

(Set-Q₁)

B.Tech-7th (EE)

Switch Gear and Protective Devices

Full Marks : 70

Time : 3 hours

Q.No.1 is compulsory and answer
any **five** from the rest questions

The figures in the right-hand margin indicate marks

1. Answer the following questions : 2 × 10

- (a) What are the different types of faults occurred in power system ? Which type of faults is most dangerous ?
- (b) Explain the term PSM and TMS with reference to IDMT overcurrent relay.
- (c) Why is the application of overcurrent relays difficult in the case of varying generating conditions ?
- (d) Discuss over-reach and under-reach in connection with distance relay.

(Turn Over)

- (e) How the resistance of the fault affect on the protective zone of the distance relay.
 - (f) Explain why a delta-star power transformer must have the protective CTs connected in star-delta for differential relaying.
 - (g) Name the various forms of unit and non-unit type protection schemes for a bus-bar.
 - (h) What is the effect of power factor of current being interrupted on the recovery voltage?
 - (i) Why the making capacity required for a circuit breaker is more than asymmetrical breaking capacity?
 - (j) Why SF₆ circuit breakers are smaller in size than oil circuit breakers of the same ratings?
2. (a) Discuss the comparative benefits and limitations of electromagnetic, static and microprocessor based digital relays. 5

(3)

- (b) For the circuit given in Fig. 1, the ground relay R is IDMT overcurrent relay with plug setting = 20 % and TMS = 0.2. The excitation current of three line CTs is 0.05 A each. Determine the fault current for single-line-to-ground fault for which the relay will just pickup. Also, find out the operating time of the relay for the fault current of 100 A. 5

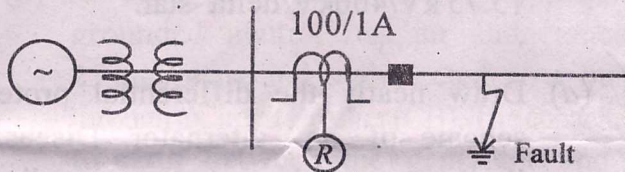


Fig. 1

3. (a) Explain the need for a three-stepped distance protection used for transmission line protection. 5
- (b) The impedance seen from the relay side in a distance relay is 10Ω . Given that CT ratio is 1000 : 1. And the PT ratio is 100,000 : 110. Determine the actual impedance. Given that the line has a resistance of $1.0 \text{ m}\Omega/\text{km}$ and a reactance of $20.0 \text{ m}\Omega/\text{km}$. Find the distance to fault. Assume single-phase line. 5

4. (a) What is Buchholz relay ? Discuss its working principle. 5

(b) Design and draw a detailed protection scheme for biased differential protection for a three-phase, 50 Hz power transformer with the following name plate rating : 250 MVA, 15.75 kV/400kV, delta -star. 5

5. (a) Draw neatly the differential protection scheme of an alternator. Discuss its limitations and suggest remedies to overcome them. 5

(b) A 11kV, 10 MVA star connected alternator has reactance of 3.0Ω per phase and negligible resistance. Merz-price protection is used for protection of winding. The neutral grounding resistance is 5Ω . If only 10% of the winding is to remain unprotected, find the setting of the relay. 5

6. (a) Describe with a neat sketch the principle of operation of a minimum oil circuit breaker. 5

- (b) A 220 kV, 3-phase, 50 Hz, 200 km transmission line has a capacitance to earth of $0.01 \mu\text{F}/\text{km}/\text{phase}$. Calculate the inductance and kVA rating of the Peterson coil used for earthing the above system. 5

7. (a) Explain the various arc interruption theories. 5

- (b) A 50 Hz, 11 kV, three-phase generator with grounded neutral has an inductance of $25 \text{ mH}/\text{phase}$ and is connected to a busbar through a Circuit Breaker (CB). The capacitance to earth between the generator and the CB is $0.1 \text{ mF}/\text{phase}$. Determine, (i) Maximum restriking voltage (ii) Time for maximum RRRV, (iii) Average RRRV upto the first peak and (iv) frequency of oscillations. 5

8. Write short notes on any two : 5 × 2

- (i) Surge absorber
- (ii) Synthesis of Mho relay using static phase comparator
- (iii) Metal Oxide lightning arrester.