

Time allowed: 3 Hours

NOTE: Attempt five questions in all, including Question No. 1 which is compulsory and selecting two questions from each Unit.

Max. Marks: 50

x-x-x

I. Write short notes on:-

- a) What are the problems arising in differential protection in power transformer and how are they overcome?
- b) Why double bus double breaker arrangement is rarely used at substations?
- c) What is a static relay and under what conditions it is preferred?
- d) What is the difference between directional and non-directional relay?
- e) Draw the voltage and current waveforms of an AC arc representing the relation between arc voltage and arc current in a circuit breaker. (5x2)

UNIT – I

II. a) What are the causes of overvoltage in power system? Also give its classification and state the various causes of its occurrence in detail.

b) A 15 kV, 2 MVA generator has a reactance of 15% connected to a transformer of 15/3.3 kV, 2 MVA, with leakage reactance of 8%. A load of 2 ohms is connected to the low tension side of the transformer. Find the per unit impedance of load referred to in the circuit and draw the reactance diagram for the whole system. (5,5)

III. a) A 50 Hz, 11 kV, three-phase alternator with earthed neutral has a reactance of 6 ohm/phase and is connected to the bus-bar through a CB. The distributed capacitance upto the CB between phase and neutral is 0.01 μ F. Determine:

- i) Peak restriking voltage across the CB.
- ii) Frequency of oscillations
- iii) Average RRRV upto the first peak.

b) Explain the construction and working of MOCB. Discuss its advantages and limitations. Also discuss the Axial flow and Cross flow of oil during arc interruption using suitable diagrams. (5,5)

IV. a) A 33/6.6 kV, three-phase, 50 Hz, star/delta connected transformer is protected by a differential scheme. Draw the detailed connection diagram for the differential protection of the transformer. If the CTs employed on the HT side have a ratio of 6.93/1A, determine the CT ratio on the LT side. Let the current on the LT lines be 300A.

P.T.O.

(2)

b) Explain the concept of insulation coordination.

(7.3)

UNIT – II

V. A circuit breaker equipped with a 1000/5 CT is used to protect a 20 MVA transformer operating at 30% overload and feeding all kV bus-bar. The feeder circuit breaker is also equipped with a 400/5 CT. Both the CTs feeding IDMTL relays have the following characteristics:

PSM	2	3	3.4	5	10	15	20
Time(s):	10	6	5.6	4.1	3	2.5	2.2

The relay on the feeder circuit breaker has 125% plug setting and a TMS of 0.3. If a fault current of 5 kA flows from the transformer to the feeder, determine

a) Operating time of feeder relay

b) Suggest suitable plug setting and PSM of the transformer relay

(10)

VI. A 30,000 kVA, 11 kV generator with $x_d'' = 20\%$ is connected to a synchronous motor through a transformer. The transformer is rated at 35,000 kVA, 11 kV/6.6 kV with leakage reactance of 10%. The motor is rated at 30,000 kVA, 6.6 kV with sub-transient reactance of 25%. Find the sub-transient current when a symmetrical fault occurs at the terminals of motor using Thevenin's impedance method.

(10)

VII. a) Describe the advancement in relay technology that has occurred during the last years. Also explain the various functions of digital programmable relays.

b) Explain using diagrams, the differences between an isolated neutral system and solidly grounded system. Also draw the phasor diagrams.

(5,5)