

COURSE NAME : ELECTRICAL ENGINEERING GROUP
COURSE CODE : EE/EP
SEMESTER : FIFTH
SUBJECT TITLE : SWITCHGEAR & PROTECTION
SUBJECT CODE : 9085

Teaching and Examination Scheme:

Teaching Scheme			Examination Scheme						
TH	TU	PR	PAPER HRS	TH	TEST	PR	OR	TW	TOTAL
04	--	02	03	80	20	--	25@	--	125

Rationale:

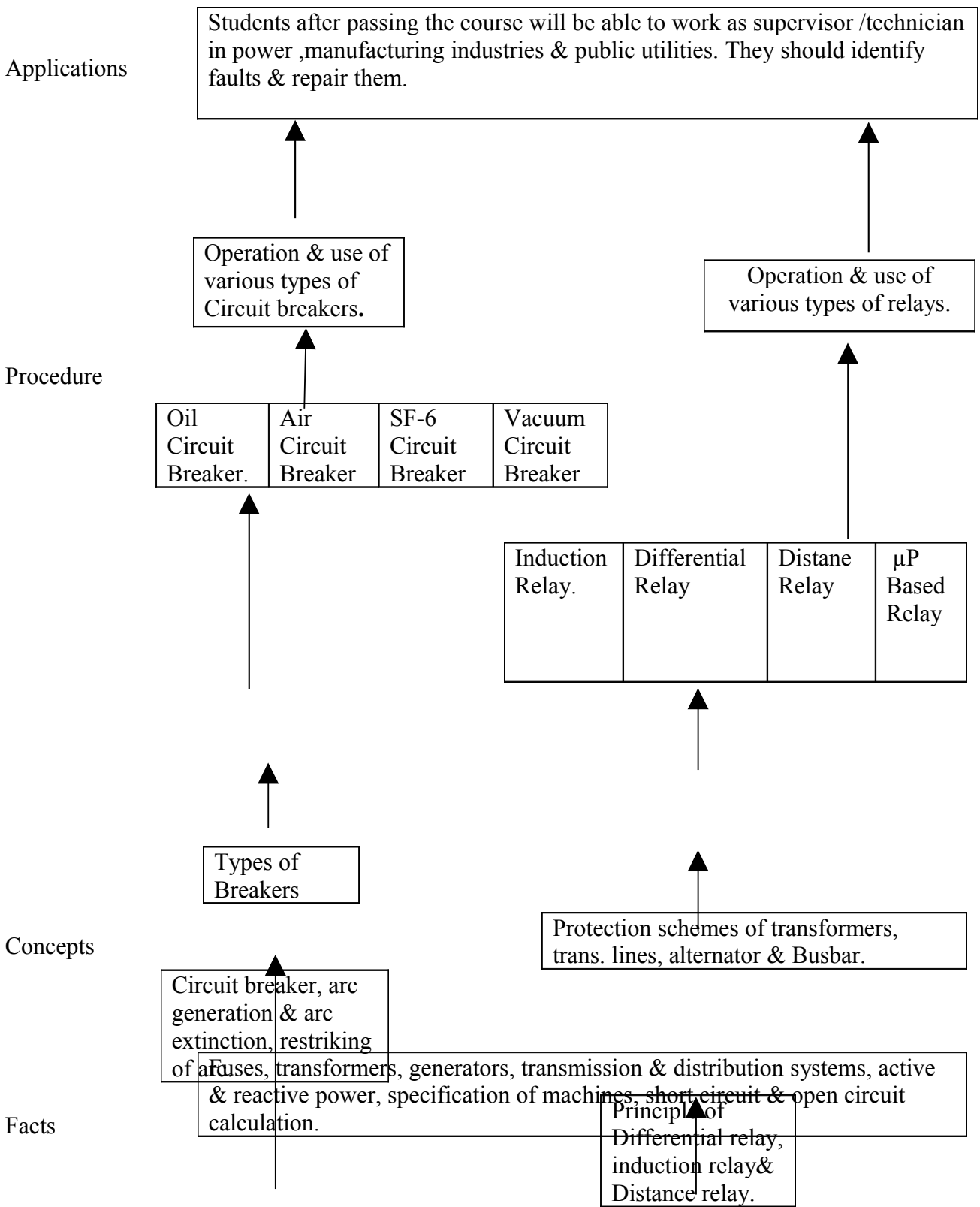
In modern world electrical power system is growing fast due to expanding technical activities. As such the students must know about the switchgear and protection system. It is expected that the knowledge of facts, concepts, principles & procedural aspects of switchgear and protection system must be known by students which ultimately help the students in discharging their duties as a supervisor or a technician in substations, manufacturing industries & public service utilities.

Objectives:

The students will be able to:

- 1) learn the principles, concepts & procedural aspects of switchgear & protection .
- 2) identify the various components of switchgear & protection systems.
- 3) know the specifications & select switchgear & protection system
- 4) identify the faults & repairs.

