B.E. ELECTRICAL ENGINEERING
FOURTH YEAR
FIRST SEMESTER EXAM 2019

POWER SYSTEM PROTECTION AND SWITCHGEAR

Time: Three Hours   Full Marks: 100

(50 marks for each part)
Use a separate Answer-Script for each Part

PART-I

Group A

Answer *any two* questions from Group A.

1. a) Explain why current interruption is easier in ac circuit breaker than in dc circuit breaker.   3+5
   Discuss the role of main and arcing contacts in the interruption of arc in air circuit breaker.

   b) Discuss why arc chute and blow out coil are used in air circuit breaker.   5

   c) Why RRRV is considered to be an important factor in circuit breaking?   3

2. a) Discuss how thermionic and field emissions are responsible for arc formation in a circuit breaker.   4

   b) Why formation of arc is desirable in the process of circuit breaking?   4

   c) Describe how the type of fault and condition of neutral point affect the active recovery voltage in a circuit breaker.   4

   d) 'Autoreclosing is not always beneficial' - Explain.   4

3. a) Mention the main features of SF_6 as an arc quenching medium.   4

   b) Name the different types of operating mechanisms of a circuit breaker.   3

   c) Comment on the selection of contact materials for vacuum circuit breaker.   5
   d) Differentiate between symmetrical and assymetrical breaking current with the help of necessary diagram.   4

Group B

Answer *any one* question from Group B.

4. a) Describe with suitable diagrams how earthing transformer can provide low impedance path to the flow of ground fault current in an ungrounded system   8

b) Show that the sequence impedances of transmission lines are uncoupled even when mutual impedances exist between the phases.   8

c) Explain why line resistance is neglected for fault analysis of high voltage systems.   2

5.   a) Derive expression for the fault current when a single line to ground fault occurs at the terminals of an unloaded alternator considering fault impedance Z_f. Draw the relevant sequence network diagram.   6

b) A 13.8 kV, 3 phase, 100 MVA solidly grounded generator supplies power through a three phase 100MVA, 13.8/ 220kV transformer as shown in the figure. The subtransient positive, negative and zero sequence reactances are 0.15 pu, 0.2 pu and 0.05 pu respectively. The transformer has a winding impedance of 0.1 pu. A line to line fault occurs at the 220kV end of the transformer. Draw the sequence network and determine the fault current.   12
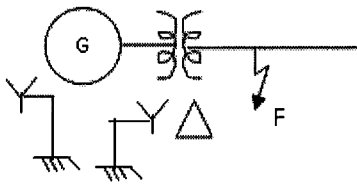
B.E. ELECTRICAL ENGINEERING FOURTH YEAR FIRST SEMESTER – 2019
Subject: POWER SYSTEM PROTECTION & SWITCHGEAR

Time: Three Hours   **Full Marks**: 100

(50 marks for each part)
Use a separate Answer-Script for each Part

PART-II

Answer *any three* questions from this part.
Two marks are reserved for neat and well organised answer

6. (a) (i) Explain the sensitivity property and selectivity property of a power system protective relay?   (2+6)=8

   (ii) Explain each of the basic elements of Protective relaying Scheme along with a suitable diagram.

   (b) Explain with suitable diagram why an induction disc type over-current relay is superior to attraction type relays for protection of radial feeder sections. Also mention clearly how proper discriminating time margin is maintained between the relays of consecutive sections.   8

7. (a) Discuss the factors on which the reach of overcurrent relays depends.   3

   (b) Explain with suitable diagram how directional feature is incorporated into an IDMTL relay. Derive the torque equation of this directional unit. Draw the connection diagram and phasor diagram of 30^0 power relay.   (4+4+5)=13

8. (a) A 20 MVA transformer which may be called upon to operate at 30% overload, feeds 11 kV bus bar through a CB. Other CBs supply outgoing feeders. The transformer CB is equipped with 1000/5 Amp CTs, and feeder CBs with 400/5 Amp CTs and all CTs feed IDMTL relays having following characteristics   8

PSM	2	3	5	10	15	20
Time(sec)	10	6	4.1	3	2.5	2.2

The relays on the feeder CBs have a 125 % plug setting and 0.3 Time setting. Allow a time discrimination of 0.5 sec. A fault current of 5000 Amp flows from the transformer to one of the feeders. Find the operating time of the feeder relay and the PSM and time setting for the transformer relay.

   (b) Derive torque equation of reactance relay from universal relay torque equation with   (4+2)=6

proper justification. Explain the advantages and disadvantages of this relay in distance protection.

(c) What do you understand by Ohm relay?   2

9. (a) Explain the effect of power swing on the operation of distance relay. Discuss the remedial measure against it by using Offset mho relay.   10

(b) An 11 kV, 15 MVA alternator is earthed through a resistance of 10 Ω. An earth fault relay connected to the secondary of a 1000/5 A.C.T operates at a current of 1.0 A. What percentage of winding is protected?   6

10. Discuss the following: (any two)   (8×2) = 16

    (i) Carrier acceleration scheme and carrier inter-tripping scheme for carrier aided distance protection.

    (ii) 3-step 3-zone distance protection.

    (iii) Impedance Relay.

    (iv) Use of Biased Differential Relay for protection of generators.

    (v) Buchholz relay for transformer protection.