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

Electrical Power System - II

P. Pages : 4 NRJ/KW/17/4599

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) The line-to-ground voltages on the high voltage side of a ste-up transformer are 100kV, 33kV 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 component of voltages. **7**

b) Symmetrical component transformation is power invariant. Justify. **6**

OR

2. A 300 MVA, 20 kV, 3-phase generator has a subtransient and zero sequence reactance of 20% and 5% respectively. The generator supplies two number of synchronous motor over 64 km transmission line having transformers at both ends as shown in single line diagram. current limiting reactors of 0.4Ω each are connected to the neutral of generator and larger motor. Ratings of each element of power system are given below: **13**

Motor M1 : 200 MVA, 13.2 kV, $X'' = 20\%$, $X_0 = 5\%$

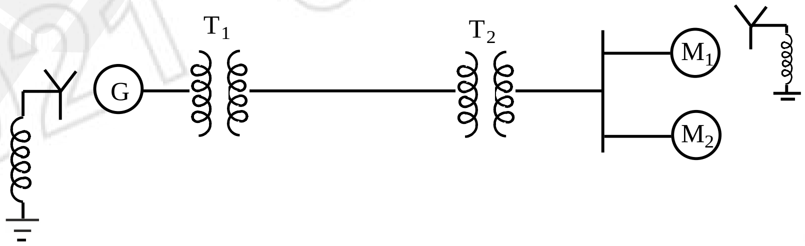
Motor M2 : 100 MVA, 13.2 kV $X'' = 20\%$, $X_0 = 5\%$

Transformer T1 : 350MVA, 220/20 kV, $X'' = 10\%$

Transformer T2 : 300 MVA, 220/13.2 kV, $X'' = 10\%$

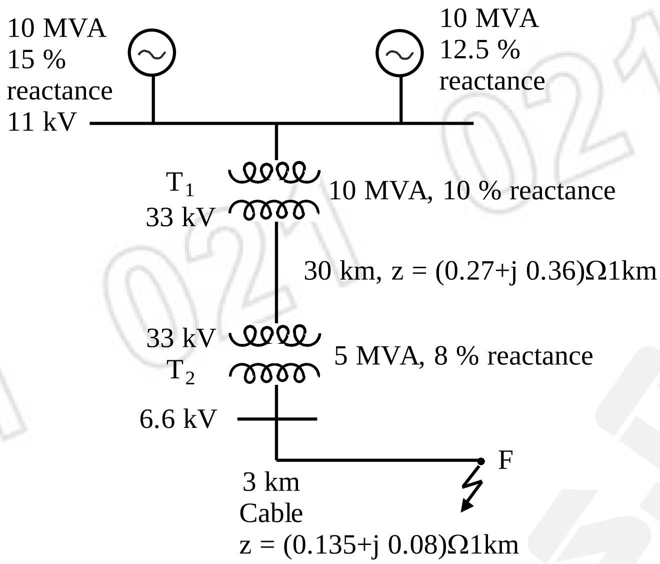
Transmission line : $X'' = 0.5\Omega/\text{km}$, $X_0 = 1.5\ \Omega/\text{km}$

Draw the positive, negative and zero sequence network for the system. Assume that all the negative sequence reactance equal to their subtransient reactances.



3. a) Explain the phenomenon of transient in transmission line if a synchronous generator is subjected to sudden three phase short circuit. Draw the circuit for subtransient period and show the oscillogram. **7**

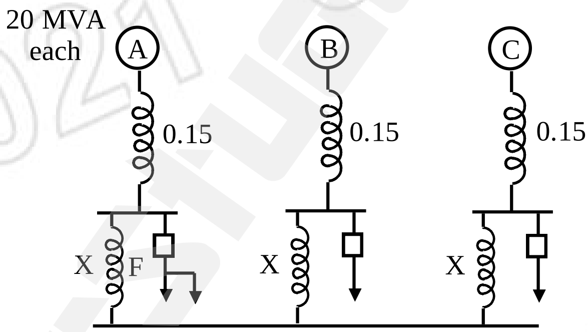
b) For the radial network shown in figure a three phase fault occurs at F. Determine the fault current and the line voltage at 11 kV bus under fault condition. **7**



