

**Switchgear & Protection**

P. Pages : 3

**NKT/KS/17/7579/7640**

Time : Three Hours



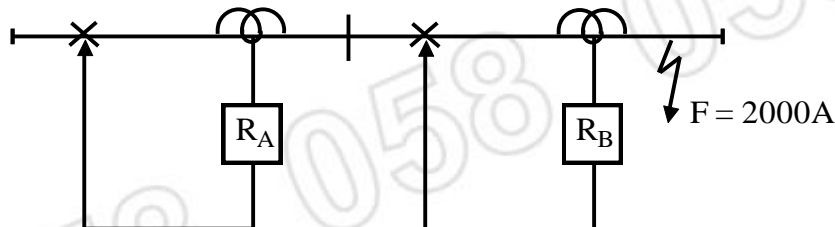
Max. Marks : 80

- Notes :
1. All questions carry marks as indicated.
  2. Solve Question 1 OR Questions No. 2.
  3. Solve Question 3 OR Questions No. 4.
  4. Solve Question 5 OR Questions No. 6.
  5. Solve Question 7 OR Questions No. 8.
  6. Solve Question 9 OR Questions No. 10.
  7. Solve Question 11 OR Questions No. 12.
  8. Due credit will be given to neatness and adequate dimensions.
  9. Assume suitable data whenever necessary.
  10. Illustrate your answers whenever necessary with the help of neat sketches.
  11. Use of non programmable calculator is permitted.

1. a) Why back-up protection is necessary ? Compare back-up protection & primary protection from operation & setting point of view. 6
- b) Explain desirable qualities of relay. 7

**OR**

2. a) Why should protective zones overlap around a circuit breaker ? Show with required circuit diagram. 6
- b) Explain types of faults, causes of faults, consequences of faults and removal of faults. 7
3. a) Explain the construction & principle of non-directional over-current relay. 6
- b) Consider a system : 7



Given :  $I_F = 200 \text{ A}$  ; CT Ratio = 200/1 for each relay ;  $R_B = 100\%$  setting &  $R_A = 125\%$   
Time discrimination = 0.5 sec between relays. Determine the time of operation of the two relays & TSM of relay 'A'. Assuming relay  $R_B$  has TSM = 0.2.

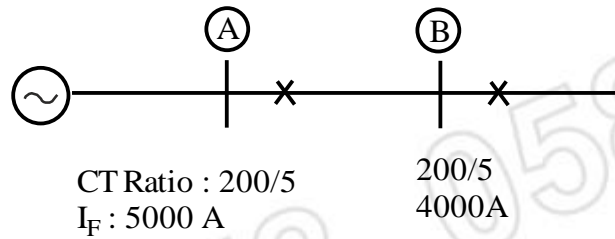
At TSM = 1, O.T. at various PSM are

PSM	2	4	5	8	10	20
O.T. (sec.)	10	5	4	3.2	2.8	2.4

**OR**

4. a) Design the time current grading scheme for the following system :

8



At TSM = 1, the Time/Current characteristic of the relay is as given below :

PSM	2	3	5	10	15	20
O.T. (sec.)	10	6	3.9	3	2.2	2.1

- b) Show the protection scheme of parallel feeders by using overcurrent relays. 5
5. a) Explain how you provide directional feature to - 4  
 i) Impedance &                                      ii) Reactance relay
- b) In what way is distance protection superior to over-current for the protection of high voltage transmission lines ? 3
- c) Explain the carrier current protection based on phase comparison. 7
- OR**
6. a) Draw & explain the circuit connection of three reactance units used at a particular location for 3-zones of distance protection. 7
- b) Draw impedance, reactance & Mho relay characteristic to protect 100% length of line having impedance of  $(2.5 + j6) \Omega/\text{ph}$ . A fault may occur at any length of the line with arc resistance of  $2\Omega$ . Determine the % of line, which can be protected by each type of the relays. 7
7. a) An 11 kV, 100 MVA generator is provided with differential scheme of protection. The percentage of winding to be protected against phase to ground fault is 85%. The relay is set to operate when there is 20% out of balance current. Determine the value of the resistance to be placed in neutral to ground connection. 7
- b) With neat diagram discuss the differential scheme for bus zone protection. 6
- OR**
8. a) Explain various types of faults in induction motor & their remedies in short. 6
- b) A three phase 60/11 kV star-delta connected transformer is provided by Merz-price protection scheme. The CT is on LT side have a ratio of 420/5 Amps. Show that the CTs on HT side will have a ratio of  $77 : 5/\sqrt{3}$ . Draw a circuit diagram. 7
9. a) Compare Electromagnetic & static relays. 6

- b) Explain duality between the comparator. 7

**OR**

**10.** Write a short notes on the following with block diagram :

- a) Static over current relay. 6
- b) Integrating type phase comparator. 7

**11.** a) Explain the theories related to current zero interruption method. 6

- b) In a 220 kV system, the reactances & capacitance upto the location of circuit breaker is 8 ohms & 0.025 micro F. respectively. A resistance of 600 ohms is connected across the contacts of the C.B. Determine the following : 8
- i) Natural frequency of oscillation.
- ii) Damped frequency of oscillation
- iii) Critical value of resistance which will give no transient oscillation &
- iv) The value of resistance which will give damped frequency of oscillation, one fourth of the natural frequency of oscillation.

**OR**

**12.** a) Write a short notes on : SF<sub>6</sub> circuit breaker with circuit, its operation & applications. 8

- b) In a system of 132 kV, the line to ground capacitance is 0.01 micro F & the inductance is 5 henries. Determine the voltage appearing across the pole of CB, if a magnetizing current of 5 amps (instantaneous value) is interrupted. Also determine the value of resistance to be used across the contacts to eliminate the restriking voltage. 6

\*\*\*\*\*

