(vi) In air-blast circuit breaker resistance switching is used to
(a) reduce the magnitude of fault current
(b) control the circuit-breaker operating time
(c) damp out the fast transient
(d) change the fault current power factor.

(vii) In a star connected system without neutral grounding, zero sequence currents are
(a) zero
(b) phasor sum of phase currents
(c) three times of the phasor sum of phase currents
(d) 0.577 times the phasor sum of phase currents.

(viii) Why are load flow studies carried out?
(a) To study stability of the system (b) For fault calculations
(c) For planning the power system (d) For load frequency control.

(ix) For n-bus power system size of Y bus matrix is
(a) (n - 1) × (n - 1) (b) (n - 2) × (n - 2)
(c) n × n (d) (n - 1) × (n - 2).

(x) If the inertia constant, H = 8 MJ/MVA for a 50 MVA generator, the stored energy is
(a) 50 MJ (b) 8 MJ (c) 400MJ (d) 6.25 MJ.

Group – B

2. (a) Discuss and explain the sub-transient, transient and steady-state reactance when a sudden 3-phase short circuit occurs at the generator terminals.

(b) Two generating stations each having short circuit capacities of 1300 MVA and 900 MVA respectively are operating at 11 kV and are linked by a interconnected cable having a reactance of 0.55 Ω/phase. Determine the short- circuit capacity of each station.

5 + 7 = 12

3. (a) Prove that a line-to-ground fault at the terminals for a synchronous generator with solidly grounded neutral is more severe than a three phase fault.

(b) Two 25 MVA, 11 kV synchronous generators are connected to a common bus bar which supplies a feeder (fig.1). The star point of one of the generator is grounded through a resistance of 1 Ω, while that of the other generator is isolated. A line to ground fault occurs at the far

Group – E

8. (a) Discuss briefly the construction, principle of operation and application of SF_6 circuit breaker.

(b) An 11 KV, 50 Hz, three phase neutral earthed alternator is connected to the bus-bar through a circuit breaker. The system has inductive reactance of 50 Ω/phase and capacitance of 0.02 μF/phase. Assuming the resistance of the generator to be negligible, calculate
(i) the maximum voltage across the contacts of Circuit Breaker when it breaks a short-circuit current at zero current.
(ii) the frequency of transient oscillation.
(iii) the average value of RRRV.

7 + (2 + 1 + 2) = 12

9. (a) A 132 KV, 50 Hz, three phase 50 Km long overhead line has a capacitance to earth for each line of 0.0157 μF/Km. Determine the inductance and KVA rating of the arc suppression coil suitable for this system.

(b) What do you mean by Step potential and Touch potential? Explain the role of earthing transformer in neutral grounding.

5 + (2 + 2 + 3) = 12

POWER SYSTEM - II
(ELEC 3201)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

   (i) Four alternators, each rated at 5 MVA, 11kV, with 20% reactance are working in parallel. The short -circuit level at bus-bar is
   (a) 6.25 MVA (b) 20 MVA
   (c) 25 MVA (d) 100 MVA.

   (ii) The rating of circuit breaker is usually determined on the basis of
   (a) symmetrical fault (b) single line-to-ground fault
   (c) double line-to-ground fault (d) line-to-line fault.

   (iii) The zero-sequence current of a generator for line-to-ground fault is j2.4 pu. Then the current through the neutral during the fault is
   (a) j2.4 pu (b) j0.8 pu (c) j7.2 pu (d) j0.24 pu.

   (iv) The arc voltage in a circuit breaker is
   (a) in phase with the arc current
   (b) lagging the arc current by 90^0
   (c) leading the arc current by 90^0
   (d) lagging the arc current by 180^0.

   (v) The inrush current of a transformer at no load is maximum if the supply voltage is switched on
   (a) at peak voltage value
   (b) at zero voltage value
   (c) at half the rated voltage value
   (d) at 0.866 time the rated voltage value.

end of the feeder. Determine (i) fault current, (ii) voltage to ground of sound phases of feeder at fault point.

