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06EE61

Sixth Semester B.E. Degree Examination, June 2012

Power System Analysis and Stability

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

1 a. Give brief answers for :
   i) What is a single line diagram?
   ii) Name the various divisions of a power system
   iii) Define per unit value
   iv) What is reactance diagram of a power system
   v) Write the expression for converting the per unit impedance expressed on one base to be changed over to another new base. **(10 Marks)**

b. Develop the bus admittance matrix for the system shown in Fig. Q1(b). All the live reactance are marked in p.u. **(10 Marks)**

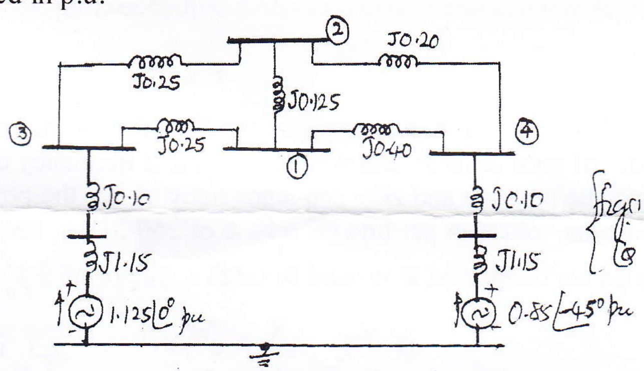

Fig. Q1(b)

2 a. Explain the following :
   i)Sub transient reactance ii) transient reactance iii) steady state reactance of a synchronous machine, and how these are measured in practice. **(10 Marks)**

b. A 25 MVA, 13.8 KV alternator with X_d^{11} = 15% is connected through a transformer to a bus that supplies four identical motors, as shown in Fig. Q2(b). Each motor is rated 5 MVA, 6.9 KV, X_d^{11} = 20% and $X_d^{'}$ = 30%. The transformer is of rating 25 MVA, 13.8 – 6.9 KV with X = 10%. The bus voltage at the motors in 6.9 KV. A three phase fault occurs at the point P. for the fault specified, determine :
   i) the subtransient fault in the fault
   ii) the subtransient fault in breaker A
   iii) the momentary current in breaker B.
   [chose a base of 25 MVA, 13.8 KV generator size] **(10 Marks)**

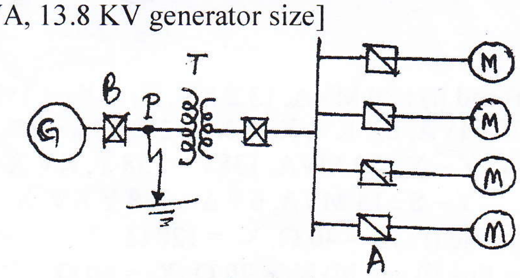

Fig. Q2(b)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

3 a. What are sequence impedances and sequence networks and show how the sequence reactance are obtained for the transmission line in terms of the self and mutual reactance. **(08 Marks)**

b. Across a symmetrical star connected load of z = 10 ohm per phase, a 3 –phase unbalanced system of voltage with $V_a = 220\angle 0^0$ $V_b = 200\angle -110^0$ V and $V_c = 180\angle 110^0$ V is applied. Determine the line currents if the system is a 4 – wire system. Also find the power in terms of symmetrical components. **(12 Marks)**

4 a. Explain the zero sequence representation of a 3-phase transformer connected for the following operation.

Fig. Q4(a)

Draw the winding diagrams and mark all the currents. **(08 Marks)**

b. A single phase load of 100 KVA is connected across lines B and C of a balanced 3 KV system. Compute the symmetrical components of line currents. **(08 Marks)**

c. Show that in a balanced system positive sequence components alone exits. **(04 Marks)**

PART – B

5 a. Define 'FAULTS' in power system, and how are the faults be classified and write them in the order of their severity and which is the most frequency occurring fault. **(08 Marks)**

b. Develop the positive and zero sequence network for the power system shown in Fig. Q5(b). Mark all the values in per unit on a base of 250 MVA, 138 KV. The neutrals of all rotating machines are connected to ground through a reactor of 5 $^1/_0$ based on their own rating.

