VKR/KS/13/3279/3557/3411

Faculty of Engineering & Technology

Eighth Semester B.E. (Electrical Engg.)/Power Engg./ Seventh Semester B.E. P.T. (Electrical)/Eighth Semester B.E. (PEngg.) Examination

SWITCHGEAR AND PROTECTION

Sections—A & B

Time : Three Hours]   [Maximum Marks : 80

INSTRUCTIONS TO CANDIDATES

(1) Answer **THREE** questions from Section A and **THREE** questions from Section B.

(2) Assume suitable data wherever necessary.

(3) Illustrate your answers wherever necessary with the help of neat sketches.

(4) Use of slide rule, Drawing instruments and non-programmable calculator is permitted.

SECTION—A

1. (a) Explain in short :—

    (i) What is meant by an external and an internal fault ?   2

    (ii) Why are adjacent zones made to overlap ?   2

(iii) Why speed of protection is important ? 2

(iv) "Power systems are moving towards increasing complexity, demand and equally complex protection". Discuss. 2

(b) What is meant by back-up protection ? What is its necessity ? Explain its various types. 5

2. (a) Compare the time-current characteristics of inverse, very inverse and extremely inverse overcurrent relays ? Discuss their area of applications. 6

(b) What do you mean by TSM and PSM ?

The rating of an overcurrent relay is 5 A. PSM = 2, TSM = 0·3, CT ratio = 400/5, Fault current = 4000 A.

Determine the operating time of the relay. At TSM = 1, operating times at various PSM are :—

PSM	2	4	5	8	10	20
Operating time in seconds	10	5	4	3	2·8	2·4

7

3. (a) Explain how you provide directional feature to (i) impedance and (ii) reactance relay. 3

(b) Draw and explain the circuit connection of three reactance units used at a particular location for 3 zones of distance protection. 7

(c) In what way is distance protection superior to overcurrent protection for the protection of H.V. transmission lines ? 3

4. (a) Explain the need of directional relay. Derive torque equation from the phasor diagram. 6

(b) A 110 kV line of 35 km length is protected by impedance relay. The first stage of distance relay protects 80% of the line. Calculate the setting of impedance relay and draw the characteristic of line and the relay on R-X plane. Neglect the influence of arc resistance.

The line impedance is $(0·24 + j0·41)$ Ω per conductor per km. CT ratio is 300/1 A and PT ratio is 110 kV/110 V. 7

5. Write short notes on (any **TWO**) :—

(i) Induction cup relay. 7

(ii) Directional overcurrent relay. 7

(iii) Underreach and overreach of distance relay. 7

SECTION—B

6. (a) Explain the various faults in induction motor and their remedies in short. 6

(b) A 3-phase 33 kV star connected alternator is to be protected using circulating current protection. The pilot wires are connected to the secondary windings of 100/5 ratio current transformer. The protective relay is adjusted to operate with an out of balance current of 1 Amp in the pilot wires. Determine the :

(i) earthing resistance which will protect 90% of the winding and

(ii) the % of the winding which would be protected if the earthing resistance is 15 Ω.

8

7. (a) With a neat sketch, discuss the differential scheme for bus-zone protection. 5

(b) A 3-phase 60/11 kV star-delta connected transformer is provided by Merz-price protection system. The CTs on LT side have a ratio of 420/5 Amps. Show that the CTs on H.T. side will have a ratio of $70:5/\sqrt{3}$.

Draw circuit diagram. 8

8. (a) Explain static definite time over-current relay. 6

(b) Explain the duality between phase and amplitude comparator. 7

9. (a) Discuss the principle of an arc interruption in

(i) an oil circuit breaker and

(ii) air blast circuit breaker. 5

(b) Explain the terms :—

(i) restriking voltage

(ii) recovery voltage and

(iii) RRRV.

Derive an expression for the restriking voltage in terms of system voltage. 8

10. (a) An 11 kV, 50 Hz alternator is connected to a system which has inductance and capacitance per phase of 10 mH and 0·01 μF respectively. Determine :

(i) the maximum voltage across the breaker contacts.

(ii) frequency of transient oscillation

(iii) the average RRRV and

(iv) Maximum RRRV. 6

(b) Explain SF_6 circuit breaker. 7