USN | | | | | | | | | | |

10EE61

Sixth Semester B.E. Degree Examination, Dec.2016/Jan.2017
Power System Analysis & Stability

Time: 3 hrs. Max. Marks:100

Note: *1. Answer any FIVE full questions, selecting atleast TWO questions from each part.*
2. Assume missing data, if any suitably.

PART – A

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

b. What is single line diagram? Explain how to obtain impedance and reactance diagrams from single line diagram of a power system. **(06 Marks)**

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

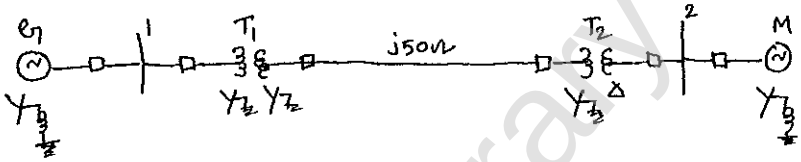

Fig.Q1(c)

Use a base of 100 MVA, 220 kV in 50Ω line.
The ratings of the generator, motor and transformers are
Generator : 40 MVA, 25 kV, X″ = 20%
Motor : 50 MVA, 11 kV, X″ = 30%
Y – Y Transformer : 40 MVA, 33Y / 220Y kV, X = 15%
Y – Δ Transformer : 30 MVA, 11Δ / 220Y kV, X = 15% **(08 Marks)**

2 a. Discuss the different types of faults in Power system. **(04 Marks)**

b. Explain clearly, how circuit breakers are rated? **(08 Marks)**

c. A generator is connected to a synchronous motor through transformer. Reduced to a common base, the per unit subtransient 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 generator is 1 pu at 0.8 p.f. leading. Find the subtransient 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 & B specified. Find the symmetrical components of the currents. **(08 Marks)**

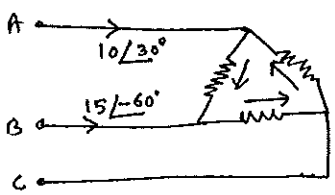

Fig.Q3(c)

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 network? Draw the zero sequence networks for different combinations of 3ϕ transformer bank. **(08 Marks)**

PART – B

5 a. Mention the different types of faults occurring in electrical power system and their probability of occurrence. **(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 about 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(a). Determine the fault current in pu and in amperes from generator if the system were on no load and at a voltage of 100 kV at the fault point.

Fig.Q6(a)

The ratings are
Generator : 11.5 kV, 500 MVA, $X_1 = 0.3$ pu, $X_2 = 0.2$ pu, $X_0 = 0.1$ pu
Transformer – T_1 : 11/110 kV, 45 MVA, $X = 0.1$ pu
Transformer – T_2 : Consists of 3 single phase units each rated
20 MVA, 66/6.6 kV, $X = 10\%$
Motor : 6 kV, 55 MVA, $X_1 = 0.4$ pu, $X_2 = 0.3$ pu, $X_0 = 0.2$ pu
Line : $X_1 = X_2 = 48.5\ \Omega$, $X_0 = 90\ \Omega$
Choose a 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 swing equation with usual notation. **(08 Marks)**

c. Explain the equal area criterion for investigating the stability of power system. **(06 Marks)**

8 a. 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)**

b. Explain the analysis of 3ϕ induction motor with one line open. **(06 Marks)**

c. Explain the analysis of 3ϕ induction motor with unbalanced voltage. **(06 Marks)**

* * * * *