CBCS Scheme

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15EE62

Sixth Semester B.E. Degree Examination, June/July 2018
Power System Analysis – I

Time: 3 hrs. Max. Marks: 80

Note: ***Answer FIVE full questions, choosing one full question from each module.***

Module-1

1 a. With suitable example explain one line diagram and discuss the elements represented. **(06 Marks)**

b. Draw the per unit reactions diagram for the power system shown in Fig. Q1 (b). Selecting the generator rating as the base. Also find the generator terminal voltage.

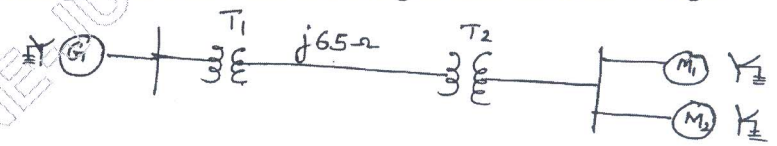

Fig. Q1 (b)

The ratings of the various components are,
G = 13.8 kV, 25 MVA, X″ = j0.15 pu ;
T_1 = 13.2/69 kV, 25 MVA, X = j0.11 pu; T_2 = 69/13.2 kV, 25 MVA, X = j0.11 pu;
M_1 = 13 kV, 15 MVA, X″ = j0.15 pu ; M_2 = 13 kV, 10 MVA, X″ = j0.15 pu
Determine the generator terminal voltage when both the motors operate at 12 kV 75% full load and unity power factor. **(10 Marks)**

OR

2 a. With help of typical electrical power system, explain impedance and reactance diagram and mention the assumptions made in that. **(06 Marks)**

b. The schematic diagram of a radial transmission system is shown in Fig. Q2 (b). The ratings and reactance of the various components are show there in. A load of 60 MW at 0.9 p.f lagging is tapped from 66 kV sub station which is to be maintained at 60 kV. Calculate the terminal voltages of the machine. Represent the transmission line and transformer by series reactance only. **(10 Marks)**

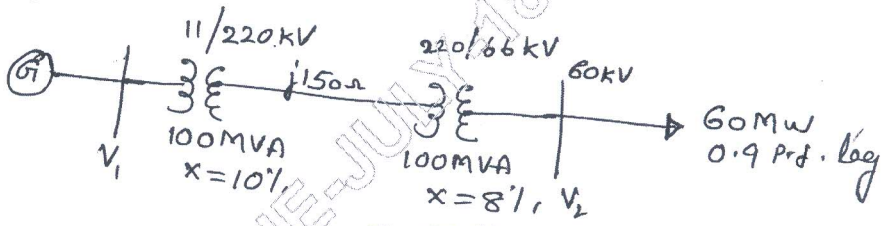

Fig. Q2 (b)

Module-2

3 a. What is the significance of transient and subtransient reactances in short circuit studies. Distinguish between transient and subtransient reactances of a synchronous machine. **(06 Marks)**

b. For the radial network shown in Fig. Q3 (b) a 3 phase fault occurs at point F. Determine the fault current, choose the generator ratings as base values:
Generator G_1: 10 MVA, 11 kV, X″ = 15% ; Generator G_2: 10 MVA, 11 kV, X″ = 12.5%
Transformer T_1 : 10 MVA, 11/33 kV, X = 10%; Transformer T_2 : 5 MVA, 33/6.6 kV, X= 8%
Overhead line impedance $z = +j\ \Omega$; Feeder impedance $z = (0.135 + j0.08)\ \Omega/km$ **(10 Marks)**

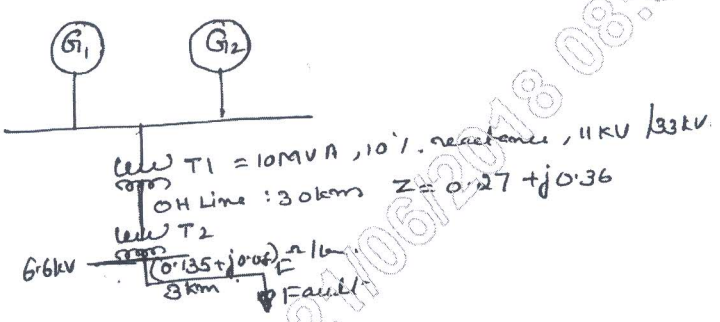

Fig. Q3 (b)

OR

4 a. What is doubling effect in a transmission line? Substantiate with equations. **(06 Marks)**

b. Generator G_1 and G_2 are identical and rated 11 kV, 20 MVA and have a transient reactance of 0.25 pu at own MVA base. The transformer T_1 and T_2 are also identical and are rated 11/66 kV, 5 MVA and have a reactance of 0.06 p.u. to their own MVA base. The tie line is 50 km long each conductor has a reactance of 0.848 Ω/km. The three phase fault is assumed at F, 20 km from generator G_1, as shown in Fig. Q4 (b). Find the short circuit current. **(10 Marks)**

