B.E. (Electrical Engineering (Electronics & Power)) Seventh Semester (C.B.S.)

Electrical Power System – II

P. Pages : 4 **NRT/KS/19/3544**

Time : Three Hours *0249* 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) Symmetrical component transformation is power invariant. Justify. **6**

b) The line to ground voltages on high voltage side of a step – up transformer are 100 kV, 33 kV and 38 kV on phases a, b and c respectively. The voltage of phase 'a' leads that of phase 'b' by 100º and lags that of phase 'c' by 176.5º. Determine analytically the symmetrical components of voltage. **7**

OR

2. a) Derive the sequence impedances of three phase transmission line. Hence draw the sequence networks; respectively the line. **6**

b) A 25 MVA, 11 kV generator has a reactance of 20%. It supplies two motors which are rated 15 MVA and 7.5 MVA both 10 kV with 25% sub transient reactance. The zero sequence reactance of generator and motor are 6%. The three phase transformers both rated 30 MVA, 10.8 kV/121 kV with 10% leakage reactance each. The positive and negative sequence reactance of transmission line are 100Ω. The zero sequence reactance of transmission line is 300Ω. Draw positive, negative and zero sequence networks selecting generator ratings as base in generator circuit. **7**

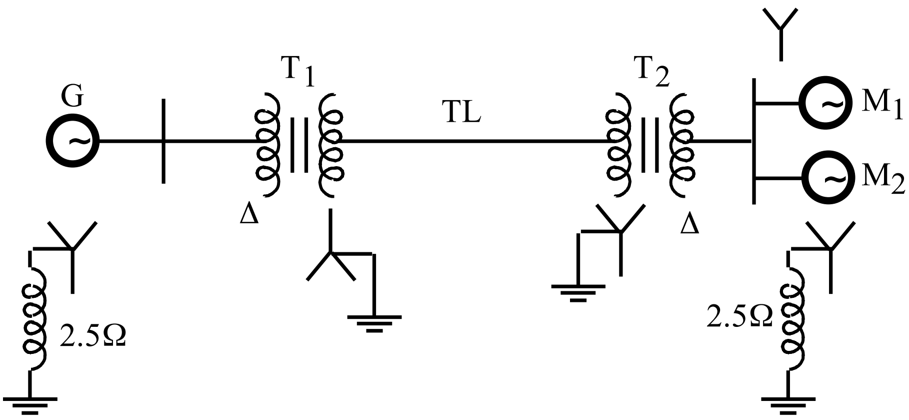

fig. 2(b)

3. a) Discuss various types of current limiting reactors used in power system. **6**

b) For the radial network shown in fig. 3 (b), a, 3 – phase fault occurs at point 'F'. Determine the fault current. Select 100 MVA Base. **7**

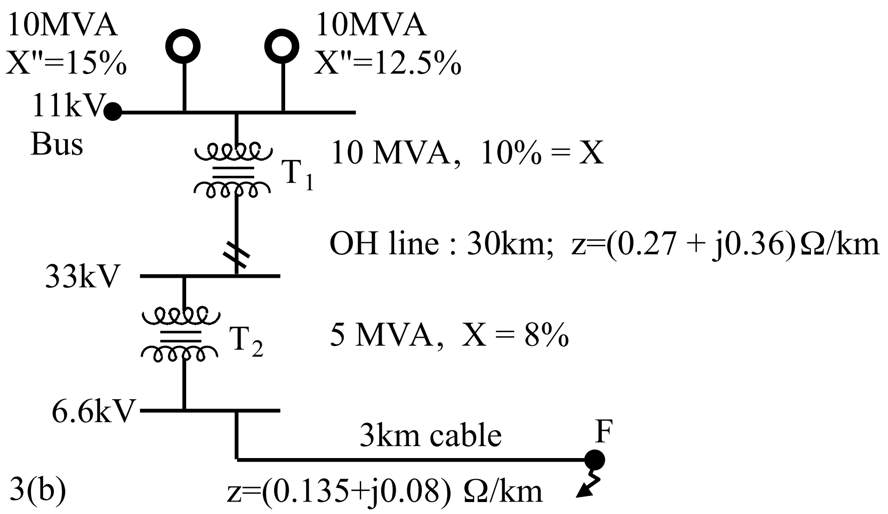

Fig. 3(b)

OR

4. a) Write a short note on ratings of circuit breakers. **5**

b) Three 6.6 kV generators A, B, C each of 10% reactance and MVA rating 40, 50, 25 respectively are connected by a tie bar through current limiting reactors each of 12%, based on the ratings of generator to which it is connected. A 3 phase feeder is supplied from bus bar of generator 'A'. The feeder resistance is 0.06Ω and inductive reactance of $0.12\Omega/1$phase. Estimate the maximum MVA that can be fed into a symmetrical short circuit fault at far end of the feeder. **8**

