

16EE306 SWITCH GEAR AND PROTECTION

Hours Per Week :

L	T	P	C
3	-	-	3

Total Hours :

L	T	P	WA/RA	SSH/HSB	CS	SA	S	BS
45	-	-	5	40	-	8	5	2

Course Description and Objectives:

This course introduces basic concepts of Relays, Protection schemes, Switch gear and Modern trends in protection of power system equipments. The objective of the course is to understand the operation and application of power system protection equipments such as relays, circuit breakers and fuses; master various protection schemes for generators, transformers and transmission lines against faults.

Course Outcomes:

The student will be able to:

- understand the working of different types of switchgear equipments like circuit breakers and relays.
- specify the ratings for fuses according to application.
- elucidate various protection schemes for various power system components like alternators, transformers and bus-bars.
- understand various methods of over voltage and over current protection in power systems.

SKILLS:

- ✓ Draw line diagram of substation.
- ✓ Identify various types of faults in power system.
- ✓ Identify proper settings for relays to protect a given equipment.
- ✓ Suggest the protection schemes for alternator, transformers and busbars.
- ✓ Create and manage safe and reliable switch gear system.

UNIT – 1**L-9**

INTRODUCTION TO POWER SYSTEM PROTECTION: Importance and requirements of protective system, Overview of switchgear equipments.

CIRCUIT BREAKERS: Elementary principles of arc interruption, Recovery, Restricting voltage, Restricting phenomenon, Average and maximum RRRV, Numerical problems, Current chopping and resistance switching, CB ratings and specifications, Auto reclosures.

DESCRIPTION AND OPERATION OF CIRCUIT BREAKERS: Structure and working of minimum oil circuit breakers, Air blast circuit breakers, Vacuum and SF6 circuit breakers.

UNIT – 2**L-9**

ELECTROMAGNETIC AND STATIC RELAYS : Principle of operation and construction of attracted armature, Balanced beam, induction disc and Induction cup relays.

RELAYS CLASSIFICATION: Characteristics of instantaneous, DMT and IDMT, Over current relays, Direction relays, Differential relays and percentage differential relays, Universal torque equation.

DISTANCE RELAYS: Characteristics of impedance, Reactance and Mho type distance relays and their comparison.

STATIC RELAYS: Construction of static relays and compare with electromagnetic relays.

UNIT – 3**L-9**

FUSES: Desirable characteristics of fuse elements, Terminologies associated with fuse, Types of fuses, HRC fuse.

FEEDER AND BUS-BAR PROTECTION : Protection of lines using over current, Carrier current and three-zone impedance type distance relays, Translay relay, Protection of bus bars, Differential protection.

NEUTRAL GROUNDING : Grounded and ungrounded neutral systems, Methods of neutral grounding - Solid, Resistance, Reactance; Arcing grounds and grounding practices.

UNIT – 4**L-9**

GENERATOR 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.

TRANSFORMER PROTECTION : Percentage differential protection, Numerical problem on design of CT Ratio, Buchholtz relay.

UNIT – 5**L-9**

PROTECTION AGAINST OVER VOLTAGES : Generation of over voltages in power systems, Protection against lightning over voltages - Valve type, Zinc-Oxide lightning arresters; Insulation co-ordination, BIL, Impulse ratio, Standard impulse test wave, Volt-time characteristics.

TEXT BOOKS:

1. Sunil S. Rao, "Switchgear and Protection" 12th edition, Khanna Publishers, 2007.
2. Badari Ram, "Power System Protection and Switchgear" 1st edition, D.N Viswakarma, Tata Mc-Graw Hill, Publications, 2005.

REFERENCE BOOKS:

1. T S Madhav Rao, "Power System Protection : Static Relays", 2nd edition, Tata Mc-Graw Hill, 2007.
2. CL Wadhwa, "Electrical Power Systems", 4th edition, New Age international (P) Limited, 2008.
3. Paithankar and S.R.Bhide, "Fundamentals of Power System Protection" 1st edition, Prentice Hall of India, 2007.

ACTIVITIES:

- o Visit a substation and prepare it's technical report on control side.
- o Check the polarity of CT and PT and connect it with relay.
- o Find the fusing factor of a given fuse material.
- o Test over-load relay and plot time current characteristics.
- o Test static relay for protection of motor.
- o Set up a horn gap lightning arrester.