

SWITCHGEAR AND PROTECTION

Course Code: 13EE1119

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Pre requisites:

Electrical Machines and Power Transmission Engineering

Course Outcomes:

At End of course, a student will be able to

- CO 1** Describe and determine the rating of the different types of circuit breakers.
- CO 2** Describe the construction and working principle of various types of electromagnetic relays.
- CO 3** Determine the characteristics of distance relay for transmission line protection.
- CO 4** Use different protection schemes for protecting various components of power systems.
- CO 5** Describe and determine different cause for over voltages in power system and can implement protective scheme overcome those problems.

UNIT-I

(12 Lectures)

CIRCUIT BREAKERS:

Principle of operation – RRRV – Current chopping- Circuit Breaker ratings and specifications, Testing of Circuit Breakers.

Constructional features and selection of LT breakers (Miniature circuit breakers/Metal clad circuit breakers/Earth leakage circuit breaker) and HT breakers (Air blast circuit breaker-Oil circuit breakers-SF₆ CB-Vacuum Circuit Breakers)

UNIT-II**(12 Lectures)****PROTECTIVE RELAYS-I:**

Electromagnetic Relays: Principle of Operation and Construction of Attracted armature, Balanced Beam, induction Disc and Induction Cup relays. Relays Classification - Instantaneous, DMT and IDMT types - Application of relays - Over current, Under voltage, Directional, Differential and Percentage Differential.

UNIT-III**(12 Lectures)****PROTECTIVE RELAYS-II:**

Universal Torque Equation - Distance relays - Impedance, Reactance and Mho and Off-Set Mho relays, Characteristics of Distance Relays and Comparison - Static Relays - Static Relays versus Electromagnetic Relays - Microprocessor Based Relays - impedance, directional, reactance, Mho & offset Mho and mathematical expression for distance relay.

UNIT-IV**(12 Lectures)****PROTECTION OF GENERATORS, TRANSFORMERS, FEEDERS AND BUS BARS:**

Protection of Generators against Stator faults, Rotor faults, and Abnormal Conditions - Restricted Earth Fault - Numerical Problems on % Winding Unprotected.

Percentage Differential Protection of transformers - Numerical Problems on Design of CT's Ratio - BUCHHOLTZ Relay Protection
Protection of transmission Lines - Over Current, Carrier Current and Three-zone Distance Relay Protection using Impedance Relays - Translay Relay.

Protection of Bus bars – Differential protection.

UNIT-V**(12 Lectures)****GROUNDING TECHNIQUES & OVER VOLTAGE PROTECTIONS:**

Grounded and Ungrounded Neutral Systems- Effects of Ungrounded Neutral on system performance- Methods of Neutral Grounding - Arcing Grounds and Grounding Practices.

Protection against Over Voltages- Volt-Time Characteristics- Valve type and Zinc-Oxide Lighting Arresters - Insulation Coordination- BIL, Impulse Ratio, Standard Impulse Test Wave.

TEXT BOOKS:

1. C R Mason, “*Art & Science of Protective Relaying*”, Wiley Eastern Ltd.
2. Sunil S Rao, “*Switchgear Protection and Power Systems*”, Khanna Publishers, New Delhi, 11th Edition reprint 3rd Edition, 2008

REFERENCES:

1. Badri Ram, Viswakarma.D.N., “*Power System Protection and Switchgear*”, TMH Publications, 2nd Edition 2011.
2. T. S. MadhavRao, “*Power System Protection Static relays with Microprocessor Applications*”, TMH Publication, 2nd Edition, 2006.
3. C.L. Wadhwa, “*Electrical Power Systems*”, New Age International (P) Limited, Publishers, 5th Edition, 2009.
4. B.L. Soni, Gupta, Bhatnagar, Chakrabarthy, “*A Text book on Power System Engineering*”, DhanpatRai & Co, 2008.
5. Warrington and Coll, “*Protective Relays*”, Vol I & II.

