

4/4 B.Tech. SEVENTH SEMESTER**EE7T3 SWITCHGEAR PROTECTION & CARRIER COMMUNICATION Credits: 3****Lecture: 3 periods/week****Internal assessment: 30 marks****Practice: 1 periods/week****Semester end examination: 70 marks****Course Objective:**

This course introduces basic electrical protection using circuit breakers, relays and substation layout. It emphasizes on generator, transformer, feeder and bus bars protection schemes.

Course Outcomes:

After completing this course, student is able to

1. Understand different protection schemes adopted in power system
2. Understand operation of various switchgear equipment
3. Understand protection of different electrical equipments.
4. Implement various grounding practices and insulation coordination in the power system.

UNIT I**Circuit Breakers**

Circuit Breakers: Elementary principles of arc interruption, Restriking voltage and Recovery voltages - Restriking phenomenon, average and max. RRRV, numerical problems - current chopping and resistance switching - CB ratings and specifications, auto reclosures - Numerical Problems.

Types of circuit breakers: Minimum oil circuit breakers , Air blast circuit breakers, Vacuum and SF6 circuit breakers.

UNIT II**Fundamentals of Protective Relaying**

Protective relaying, fundamental principles of protective relaying, protection against other abnormal conditions, functional characteristics of protective relaying, evaluation of protective relaying.

Principle of operation and construction of attracted armature, balanced beam, induction disc and induction cup relays. Introduction to static relays -phase and magnitude comparators- level detectors. Numerical relays - phase and magnitude comparators- level detectors. Comparison of electromagnetic, static and numerical relays.

UNIT III**Application of Relays**

Universal torque equation, over current relay, direction relays, differential relays and percentage differential relays-electromagnetic-static. Relays Classification: Instantaneous, DMT, IDMT types and under voltage relays. Distance relays: impedance, reactance, mho and Off-Set mho relays. Characteristics of distance relays and comparison-Electromagnetic only.

UNIT IV**Generator, Transformer and Bus bar Protection**

Protection of generators against stator faults, rotor faults, and abnormal conditions. Restricted earth fault and inter-turn fault protection. Numerical Problems on percentage winding unprotected. Protection of transformers: Percentage differential protection, numerical problem on design of CT's ratio, Buchholtz relay protection.

Protection of Lines: Over current, carrier current and three-zone distance relay protection using impedance relays, translay relay. Protection of bus bars – differential protection.

UNIT V**Protection Against Over Voltages**

Grounded and ungrounded neutral systems.- Effects of ungrounded neutral on system performance. Methods of neutral grounding: solid, resistance, reactance - arcing grounds and grounding practices. Protection of transmission lines, stations and substations against direct lightning strokes-protection against travelling waves-Insulation coordination.

Learning Resources**Text Books:**

1. Switchgear and Protection by Sunil S Rao, Khanna Publishers
2. Power System Protection and Switchgear by Badari Ram , D.N Viswakarma, TMH Publications, 2nd edition.
3. Switchgear and Protection by J.B.Gupta, S.Chand publications, 2nd edition.

Reference Books:

1. Fundamentals of Power system protection by Paithankar and S.R.Bhide.,PHI, 2003, 2nd edition.
2. Electrical power systems – by C.L.Wadhwa, New Age International (P) Limited, Publishers, 4th edition
3. A Text book on Power system engineering by B.L.Soni, Gupta, Bhatnagar, Chakrabarthy, Dhanpat Rai & Co