

3/4 B.Tech. FIRST SEMESTER

EE5T3 SWITCHGEAR-PROTECTION & CARRIER COMMUNICATION

Credits: 4

Lecture: 4 periods/week

Internal assessment: 30 marks

Tutorial: 1 period /week

Semester end examination: 70 marks

Objective:

This course introduces basic electrical protection using circuit breakers relays and substation layout .Unit protection of Generator, Generator -Transformer and Feeder bus bars.

Learning outcomes :

1. Upon completing course student understands different protection schemes adopted in power system
2. Upon completing course student understands operation of various switchgear equipment
3. Upon completing course student understands protection of different electrical equipments.

UNIT I Fundamentals of Protective Relaying

what is protective relaying, function of protective relaying fundamental principles of protective relaying, protection against other abnormal conditions, functional characteristics of protective relaying, protective relaying versus a station operator, the evaluation of protective relaying, how do protective relays operate.

UNIT II Relay Operation Principle

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- output relay. Numerical relays - phase and magnitude comparators- level detectors- output relay. Comparison of electromagnetic static and numerical relays.

UNIT III Application of Relays-I

Universal torque equation. Over current relay, Direction relays, Differential Relays and Percentage Differential Relays-electromagnetic-static, Relays Classification: Instantaneous, DMT and IDMT types.

UNIT IV Application of Relays-II

Under voltage relays, Distance relays: Impedance, Reactance and Mho and Off-Set Mho relays, Characteristics of Distance Relays and Comparison-Electromagnetic only.

UNIT IV Generator and Transformer Protection

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.

UNIT V Feeder and Bus-Bar 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. 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 VII Protection Against Over Voltages

Protection of transmission lines, stations, and substations against direct lightning strokes- protection against travelling waves-Insulation coordination.

UNIT VIII Substation Layout and Circuit Breakers

Schemes of layout and bus bar design, Circuit Breakers: Elementary principles of arc interruption, Recovery, Restriking Voltage and Recovery voltages.- Restriking Phenomenon, Average and Max. RRRV, Numerical Problems - Current Chopping and Resistance Switching - CB ratings and Specifications: Types and Numerical Problems. – Auto reclosures.

Types of circuit breakers: Minimum Oil Circuit breakers and Air Blast Circuit Breakers in brief, Vacuum and SF6 circuit breakers.

Learning Resources

Text Books:

1. Switchgear and Protection – by Sunil S Rao, Khanna Publishers(8)
2. Power System Protection and Switchgear by Badari Ram , D.N Viswakarma, TMH Publications(1,2,3,4,6)
3. Switchgear and Protection by J.B.Gupta ,S.Chand publications(1,2,3,4,5,7,8)
4. Art & Science of Protective Relaying – by C R Mason, Wiley Eastern Ltd.(1,2,3)

Reference Books:

1. Fundamentals of Power System Protection by Paithankar and S.R.Bhide.,PHI, 2003.
2. Electrical Power Systems – by C.L.Wadhwa, New Age international (P) Limited, Publishers, 3rd editon
3. A Text book on Power System Engineering by B.L.Soni, Gupta, Bhatnagar, Chakrabarthy, Dhanpat Rai & Co