Learning Structure:



Contents: Theory

Chapter	Name of the Topic	Hours	Marks
01	Fundamental: 1.1 Necessity & functions of protective system. 1.2 Normal & abnormal conditions. 1.3 Types of faults & their causes. 1.4 Short circuit calculations(Symmetrical faults only) 1.5 Use of current limiting reactors & their arrangements.	05	08
02	Circuit interrupting devices 2.1 HRC fuses – construction, types, working, characteristics, selection and applications 2.2 Isolators- vertical break, horizontal break & pentograph type 2.3 Arc formation process, methods of arc extinction, related terms. 2.4 Circuit breakers- Concept, Classification, Working principle, Construction, Specification & Applications of 2.4.1 H.T – Bulk oil circuit breaker, Minimum oil circuit breakers (M.O.C.B.), Sulphur Hexa Fluoride circuit breaker (SF6). vacuum circuit breaker. 2.4.2 L.T.- Air circuit breakers (ACB),miniature circuit breakers (M.C.B.), Moulded case circuit breakers (M.C.C.B.), Earth leakage circuit breaker (E L C B of R.L.C.B), Comparison of fuse & MCCB 2.5 Selection of MCCB for motor earth fault, over heating protection. 2.6 Selection and rating of circuit breakers.	12	14
5	Protection of Transformer 5.1 Abnormalities & faults 5.2 Differential, over current, earth fault, interturn, restricted earth fault, over heating protection. 5.3 Buchholz relay	08	10
	Protective Relaying (Simple numerical on differential protection) 3.1 Requirements- relay time, related terms. 3.2 Classification – Electromagnetic attraction, induction static, μP based relays.		
6	Protection of Motor 6.1 Abnormalities & faults. Protective transformers. (No numerical on above topic.) 6.2 Short circuit protection, Overload protection, Single phase preventor	04	06
3	3.4 Over current relay- Time current characteristics. 3.5 Static over current relays 3.6 μP based over current relays	12	14
7	Protection of Busbar & transmission line 7.1 Distance relaying, Principle, static, μP based 7.2 Abnormalities & faults. 7.3 Directional relay. 7.4 Bus bar protection. 7.5 Differential Relay. (Simple numerical on relay setting.) 7.6 Transmission line, over current, distance protection. Pilot wire protection.	06	10
	Protection of Alternator 4.1 Abnormalities & Faults 4.2 Differential protection		
8	Neutral Earthing 8.1 Introduction & importance. 8.2 Overcurrent, earth fault, interturn fault, negative phase sequence, over heating protection. 8.3 substation earthing 4.4 Reverse power protections.	03	04
4	Over Voltage Protection (differential protection) 9.1 Causes of over voltages.	08	10
9	9.2 Lighting phenomena & over voltage due to lightning. 9.3 Protection of transmission line & substation from direct stroke. 9.4 Types of lightning arresters & surge absorbers & their Construction & principle of operation. 9.5 Protection against traveling waves. 9.6 Insulation co-ordination.	06	04
	Total	64	80

Practical:

Skills to be developed:

Intellectual Skills:

1. Identify different types of circuit breakers
2. Identify various faults on the system
3. Calculate the fault levels

Motor Skills:

1. Simulate circuit configuration to create various faults
2. Set the relays for various fault levels

List of Practical:

- 1) Identify the components of different types of circuit breakers with their specifications (through visits , video or model).
 - I) Low tension air circuit breaker.(including protective devices)
 - II) Minimum oil circuit breaker (M O C B)
 - III) Miniature circuit breaker (M C B)
 - IV) Moulded case circuit breaker (M C C B)
 - V) Earth Leakage circuit breaker (E L C B) or Residual leakage circuit breaker (R L C B)
 - VI) Sulpher - Hexa fluoride circuit breaker (S F 6)
 - VII) Vacuum circuit breaker.
- 2) Plot performance characteristics of over current relay.
- 3) Simulation of alternator protection.
- 4) Simulation of transformer protection.
- 5) Comparative study of specifications of earthing at different substations / different locations & new trends in earthing schemes (information search)
- 6) Comparative study of specification of lightning arresters of different manufacturers through Brochures / Literature
- 7) For a given 3-ph induction motor with D.O.L. starter
 - a. Check the operation of over current relay for various loads.
 - b. Check the operation of single phasing preventer by creating single phasing fault.
 - c. Check the operation of D.O.L. starter under short circuit condition.

Learning Resources:**Books:**

Sr No.	Author	Name of Book	Publication
1.	S.Rao.	Switch gear & protection	Khanna Publications, New
2.	Soni,Gupta & Bhatnagar.	A text book on electrical power system	Dhnapat Rai & Sons, New
3.	Mason C.R.	The art & science of protective relaying	-----
4.	S.L.Uppal.	A text book of Electrical power	Khanna Publisher, Delhi.
5.	Badriram & Vishwakarma P.N.	Power System Protection & Switchgear	TMH, New Delhi