EE603PC: SWITCH GEAR AND PROTECTION

B.Tech. III Year II Sem.

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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 it's classification.

Course Outcomes: After Completion of this course student will be able to

- Understand the types of Circuit breakers and choice of Relays for appropriate protection of power system equipment.
- Understand various types of Protective devices in Electrical Power Systems.
- Interpret the existing transmission voltage levels and various means to protect the system against over voltages.
- Understand the importance of Neutral Grounding, Effects of Ungrounded Neutral grounding on system performance, Methods and Practices.

UNIT - I

Introduction to Circuit Breakers: 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 Overvoltages: 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. "Badri Ram , D. N Viswakarma", "Power System Protection and Switchgear", TMH Publications, 2011
2. "Sunil S Rao", "Switchgear and Protection", Khanna Publishers, 2008.

REFERENCE BOOKS:

1. "Paithankar and S. R. Bhide", "Fundamentals of Power System Protection", PHI, 2003.
2. "C R Mason", Art & Science of Protective Relaying – Wiley Eastern Ltd, 1966.
3. "C. L. Wadhwa", "Electrical Power Systems", New Age international (P) Limited, Publishers, 6th Edition 2007