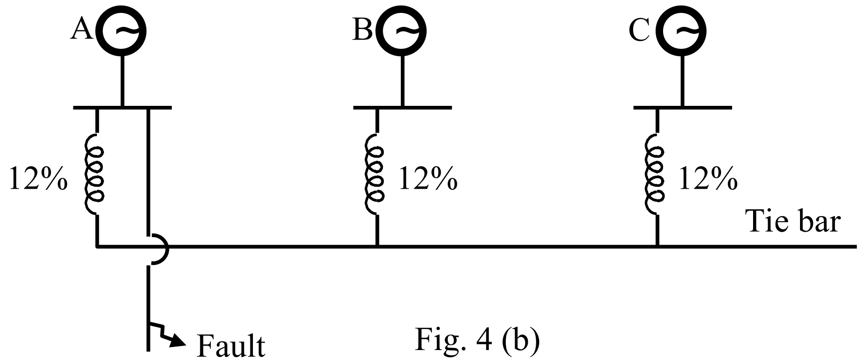

Fig. 4 (b)

5. a) Derive the relationship to determine the interconnection of sequence networks for L-L fault. Also draw the sequence network. **7**

b) Two 11 kV, 20 MVA, star connected generators operate in parallel. The positive, negative and zero sequence reactance of each being respectively j0.18, j0.15 and j0.1 pu. The star point of one of the generators is isolated and that of the other is earthed through 2.0Ω resistor. A single line to ground fault occurs at generator terminal. **7**
Estimate : (i) Fault Current, (ii) Current through grounding resistor, (iii) Voltage across grounding resistor.

OR

6. a) "L – G fault may be more severe that 3 phase short circuit". Justify. **7**

b) A generator with negligible resistance has the voltage behind transient reactance on open circuit equal to 1.1 pu. The magnitudes of fault currents for 3ϕ, L – L and L – G faults are 5 pu, 4.55 pu and 6.6 pu respectively. Calculate pu values of the sequence reactance's of the generator. **7**

7. a) What do you mean by swing curve? Derive swing equation. **6**

b) A generator at 50 Hz is on a load of 1 pu connected to infinite bus. The maximum power transfer under healthy condition is 1.8 pu. During the fault maximum power transferred is 0.4 pu. After clearance of fault maximum power transfer is 1.3 pu. Determine critical clearing angle. **7**

OR

8. a) Define Transient stability. Discuss the assumptions made in the study of transient stability of power system. **7**

b) A 50 Hz, 4 pole turbo generator rated 100 MVA, 11 kV has an inertia constant of 8.0 MJ/MVA. Determine : **6**

i) Stored energy in rotor at synchronous speed.

ii) If mechanical input is suddenly increased to 80 MW for an electrical load of 50 MW. Find rotor acceleration neglecting mechanical and electrical losses.

9. a) The fuel cost of two generating units **8**

$$C_1 = 800 + 45P_{G_1} + 0.01P_{G_1}^2$$

$$C_2 = 2000 + 43P_{G_2} + 0.003P_{G_2}^2$$

If total load supplied is 700 MW. Find the optimal power dispatch with and without generator limits.

$$50MW \leq P_{G_1} \leq 200MW$$

$$50MW \leq P_{G_2} \leq 600MW$$

b) Define the terms : **6**

i) Penalty factor

ii) Transmission loss

iii) Incremental fuel cost

iv) Equality & inequality constraints.

OR

10. a) Derive the co-ordination equation for economic load dispatch of power plants including transmission losses. Give the algorithm for solution of co-ordination equations. **7**

b) A power system has two units and power is being dispatched economically with **7**

$P_1 = 150MW$ and $P_2 = 275MW$

$B_{11} = 0.1 \times 10^{-2} MW^{-1}$

$B_{22} = 0.13 \times 10^{-2} MW^{-1}$

$B_{12} = -0.01 \times 10^{-2} MW^{-1}$

To raise total load on system by 1MW will cost additional Rs. 200 / hour.

Find :

i) Penalty factor of plant 1.

ii) Total transmission loss.

iii) Additional cost/hr to increase output of plant 1 by 1 MW.

11. a) Derive an expression for the reactance of Peterson coil in terms of the capacitance of the protected line. Calculate the reactance of the coil suitable for a 33 kV, 3 phase transmission line of which capacitance to earth of each conductor is 5 μF. Also calculate MVA rating of coil. **7**

b) Discuss the arcing ground. **6**

OR

12. a) Explain : **6**

i) Sub – Synchronous Resonance.

ii) Zig – zag transformer.

b) What is the necessity of compensation in power system? Name the compensating devices. **7**

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