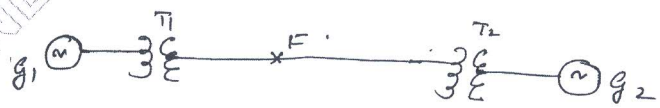

Fig. Q4 (b)

Module-3

5 a. What are symmetrical components and explain how they are useful in solving the power system problems. **(04 Marks)**

b. Prove that : (i) $\left(1+\alpha+\alpha^2\right)=0$ (ii) $\left(\alpha-\alpha^2\right)=j\sqrt{3}$ (iii) $\left(\alpha^2-\alpha\right)=-j\sqrt{3}$ **(04 Marks)**

c. A balanced delta connected load is connected to a 3 phase symmetrical supply. The line currents are each 10 A in magnitude. If fuse in one of the lines blows out. Determine the sequence components of line currents. **(08 Marks)**

OR

6 a. Explain the concept of phase shift in star delta transformer bank. **(06 Marks)**

b. Draw the positive, negative and zero sequence networks for the power system shown in Fig Q6 (b).

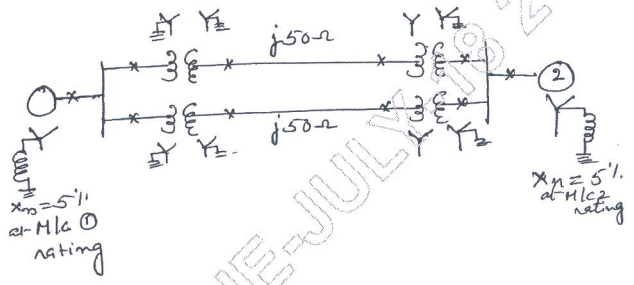

Fig. Q6 (b)

Choose a base of 50 MVA, 220 kV in the 50 Ω transmission lines and mark all reactances in p.u. The ratings of the generators and transformers are:

Generator 1 : 25 MVA, 11 kV, X″ = 20 % ; Generator 2 : 25 MVA, 11 kV, X″ = 20 %

Three phase transformer (each) : 20 MVA, $^{11Y}/_{220Y}$ kV, X = 15%

The negative sequences reactance of each syn machine is equal to the sub transient reactance. The zero sequence of each machine is 8%. Assume that the zero sequence of lines of lines are 250% of their positive sequence reactance. **(10 Marks)**

Module-4

7 a. Derive an expression for fault current when single line to ground fault occurs through a fault impedance Z_f in a power system. Draw the sequence network to represent the fault. **(10 Marks)**

b. For one conductor open fault in a power system, derive an expression for fault current. **(06 Marks)**

OR

8 a. What are the boundary/terminal condition in relation to the unsymmetrical faults. Mention the boundary conditions for LG, LL, LLL and LLG fault. **(06 Marks)**

b. A syn motor is receiving 10 MW of power at 0.8 pf lag at 6 kV. A LG fault takes place at the middle point of the transmission line as shown in Fig. Q8 (b), find the fault current. The ratings of the generator motor and transformer are as under.

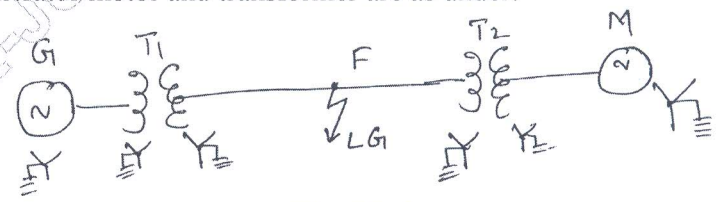

Fig. Q8 (b)

Generator: 20 MVA, 11 kV, $X_1 = 0.2$ pu, $X_2 = 0.1$ pu, $X_0 = 0.1$ pu

T_1 : 18 MVA, $^{11.5}/_{34.5}$ kV , $X = 0.1$ pu

T_2 : 15 MVA, $^{6.9}/_{34.5}$ kV , $X = 0.1$ pu

M : 15 MVA, 6.9 kV, $X_1 = 0.2$ pu, $X_2 = X_0 = 0.1$ pu

Transmission line : $X_1 = X_2 = 5\ \Omega$, $X_0 = 10\ \Omega$ **(10 Marks)**

Module-5

9 a. Briefly explain (i) Steady state stability (ii) Transient stability. **(06 Marks)**

b. A loss free alternator supplies 50 MW to an infinite bus, the SSSL being 100 MW. Determine if the alternator will remains stable if the input to the prime moves of the alternator is abruptly increased by 40 MW. **(10 Marks)**

OR

10 a. State and explain equal area criteria. What are the assumptions made in applying EAC? Discuss. **(06 Marks)**

b. The transfer reactances between a generator and an infinite bus bar operating at 200 kV under various conditions on inter connection are:

Prefault : 150 Ω per phase.

During fault : 400 Ω per phase

Past fault : 200 Ω per phase

If the fault is cleared when the rotor has advanced 60° electrical from the prefault position, determine the maximum load that could be transferred without loss of stability. **(10 Marks)**

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