

COURSE TITLE : **POWER SYSTEM PROTECTION**
COURSE CODE : **4040**
COURSE CATEGORY : **A**
PERIODS/WEEK : **4**
PERIODS/SEMESTER : **72**
CREDITS : **4**

TIME SCHEDULE

MODULE	TOPIC	PERIODS
I	Fuse	17
	Test I	1
II	Circuit breaker	17
	Test II	1
III	Protective Relays	17
	Test III	1
IV	Protection of machines & Earthing	17
	Test IV	1
	Total	72

Rationale

The energy supply system includes different protection system, which will provide at different stages of the power system. This subject helps the students to analyse the internal behaviour of different type of protection systems used. The knowledge gained in this subject is help full to the students in future.

OBJECTIVES

Upon completion of course, student should be able to:

MODULE - I

1.0 Understand fuse and fusing element

- 1.1 Define terms such as fusing current, rated current of fuse element, fusing factor, factors effecting current carrying capacity of fuse elements
- 1.2 Know the prospective and cut off currents, pre arcing time, arcing time and operating time of fuses& inverse current characteristics etc
- 1.3 Know the classifications of fuses
- 1.4 Understand the constructions and working of HRC fuses
- 1.5 Know the selection of HRC fuses
- 1.6 State the advantages of fuse

MODULE – II

2.0 Understand the Working of Circuit breakers

- 2.1 Study the Arc phenomena and extinction
- 2.2 Terms associated with circuit breaking.
- 2.3. Classification of circuit breakers
- 2.4 Describe working principle of oil circuit breaker
- 2.5 Explain the Air Blast Circuit Breaker
- 2.6 Explain the principle and operation of SF6 circuit breakers
- 2.7 Explain the principle and operation of vacuum circuit breakers and compare it with

other types

MODULE – III

- 3.0 understand the relays
- 3.1 State the basic requirements of protective relaying
- 3.2 Explain the primary and Back up protection
- 3.3 Study the typical time current characteristics
- 3.4 Explain the principles involved in obtaining
 - (a) Inverse time characteristic
 - (b) Inverse definite minimum time lag
 - (c) Different time settings
- 3.5 Classify the relay based on
 - (i) Construction & principles of operation and
 - (ii) Time of operation
- 3.6 Describe the principles of operation & applications of the following relays with sketches
 - (a) Attracted armature type
 - (b) Solenoid plunger type
- 3.7 Describe the construction and principle of operation of an induction type over current relay
- 3.8 Explain the working of directional over current relay
- 3.9 Explain the principle, construction and operation of distance relay

MODULE -IV

- 4.0 Protection of machines & earthing**
- 4.1 Explain the over current and earth leakage protection of Alternators
- 4.2 Explain the Merz Prize protection of 3 phase Transformers
- 4.3 Know the Protection of bus bars
- 4.4 Explain the various protections of transmission lines
- 4.5 Explain the causes of transient and over voltage
- 4.6 Know the apparatus used in power stations and sub stations
- 4.7 Understand the protection by ground wires
- 4.8 Analyse different protection methods used against lightning
- 4.9 Know the Lightning arrester's operation and types
- 4.10 Know Soil resistivity and measurement
- 4.11 Explain different methods of Neutral earthing

COURSE CONTENT

MODULE I

Fuses – fusing element – rated current of fuse element - fusing factor - factors affecting current carrying-capacity of fuse elements - Prospective current of a circuit- cut off – pre-arcing time - arcing time and-operating time of fuses - Inverse current characteristics – classification of fuses - Description of expulsion-and cartridge fuses-Drop out fuse – characteristic of HRC fuses - Cut off current and time current -characteristics of HRC fuses - Rupturing capacity - selection of HRC fuse - advantages and disadvantages of HRC fuses –problems

MODULE I

Circuit breakers

Circuit breakers – functions – fault clearing process - trip circuit – classification based on arc quenching process – high resistance and current zero - arc extinguish - idea of arc voltage - recovery voltage –restriking voltage - current chopping - switching – principles and applications
Oil circuit breakers – working principle – classification of circuit breakers Air blast – circuit breaker

advantages – principles with simple sketches – vacuum circuit breaker - principles with simple sketches –SF6 circuit breakers-circuit breaker advantages – working with simple sketch - Selections and specification of circuit breakers - circuit breaker ratings -breaking capacity and making-capacity - short time current rating and rated voltage normal current rating

MODULE III

Relays

Protective relays- importance of protective relays – primary and back up protection - properties of relays– Inverse time definite minimum time properties - Current setting time - setting and tripping time -Classification of relays - electromagnetic relays - induction relays - Construction and working of attracted armature type electromagnetic relay - directional and non- directional - induction over current relays - Static relays- functional circuits - brief description with block diagram - Electronic time delay –relay using transistors- microprocessor based digital relays 19 periods

MODULE IV

Protection

Protection of alternators – differential protection against internal faults - Principle and schematic diagram and working - Protection against loss of excitation –over load, over voltage, over speed protection-motoring.-Protection of ac motors.

Protection of transformers – differential protection – schematic diagram - working - current transformer connections in star and delta - Buchholz relay – brief description and working-Bus bar protection-arrangement-bus-zone fault-back up protection-differential over current protection

Protection of transmission lines – over current, over load and earth fault-time graded –current graded-pilot wires protection-protection of radial -

Earthing and Lightning arresters -Surges – causes of transient- over voltage- mechanism of lightning phenomena-lightning strokes- -Lightning arresters- thyrite lightning arrester – surge absorbers –rod gap, sphere gap, horn gap, multiple - gap arresters-testing of arresters-

Earthing-effects on human body-soil resistivity and measurement-earthing mat-size of earthing

conductor -Power stations – substations and electrical apparatus protection by ground wire – Neutral grounding –systems - Types of grounding - description of solid -resistance and reactance earthing of neutral – earthing transformers-sub station earthing

REFERENCE BOOKS

1. Principles of Power System - V K Metha
2. Switch gear & Protection- Sunil S Rao
3. Electrical power system- Uppal