(vi) Circuit breakers usually operate under
(a) steady short-circuit current
(b) sub-transient state of short circuit current
(c) transient state of short circuit current
(d) either sub-transient state or transient state of short circuit current.

(vii) The transient voltage that appears across the contacts at the instant of arc extinction is called
(a) recovery voltage (b) re striking voltage
(c) supply voltage (d) peak voltage.

(viii) In a power system, the maximum number of buses are
(a) slack bus (b) load bus
(c) PV bus (d) generator bus.

(ix) In comparison with Gauss-Seidel method, Newton-Raphson method takes
(a) less number of iterations and more time per iteration
(b) less number of iterations and less time per iteration
(c) more number of iterations and more time per iteration
(d) more number of iterations and less time per iteration.

(x) A fault current of 2000A is passing on the primary side of a 400/5 C.T. On the secondary side of the C.T., an inverse-time overcurrent relay is connected whose plug setting is set at 50%. The plug setting multiplier will be
(a) 25 (b) 50 (c) 10 (d) 30.

Group – B

2. (a) What are current limiting reactors? What are the different types of busbar reactors? Which busbar reactor is more advantageous and why?

(b) A synchronous generator and a synchronous motor, each rated 25 MVA, 11 kV having 15% sub-transient reactance are connected through transformers and a line as shown in Fig.1. The transformers are rated 25 MVA, 11/66 kV and 66/11 kV with leakage reactance of 10% each. The line has a reactance of 10% on a base of 25 MVA, 66 kV. The motor is drawing 15 MW at 0.8 pf leading and a terminal voltage of 10.6 kV when a symmetrical three-phase fault occurs at the motor terminals. Find the sub-transient current in the generator, motor and fault.

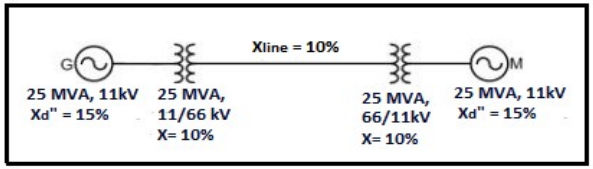

Fig. 1

(1 + 1 + 2) + 8 = 12

3. (a) Derive the relationship to determine the fault current for a line–to–ground (L-G) fault. Draw an equivalent network showing the interconnection of sequence networks to simulate L-G fault.

(b) A 50 MVA, 11kV, three-phase synchronous generator was subjected to different types of faults. The fault currents are as follows:
LG fault – 4200 A; LL fault – 2600A; LLL fault – 2000A.
The generator neutral is solidly grounded. Find the per unit values of the three sequence reactances of the generator.

(4 + 2) + 6 = 12

Group – C

4. (a) Explain the equal area criterion related to the stability of an alternator supplying infinite bus-bar via an inductive interconnector. Mention the limitations of the method.

(b) A synchronous generator of reactance 1.20 pu is connected to an infinite busbar (|V| = 1.0 pu) through transformers and a line of total reactance of 0.60 pu. The generator no-load voltage is 1.20 pu and its inertia constant is H = 4 MW-s/MVA. The resistance and machine damping may be assumed negligible. The system frequency is 50 Hz. Calculate the frequency of natural oscillations if the generator is loaded to 50% of its maximum loading.

(6 + 1) + 5 = 12

5. (a) Mention the different types of buses related to load flow analysis.

(b) What are the advantages and disadvantages of Newton-Raphson method over Gauss-Seidel method of load flow solution?

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

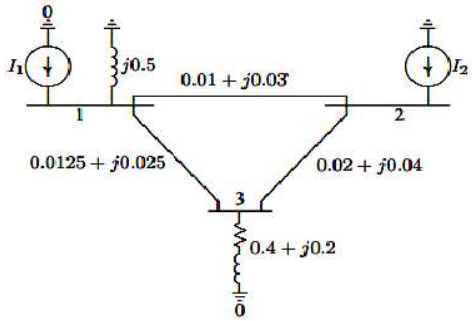

Fig. 2

3 + 4 + 5 = 12

Group – D

6. (a) Explain, with proper diagram, the operating principle of an induction disc type overcurrent relay. Also derive the torque equation.

   (b) An overcurrent relay of current rating 5 A and current setting 150% is connected to the secondary of C.T. of ratio 300/5. Calculate the current in lines for which the relay picks up. Also calculate the line current for which plug setting multiplier (PSM) is 2.

(4 + 4) + (2 + 2) = 12

7. (a) Explain the basic principle of operation of a percentage biased differential relay for (i) internal fault and (ii) through fault.

   (b) A three phase 11kV/33 kV power transformer is connected in delta/star. The transformer is protected by Mertz-Price circulating current system. Protecting current transformer on the high voltage side has a ratio of 250/5. Find the ratio of the current transformers on low voltage side.

(3 + 3) + 6 = 12

Group – E

8. (a) A circuit breaker is rated 2500 A, 1500 MVA, 33 kV, 3 sec, 3-phase oil-circuit breaker. Determine
   (i) the rated normal current
   (ii) the breaking current
   (iii) the making current and
   (iv) the short-time rating current.

   (b) Derive the expression for restriking voltage and RRRV of a circuit breaker.

(1 + 2 + 2 + 1) + (4 + 2) = 12

9. (a) A 132 KV, 50 Hz, three phase 100 Km long overhead line has a capacitance to earth for each line of 0.012 μF/km. Determine the inductive reactance and kVA rating of the arc suppression coil suitable for this system.

   (b) What do you mean by step potential and touch potential?

   (c) Write short notes on Peterson coil grounding.

5 + 4 + 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) A transmission line has self and mutual impedances of 0.8 pu and 0.2 pu respectively. Find its positive, negative and zero sequence impedances.
   (a) 0.6, 0.8 and 1.2 pu (b) 0.6, 0.6 and 1.2 pu
   (c) 0.8, 0.8 and 1.2 pu (d) 0.8, 0.6 and 1.2 pu.

   (ii) If all the sequence voltages at the fault point in a power system are equal, then the type of fault is
   (a) 3-phase fault
   (b) line-to-ground fault
   (c) line-to-line fault
   (d) double line-to-ground fault.

   (iii) A mho relay is
   (a) voltage restrained overcurrent relay
   (b) voltage restrained directional relay
   (c) directional restrained overcurrent relay
   (d) directional restrained overvoltage relay.

   (iv) For 800 MJ stored energy in the rotor at synchronous speed, what is the inertia constant H for a 50 Hz, four pole turbo generator rated 100 MVA, 11 kV?
   (a) 2.0 MJ/MVA (b) 4.0 MJ/MVA
   (c) 6.0 MJ/MVA (d) 8.0 MJ/MVA.

   (v) Which among these quantities are to be determined in slack bus?
   (a) P and Q (b) Q and |V|
   (c) |V| and δ (d) Q and δ.