The sequence impedance of each generator and feeder are given below:

Impedance	Generator (pu)	Feeder (Ω/phase)
Positive Sequence	j0.2	j0.4
Negative Sequence	j0.15	j0.4
Zero Sequence	j0.08	j0.8

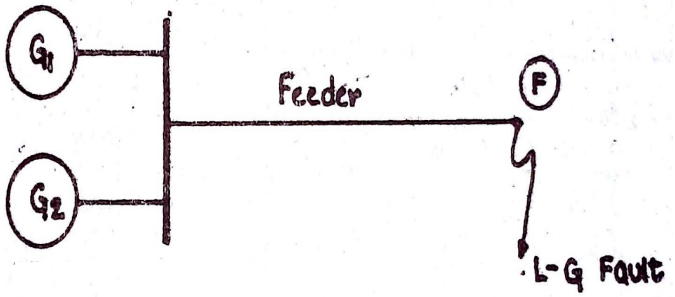

Fig. 1

4 + 8 = 12

Group – C

4. (a) Derive the 'Equal Area Criterion' for the stability of an alternator supplying infinite bus-bar via an inductive interconnector. Mention the limitations of the method.

   (b) A 200MVA, 11kV, 50Hz, 4 pole turbo generator has an inertia constant of 6MJ/MVA.
   (i) Find the stored energy in the rotor at synchronous speed.
   (ii) The machine is operating at a load of 120 MW when the load is suddenly increased to 160MW. Find out the rotor retardation. Neglect losses.
   (iii) If the retardation calculated above is maintained for 5 cycles, find the change in power angle and rotor speed in rpm at the end of this period.

6 + 6 = 12

5. (a) Explain Gauss- Seidel iterative method for solving load flow equations.

(b) Find the bus admittance matrix for the given 3-bus system of fig.2 (all the impedances and reactances are given in ohm).

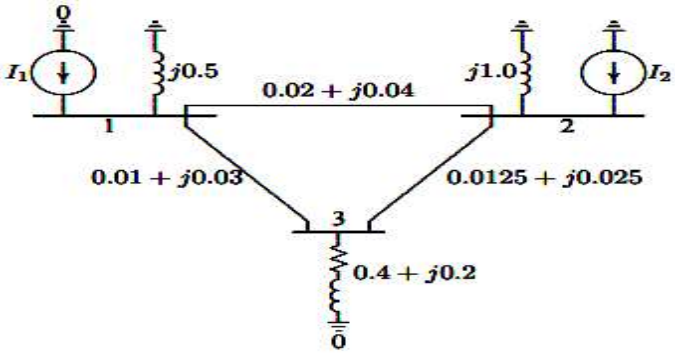

Fig. 2

7 + 5 = 12

Group – D

6. (a) Explain operating principle of induction disc type relay. Also derive its torque equation.

   (b) A 3-phase 33000/6600V transformer is connected in star/delta and the protective current transformer on the low-voltage side have a ratio of 300/5. What will be the ratio of current transformer on the high-voltage side?

(3 + 4) + 5 = 12

7. (a) Fig. 3 shows the percentage differential relay used for the protection of an alternator winding. The relay has a minimum pick up current of 0.3 Ampere and has a percentage slope of 10%. A high resistance ground fault occurs near the grounded neutral end of the generator winding with the current distribution as shown in figure. Assume CT ratio of 400/5 in both side. Determine whether the relay will operate or not.

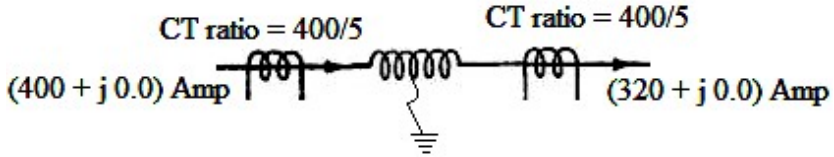

Fig.3

(b) What is Universal Torque Equation? Using this equation derive the operating characteristics of (i) Impedance relay (ii) Reactance relay and (iii) Mho relay.

5 + 1 + (2 + 2 + 2) = 12