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10EE61

Sixth Semester B.E. Degree Examination, June/July 2015
Power System Analysis and Stability

Time: 3 hrs. Max. Marks:100

Note: ***1. Answer any FIVE full questions, selecting atleast TWO questions from each part.***
2. Missing data, if any, may be suitably assumed.

PART – A

1 a. Define per unit quantity. Mention the advantages of per unit system. **(05 Marks)**

b. Show that the per unit reactance is same for both HV and LV side of a two winding transformer. **(05 Marks)**

c. The one line diagram of an unloaded generator is shown in Fig. Q1(c). Draw the PV reactance diagram. Choose a base of 50 MVA, 13.8 KV in the circuit of generator G_1. The ratings are an follows :

G_1 : 20 MVA, 13.8 KV, x" = 20% T_1 : 25 MVA, 13.8/220 KV, x = 10%
G_2 : 30 MVA, 18 KV, x" = 20% T_2 : 30 MVA, 220/18 KV, x = 10%
G_3 : 30 MVA, 20 KV, x" = 20% T_3 : 35 MVA, 220/22 KV, x = 10%. **(10 Marks)**

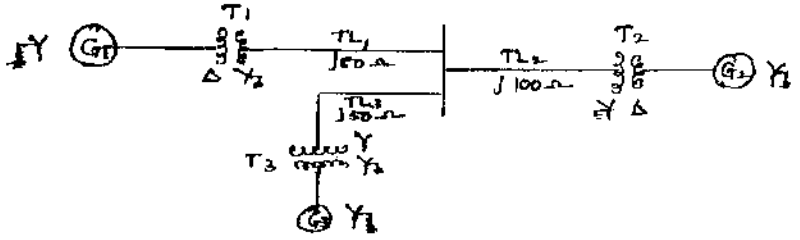

Fig.Q1(c)

2 a. With the oscillogram of the short circuit current of a synchronous machine, define sub transient reactance, transient and steady state reactances. **(10 Marks)**

b. For the system shown in the Fig. Q2(b). The ratings of the various components are :

G : 25 MVA, 12.4 KV, x''_d = 10%
M : 20 MVA, 3.8 KV, x''_d = 15%
T_1 : 25 MVA, 11/33 KV, x = 8%
T_2 : 25 MVA, 33/3.3 KV x = 10%
T line : 20 Ω reactance

The system is loaded such that, the motor is drawing 15 MW at 0.9 pf. leading, the motor terminal voltage being 3.1 KV. Find the sub-transient fault current at motor side. Choose 25 MVA as base power, 11 KV in the generator circuit. **(10 Marks)**

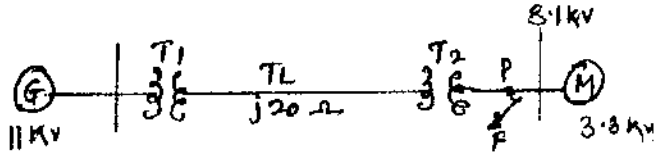

Fig.2Q(b)

3 a. Express symmetrical components interms of unbalanced phasors. **(06 Marks)**

b. Obtain an expression for the three – phase complex power in terms of sequence components. **(08 Marks)**

c. In a 3 phase, 3 wire system the line currents are $I_a = 100 \angle 0°A$ and $I_b = 100 \angle -100°A$. Determine the sequence components of a line currents. **(06 Marks)**

4 a. What are sequence impedances and sequence networks? **(04 Marks)**

b. Draw the zero sequence impedance network of a transformer for the following connection :

i) Y - Y ii) Y - Δ iii) Δ - Y iv) Δ - Δ

(08 Marks)

c. Draw the positive, negative and zero sequence network for the power system shown in Fig. Q4(c).

Choose a base of 50 MVA, 220 KV in the 50 Ω Transmission lines and marks all reactance's in PV. The ratings of the generator and transformers are :

G_1 : 25 MVA, 11 KV, x" = 20%

G_2 : 25 MVA, 11 KV, x" = 20%

3ϕ transformers (each) : 20 MVA, 11/220 KV, x = 15%

The negative sequence reactance of each synchronous machine is equal to the sub-transient reactance. The zero sequence reactance of a each machine is 8%. Assume that the zero sequence reactances of lines are 250% of their positive sequence reactances. **(08 Marks)**

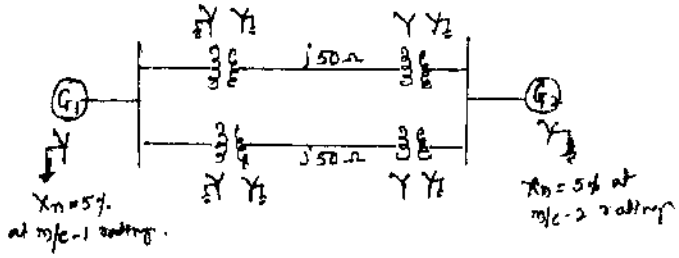

Fig. Q4(c)

PART – B

5 a. Define 'FAULTS' in power system. Give the classification of faults. **(04 Marks)**

b. Derive an expression for fault current, when single line to ground (SLG) fault occurs on an unloaded generator. **(08 Marks)**

c. A three phase generator with an open circuit voltage of 400 V is subjected to an SLG fault through a fault impedance of j2 Ω. Determine the fault current, if $Z_1 = j4\Omega$, $Z_2 = j2\Omega$ and $Z_0 = j1\Omega$. Repeat the problem for LL fault. **(08 Marks)**

6 a. Derive expression for fault current if line-line-ground (LLG) fault occurs through fault impedance Z_f in power system. Show the connection of sequence networks to represent the fault. **(10 Marks)**

b. Derive expression for fault currents for i) one conductor open fault ii) tow conductor open fault and draw the sequence network diagrams. **(10 Marks)**

7 a. Define stability pertaining to a power system and classify the different types of stability. **(04 Marks)**

b. Derive the power angle equation of a non salient pole synchronous machine connected to an infinite bus. Draw the power angle curve. **(10 Marks)**

c. A 2 pole, 50 Hz, 11 KV turbo alternator has a rating of 100 MW, 0.85 p.f. lagging. The rotor has a moment of inertia of 10000 kg-m^2. Calculate H and M. **(06 Marks)**

8 Write short notes on :

a. Swing equation

b. Steady state and transient stability

c. Equal area criterion for transient stability

d. Analysis of 3 ϕ IM with one line open. **(20 Marks)**

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