OR

4. a) Discuss the types of current limiting reactors used in power system. **7**

b) In the following tie bar system of reactors, determine minimum value of reactor reactance for the circuit breaker rating of 200 MVA. The bus bar voltage is 11kV. **7**



5. a) Derive the relationship to determine the interconnection of sequence network for L – L fault. Also draw sequence network. **6**

b) A synchronous star connected generator of 25 MVA, 11kV is operating at no load at rated voltage. Its reactances are : $x_0 = 0.08\,\text{pu},\ x_1 = x_2 = 0.2\text{pu}$ **7**

i) Calculate symmetrical subtransient line current for L – G fault at the generator terminals if the neutral of generator is solidly grounded.

ii) Calculate the value of reactance to be included in the generator neutral and ground so that the L – G fault current equals 3-phase fault current.

OR

6. a) A generator having negligible resistance has the voltage behind transient reactance on open circuit equal to 1.1 p.u. The magnitudes of fault currents for three phase, L – L and L – G faults are 5 p. u. 4.55 p. u. and 6.6 p. u. respectively. Calculate the p. u. values of the sequence reactances of the generator. **7**

b) Compare L – G with 3 – phase fault if the fault takes place at the terminals of an unloaded synchronous generator. **6**

7. a) Derive swing equation of synchronous machine. **6**

b) A synchronous generator at 50 Hz is on load of 1 p. u. connected to infinite bus the maximum power transfer under healthy condition is 1.8 p.u. During fault maximum power transfer is 0.4 p. u. After clearence of fault the maximum power transfer is 1.3 p.u. **7**

Determine the critical clearing angle for stability. Derive the expression used.

OR

8. a) Enumerate the assumptions made in the analysis of transient stability using equal area criteria. **6**

b) A motor is receiving 25% of the power that it is capable of receiving from an infinite bus. If the load on the motor is doubled, calculate the maximum value of load angle δ during the swinging of the rotor around its new equilibrium position. **7**

9. a) Discuss the following: **5**

i) Penalty factor ii) Loss coefficients.

b) The fuel inputs per hour of plants 1 and 2 are given as, **8**

$F_1 = 0.2 P_1^2 + 40 P_1 + 120$ Rs. per hr.

$F_2 = 0.25 P_2^2 + 30 P_2 + 150$ Rs. per hr.

Determine the economic operating schedule and the corresponding cost of generation if the maximum and minimum loading on each unit is 100 MW and 25 MW, the demand is 180 MW and transmission losses are neglected. If the load is equally shared by both the units, determine the saving obtained by loading the units per equal incremental production cost.

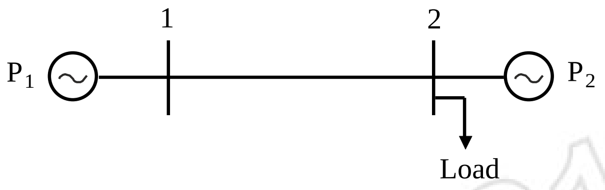
OR

10. a) Discuss optimum load dispatch including transmission losses. **6**

b) A two bus system is shown in fig. If a load of 125 mW is transmitted from plant 1 to the load, a loss of 15.625 mW is incurred. Determine the generation schedule and the load demand if the cost of received power is Rs. 24/mWhr. The incremental production costs of the plants are **7**

$$\frac{dF_1}{dP_1} = 0.025 P_1 + 15$$

$$\frac{dF_2}{dP_2} = 0.05 P_2 + 20$$



Solve the problem using coordination equations and the penalty factor method.

11. a) Discuss the advantages of neutral grounding. **8**

b) A 50 Hz overhead line has line to earth capacitance of 1μf. It is decided to use an earth fault neutralizer. Determine the reactance to neutralize the capacitance of **6**

i) 100% of the length of line
ii) 90% of the length of line
iii) 80% of the length of line

OR

12. a) Discuss briefly various compensations carried out in power systems. **7**

b) Mention various loads which require compensation. **7**

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