relays, Differential relays. Feeder Protection: Over current, Distance and Pilot Protection. Static Relays: (Comparators and different relays) Amplitude comparator, Phase Comparator, Coincidence type phase comparator, Basic elements of a static relay, Over Current Relays, Differential Protection, Static distance Protection.

Module III (5 Hours)

Apparatus Protection: Transformer Protection, Generator Protection, Motor Protection, Bus bar protection schemes.

Module IV (6 Hours)

Numerical relays: Block Diagram of Numerical Relay, Signal Sampling & Processing, Numerical Over-current protection, Numerical Transformer differential Protection, Numerical distance Protection of Transmission Line.

Module V (6 Hours)

Circuit Breaker: Physics of arcing phenomenon and arc interruption – DC and AC circuit breaking – re-striking voltage and recovery voltage - rate of rise of recovery voltage - current chopping - interruption of capacitive current - resistance switching - Types of circuit breakers – air blast, oil, SF6 and vacuum circuit breakers – comparison of different circuit breakers – HVDC Breaker.

Course Outcomes (CO): On completion of this course, students are able to:

CO1 Understand and select proper protective scheme and type of earthing.
CO2 Explain the operating principles of various relays.
CO3 Suggest suitable protective scheme for the protection of various power system apparatus.
CO4 Analyze the importance of static relays and numerical relays in power system protection.
CO5 Summarize the merits and demerits and application areas of various circuit breakers.

Text Book(s):

1. Power System Protection and Switchgear – B.Ravindranath&M.Chander–New Age International Publishers (Second Edition)
2. Fundamentals of Power System Protection – Y.G.Paithankar and S.R.Bhide, PHI Publication.(Second Edition)
3. Electrical Power System - C.L.Wadhwa New Age International Publishers. (Sixth Edition).
4. Power System Engineering - M.L.Soni, P.V.Gupta, U.S.Bhatnagar, A.Chakrabarti, Dhanpat Rai & Co. (P) Ltd.
5. Protection and Switchgear - B.Bhalja, R.P.Maheshwari, N.G. Chothani, OXFORD University Press.
6. Power System Protection and Switchgear - Badri Ram, Vishwakarma, Tata McGraw hill.

Reference Book(s):

1. Power System relaying by Horwitz, Phadke, Research Press.
2. Arun Ingole, 'Switch Gear and Protection' Pearson Education, 2018.
3. Sunil S.Rao, 'Switchgear and Protection', Khanna Publishers, New Delhi, Four Edition,2010.
4. NPTEL - https://nptel.ac.in/courses/108/105/108105167/