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06EE61

Sixth Semester B.E. Degree Examination, May/June 2010
Power System Analysis and Stability

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. What is per unit quantity? Mention the advantages of per unit quantities. **(06 Marks)**

b. Show that per unit reactance of two winding transformer will remain same refereed to primary as well as secondary. **(06 Marks)**

c. Draw the per unit reactance diagram for the power system shown in Fig. Q1(c).

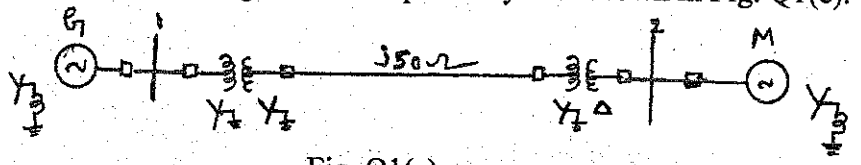

Fig. Q1(c)

The rating of the generator, motor and transformers are:
Generator : 40 MVA, 25 KV, X″ = 20%
Motor : 50 MVA, 11KVA, X″ = 30%
Y-Y transformer : 40 MVA, 33Y/220YKV, x = 15%
Y-Δ transformer : 30 MVA, 11Δ/220YKV, X = 15%
Use a base of 100 MVA, 220 KV in 50 Ω line. **(08 Marks)**

2 a. Determine Y_{BUS} by inspection method for the system details given in Table.1 **(06 Marks)**

Bus code	1 – 2	2 – 4	3 – 4	3 – 1	1 – 4
Series reactance of the line	j0.20	j0.25	j0.15	j0.10	j0.30

Table.1

b. Explain clearly, how circuit breakers are rated? **(06 Marks)**

c. A generator is connected to a synchronous motor through transformer. Reduced to a common base, the per unit sub transient reactances of generator and motor are 0.15 and 0.35 pu respectively. The leakage reactance of the transformer is 0.1 pu. A 3ϕ short circuit fault occurs at terminals of the motor when terminal voltage of generator is 0.9 pu and output current of the generator is 1 pu at 0.8 pf leading. Find the sub transient current in the fault, generator and motor. **(08 Marks)**

3 a. What are symmetrical components? How they are useful in solution of power system. **(04 Marks)**

b. Derive an expression for the 3ϕ complex power in terms of symmetrical components. **(08 Marks)**

c. A delta connected balanced resistive load is connected across a balanced 3ϕ supply as shown in Fig.Q3(c), with currents in lines A and B specified. Find the symmetrical components of the currents. **(08 Marks)**

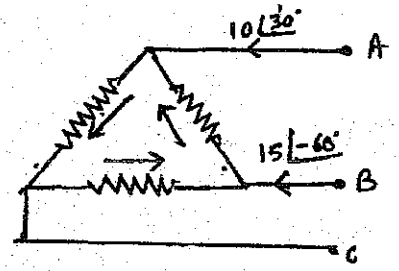

Fig.Q3(c)

4 a. With the help of relevant vector diagrams for voltages and currents, establish the phase shift of symmetrical components in Y - Δ transformer. **(12 Marks)**

b. What are sequence impedances and sequence networks? Draw the zero sequence networks for different combinations of 3ϕ transformer bank. **(08 Marks)**

PART – B

5 a. What are the different types of faults occurring in electrical power system and probability of occurrence? List out in the ascending order of their severity. **(04 Marks)**

b. A double line to ground fault occurs at the terminals of an unloaded generator. Derive an expression for the fault currents. Also draw connection of sequence networks. **(10 Marks)**

c. Discuss briefly the open-conductor faults in power system. **(06 Marks)**

6 A single-line to ground fault occurs at mid point F of transmission line in power system shown in Fig.Q6. Determine the fault current in pu and in amperes from the generator if the system were on no load and at a voltage of 100 KV at the fault point.

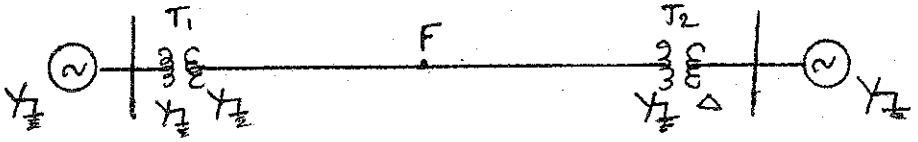

Fig.Q6

The ratings are:
Generator : 11.5 KV, 50 MVA, $X_1 = 0.3$ pu, $X_2 = 0.2$ pu, $X_0 = 0.1$ pu
Motor : 6 KV, 55 MVA, $X_1 = 0.4$ pu, $X_2 = 0.3$ pu, $X_0 = 0.2$ pu
Line : $X_1 = X_2 = 48.5\ \Omega$, $X_0 = 90\ \Omega$
Transformer – T_1 : 11/110 KV, 45 MVA, X = 0.1 pu
Transformer – T_2 : Consists of three single phase units each rated 20 MVA, 66 KV/6.6 KV, X = 10%.
Use base of 60 MVA, 110 KV in transmission line. **(20 Marks)**

7 a. Differentiate between steady state and transient state stability of a power system. Can these stability limits have multiple values? **(06 Marks)**

b. Derive the power angle equation of salient pole m/c connected to infinite bus. **(06 Marks)**

c. Derive swing equation with usual notation. **(08 Marks)**

8 a. Briefly explain the methods of improving steady state and transient state stability of a power system. **(04 Marks)**

b. Explain the equal area criterion for investigating the stability of power system. **(08 Marks)**

c. An ac generator is delivering 50% of maximum power to an infinite bus. Due to a sudden short circuit, the reactance between generator and infinite bus increases to 500% of the value before fault. The maximum power that can be delivered after clearance of the fault is 75% of the original value. Calculate the critical clearing angle to maintain the stability of the system. **(08 Marks)**

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