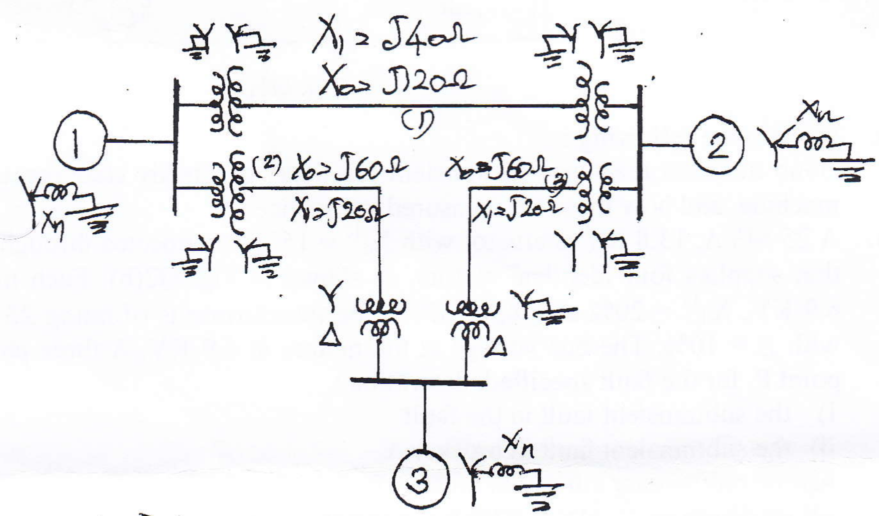

Fig. Q5(b)

The ratings of :

Generators i) and ii) : 20 MVA, 13.2 KV, $X_1 = X_2 = 15\%$, $X_0 = 8\%$

Motor iii) : 30 MVA, 6.9 KV, $X_1 = X_2 = 20\%$, $X_0 = 8\%$

Transformers : Y – Y : 20 MVA, 138Y – 138 Y, KV X = 10%

Y – S : 15 MVA, 6.9 Δ – 138 Y KV, X = 10%

Transmission line i) : $X_1 = 40\ \Omega$, $X_0 = 120\ \Omega$

Transmission line ii) and iii) $X_1 = 20\ \Omega$, $X_0 = 60\ \Omega$. **(12 Marks)**

6 a. An unloaded fully excited three phase alternator is subjected to an L–G fault at its terminals. Find the fault current, using symmetrical components by showing the interconnection of all the sequence networks. **(08 Marks)**

b. For the power system shown in Fig. Q4(b) double line to ground fault occurs at the middle of the transmission line circuit (point P). Find the total fault current, through symmetrical components on a base of 50 MVA, 220 KV in the generator circuit. **(10 Marks)**

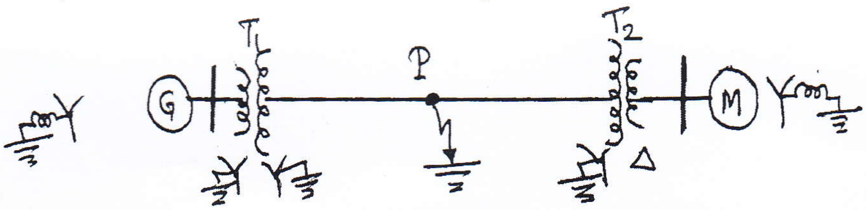

Fig. Q6(b)

The ratings are :

Generator (G) : 40 MVA, 25 KV,, $X'' = X_2 = 20\%$, $X_0 = 10\%$, $X_n = 2\%$

Motor (m) : 50 MVA, 11 KV, $X'' = X_2 = 30\%$, $X_0 = 15\%$, $X_n = 2\%$.

Transformer T_1 : 40 MVA, 33/220 KV, X = 15%

Transformer T_2 : 30 MVA, 11 /220 KV, X = 15%

Transmission line : $X_1 = X_2 = 50\ \Omega$, $= 150\ \Omega$.

7 a. Define :

i) Steady state stability
ii) Transient stability
iii) Swing curve and its use
iv) Critical clearing angle and time
v) Transient stability limit. **(10 Marks)**

b. Derive the power angle equation of a salient pore alternator connected to an infinite bus through an external reactance. Draw the vector diagram and the power angle characteristic and comment on the shape of his characteristics. **(10 Marks)**

8 a. Explain the concept of equal area criterion of stability of power system subjected to a fault. **(06 Marks)**

b. An alternator operating at 50Hz delivers 1 pu of power to an infinite bus through a transmission line. A fault takes place reducing the maximum power transferred to 0.50 pu, where as before the fault it was 2.0 pu and after the fault is cleared it is 1.50 pu. Calculate the critical clearing angle and hence # derive the formula used. **(14 Marks)**

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