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10EE61

Sixth Semester B.E. Degree Examination, June/July 2016
Power System Analysis and Stability

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Show that per unit impedance of two winding transformer will remain same referred to primary as well as secondary. **(06 Marks)**

b. List the advantages of per unit system. **(04 Marks)**

c. A 300 MVA, 20 KV, 3 phase generator has subtransient reactance of 20%. The generator supplies two synchronous motors through a 64 km transmission line having transformers at both ends as shown in Fig. Q1(c), T_1 is a 3 phase transformer and T_2 is composed of 3 single phase transformers of rating 100 MVA each, 127/13.2 KV, 10% reactance. Series reactance of transmission line is 0.5 ohm/km. Draw the reactance diagram with all reactances marked in per unit. Select generator rating as base values. **(10 Marks)**

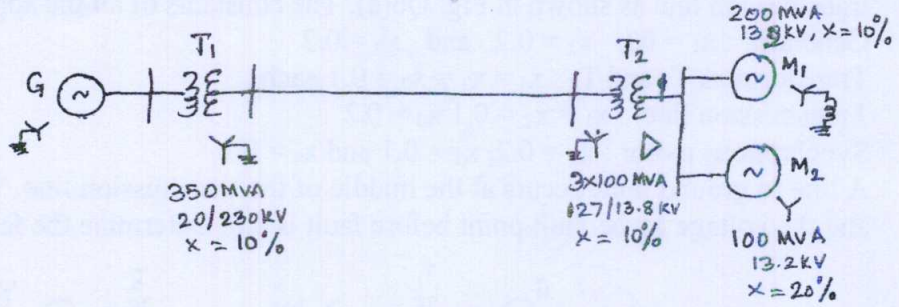

Fig. Q1(c)

2 a. A sudden three phase short circuit takes place at the terminals of an unloaded three phase alternator. Discuss briefly on different reactance's that are met with assuming that the damper windings are provided at the pole faces of the alternator. **(08 Marks)**

b. A synchronous generator and motor are rated 30 MVA, 13.2 KV and both have subtransient reactances of 20%. The line connecting them has a reactance of 10% on the base of the machine ratings. The motor is drawing 20MW at 0.8 power factor leading and a terminal voltage of 12.8 KV when a symmetrical three phase fault occurs at the motor terminals. Find the subtransient current in the generator, motor and the fault by using internal voltages of the machines. **(12 Marks)**

3 a. The phase voltages of a three phase system are $V_a = 100 \angle 0$, $V_b = 33 \angle -100$, $V_c = 38 \angle 176.5$ all in volts. Compute the symmetrical components of voltages. **(06 Marks)**

b. Obtain the relationship between line and phase sequence components of voltages in star connection. Give the relevant phasor diagrams. **(08 Marks)**

c. Obtain an expression for power interms of sequence components of line to neutral voltages and line currents. **(06 Marks)**

4 a. A delta connected resistive load is connected across a balanced three phase supply of 400 V as shown in Fig.Q4(a). Find the symmetrical components of line currents and phase currents. **(08 Marks)**

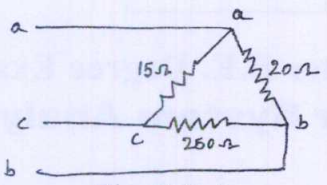

Fig. Q4(a)

b. Show that in symmetrical systems, currents of a given sequence produce voltage drops of the same sequence. **(06 Marks)**

c. Explain measurement of negative sequence impedance of synchronous generator. **(06 Marks)**

PART – B

5 a. For a double line to ground fault on an unloaded generator, derive the equation for the fault current and draw the interconnected sequence network. **(10 Marks)**

b. A 400V, star connected, neutral grounded three phase generator is subjected to various types of faults. The fault currents for various types of faults are :
i) Three phase, 120 ampere ii) Line to line, 150 amp iii) line to ground, 250 amp. If the resistances are neglected, determine the three sequence impedances and fault current for a double line to ground fault. **(10 Marks)**

6 a. An alternator is connected to a synchronous motor through two transformers and a transmission line as shown in Fig. Q6(a). The constants of all the apparatus in p.u are :
Generator : $x_1 = 03$, $x_2 = 0.2$ and $x_0 = 0.2$
Transformers T_1 and T_2 : $x_1 = x_2 = x_0 = 0.1$ each
Transmission line : $x_1 = x_2 = 0.1$ $x_0 = 0.2$
Synchronous motor : $x_1 = 0.2$, $x_2 = 0.1$ and $x_0 = 0.1$
A line to ground fault occurs at the middle of the transmission line. The system is on no load and the voltage at the fault point before fault is 1.0. Determine the fault currents. **(12 Marks)**

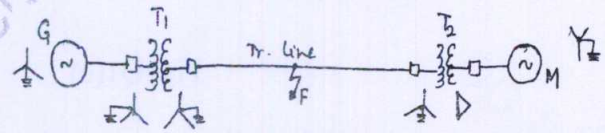

Fig. Q6(a)

b. Explain open conductor faults in power systems. **(08 Marks)**

7 a. Define the following :
i) Steady state stability
ii) Transient stability
iii) Steady state stability limit
iv) Transient stability limit. **(08 Marks)**

b. Derive swing equations with usual notations. **(06 Marks)**

c. Explain equal area criterion concept, when a power system is subjected to sudden increase in load. **(06 Marks)**

8 a. Analyse the operations of three phase induction motor when one line gets opened. Derive the torque and output power equations. **(10 Marks)**

b. A 400V, 6 pole, 50 Hz, 3 phase induction motor with $R_s = R_r = 0.5\Omega$ and $x_s = x_r = 2\ \Omega$ runs at a slip at 0.06. When are line gets open? Determine the power output and torque developed. **(10 Marks)**

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