

# SWITCH GEAR AND PROTECTION

B.Tech. III Year II Sem.

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3 1 0 4

**Course code: EE3203PC**

**Prerequisite:** Power Systems-I, Power Systems-II

**Course Objectives:**

- To introduce all kinds of circuit breakers and relays for protection of Generators, Transformers and feeder bus bars from Over voltages and other hazards.
- To describe neutral grounding for overall protection.
- To understand the phenomenon of Over Voltages and its classification.

**Course Outcomes:**

- Analyze quenching mechanisms used in air, oil and vacuum circuit breakers Apply technology to protect power system components.
- Evaluate electromagnetic, static relays.
- Apply the concepts of Static Relays and Microprocessor Based Relays to protect power system components
- Analyze the neutral grounding mechanisms
- Understand and analyze the over voltage protection schemes

**UNIT- I:**

**Introduction to Circuit Breakers:** Elementary principles of arc interruption, Recovery, Restriking Voltage and Recovery voltages.- Restriking Phenomenon, Average and Maximum RRRV, Numerical Problems - Current Chopping and Resistance Switching - CB ratings and Specifications: Types and Numerical Problems. – Auto-reclosures. Description and Operation of following types of circuit breakers: Minimum Oil Circuit breakers, Air Blast Circuit Breakers, Vacuum, and SF6 circuit breakers.

**UNIT- II:**

**Electromagnetic and Static Relays:** Principle of Operation and Construction of Attracted armature, Balanced Beam, induction Disc and Induction Cup relays.

**Types of Over Current Relays:** Instantaneous, DMT and IDMT types.

**Application of relays:** Over current/ under voltage relays, Direction relays, Differential Relays and Percentage Differential Relays. Universal torque equation, Distance relays: Impedance, Reactance, and Mho and Off-Set Mho relays, Characteristics of Distance Relays and Comparison. Static Relays: Static Relays verses Electromagnetic Relays.

**UNIT- III:**

**Protection of Power Equipment:** Protection of generators against Stator faults, Rotor faults, and Abnormal Conditions. Restricted Earth fault and Inter- turn fault Protection. Numerical Problems on % 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- IV:**

**Neutral Grounding:** Grounded and Ungrounded Neutral Systems. - Effects of Ungrounded Neutral on system performance. Methods of Neutral Grounding: Solid, Resistance, Reactance- Arcing Grounds and Grounding Practices.

**UNIT - V:**

**Protection Against Over voltages:** Generation of Over Voltages in Power Systems.- Protection against Lightning Over Voltages - Valve type and Zinc- Oxide Lighting Arresters - Insulation Coordination -BIL, Impulse Ratio, Standard Impulse Test Wave, Volt-Time Characteristics.

**TEXT BOOKS:**

1. Badriram and D.N. Vishwakarma, Power System Protection and Switchgear, TMH 2001.
2. U.A.Bakshi, M.V.Bakshi: Switchgear and Protection, Technical Publications, 2009.

**REFERENCE BOOKS:**

1. C.Russel Mason – —The art and science of protective relaying, Wiley Eastern, 1995
2. L.P.Singh —Protective relaying from Electromechanical to Microprocessorsl, New Age Internationa