

PEL7J007 SWITCH GEAR AND PROTECTIVE DEVICES

3-0-0

MODULE- I [10 Hours]

University Portion (80%) [8 Hours]

Introduction:

Principle and need for protective schemes, Nature and causes of faults, Zones of protection, Primary and back-up protection, Basic principle of operation of protective system, Components of Protection System.

[Text Book 1 : CH 1.1, 1.2, 1.5, 1.6, 1.7, 1.8, 2.1, 2.2, 2.3]

Sequence Components and Fault Analysis:

Sequence components (positive, negative and zero) and their significance, Average 3-phase power in terms of symmetrical components, sequence impedance, fault calculations, Single line to ground fault, Line to ground fault with  $Z_f$ , Faults in Power systems, Concept of short circuit capacity of a Bus.[Ref. Book 1: CH 13.1, 13.2, 13.3, 13.4, 13.5, 13.6, 13.7, 13.8, 13.10, 13.13]

College/Institute Portion (20%) [2 Hours]

Fault limiting Reactors and Fuses: Use of Reactors, Construction of Reactors, Types of Reactors, Methods of locating Reactors, Fuse element material, types of fuses, High voltage H.R.C. Fuses and its application, Selection of fuses, Advantages and Disadvantages of Fuse.

[Ref. Book 2: CH 2.1, 2.2, 2.3, 2.4, 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7] Or related advanced topics as decided by the concerned faculty teaching the subject.

MODULE- II [10 Hours]

University Portion (80%) [8 Hours]

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.

[Text Book 1: CH 3.1, 3.2, 3.3, 3.4, 4.2, 4.3, 4.4, 4.7, 4.8, 4.9, 5.2, 5.3, 5.4, 11.1, 11.2, 11.3, CH

12.1, 12.2, 12.3, 12.4]

College/Institute Portion (20%) [2 Hours]

Power System Grounding: Ungrounded system, Grounded neutral system, Choice of the method of neutral grounding, Grounding Practice, Equipment Grounding (Earthing), Grounding at substations, Grounding of [Ref. Book 2: CH 7.2, 7.5, 7.6, 7.7, 7.8, 7.9] Or related advanced topics as decided by the concerned faculty teaching the subject.

Module- III [10 Hours]

University Portion (80%) [8 Hours]

Apparatus Protection: Transformer Protection, Generator Protection, Motor Protection, Bus bar protection schemes. [Text Book 1: CH 6.2, 6.3, 6.4, 6.5] Numerical relays: Block Diagram of Numerical Relay, Signal Sampling & Processing, Numerical Over-current protection, Numerical Transformer differential Protection, Numerical distance Protection of Transmission Line. [Text Book 2: CH 11.2, 11.3, 11.7, 11.8, 11.9]

College/Institute Portion (20%)

[2 Hours]

Protection of Transmission Lines: (Over current and Carrier-aided Protection)

Over current Relay, Application of Definite Time OC Relay and IDMT Relay for protection of a distribution feeder, protection of a three phase feeder, Directional Over current Relay, Need for Carrier-aided Protection, Various options for a Carrier, Coupling and Trapping the carrier into the desired line section, Unit type Carrier-aided Directional comparison Relaying, Carrier-aided Distance schemes for Acceleration of Zone II, Phase comparison Relaying.[Text Book 2 : CH 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6] Or related advanced topics as decided by the concerned faculty teaching the subject.

Module- I V

[10 Hours]

University Portion (80%)

[8 Hours]

Switchgears: Auto reclosing, Theory of Circuit interruption, Circuit constants in relation to Circuit breaking, Re-striking voltage transient, characteristics of Re-striking Voltage, Interaction between breaker and circuit, Current chopping. Circuit Breakers: Types of circuit breakers (air blast, air break, oil, vacuum, SF<sub>6</sub> , DC circuit breaker), advantages and testing of circuit breaker.[Text Book 1: CH 7.1, 7.2, 7.3, 7.4, CH 13.1, 13.2, 13.3, 13.4, 13.5, 13.6, 14.2,14.3, 14.4, 14.5, 14.6, 14.7, 15.2, 15.3, 15.5, 16.2, 16.3, 16.4, 18.2, 18.5, 18.6, 18.7, 18.8]

College/Institute Portion (20%)

[2 Hours]

Protection against Over voltage due to lightning: Mechanism of Lightning, Lightning stroke, Over voltage due to lightning, Protection against lightning, Different types of Arrester, Arrester Ratings, Arrester locations and effect of cables, Surge Absorber.[Ref. Book 2: CH12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.7, 12.8] Or related advanced topics as decided by the concerned faculty teaching the subject.

Text Books:

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)

Reference Books:

1. Electrical Power System - C.L.Wadhwa New Age International Publishers. (Sixth Edition).
2. Power System Engineering - M.L.Soni, P.V.Gupta, U.S.Bhatnagar, A.Chakrabarti, Dhanpat Rai & Co. (P) Ltd.
3. Protection and Switchgear - B.Bhalja, R.P.Maheshwari, N.G. Chothani, OXFORD University Press.
4. Power System Protection and Switchgear - Badri Ram, Vishwakarma, Tata McGraw hill.
5. Switchgear and Protection – Sunil S Rao , Khanna Publishers, New Delhi.
6. Power System relaying by Horwitz, Phadke, Research Press.