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10EE61

Sixth Semester B.E. Degree Examination, Dec.2018/Jan.2019

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. Draw the PU Reactance diagram for power system shown in Fig.Q1(a). Select the base values of 20 MVA, 6.6 KV in the generator 1 circuit. The ratings of various components are:
Generator 1: 10 MVA, 6.6 KV, X″ = 0.1 p.u
Generator 2: 20 MVA, 11.5 KV, X″ = 0.1 p.u
Transformer T_1 = 10 MVA, 3 phase, 6.6/115 KV, X = 0.15 p.u.
Transformer T_2 = 3 single phase units each rated 10 MVA, 7.5/75 KV, X = 0.1 pu.

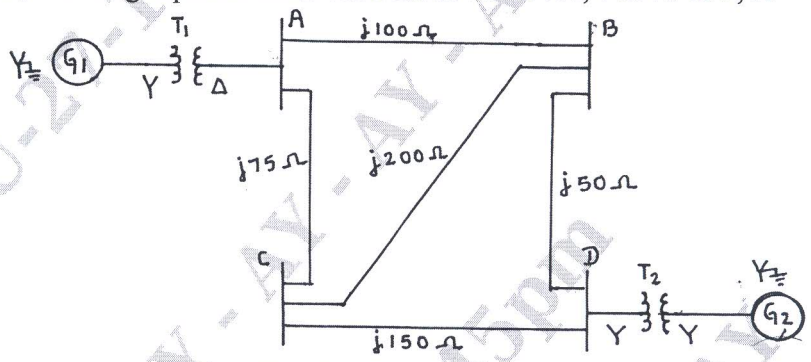

Fig.Q1(a) **(12 Marks)**

b. What are the advantages of per unit quantities? Show that:

$$\text{PU reactance}_{new} = \text{PU reactance}_{given} \frac{\text{base MVA}_{new}}{\text{base MVA}_{old}} \times \frac{\text{base KV}^2_{old}}{\text{base KV}^2_{new}}.$$ **(08 Marks)**

2 a. Explain in detail the transients on a transmission line due to short circuit. **(08 Marks)**

b. A transmission line of inductance L = 0.1 H and resistance R = 5Ω is suddenly short circuited at t = 0, at the far end of the line as shown in Fig.Q2(b). If the source voltage is $v = 100\sin(100\pi t + 15)$. Obtain the following:

i) Expression for the short circuit current, i(t)
ii) Value of the first current maximum (maximum momentary current).
iii) Instant of short circuit so that DC off set current is zero.
iv) Instant at which DC offset current is maximum.

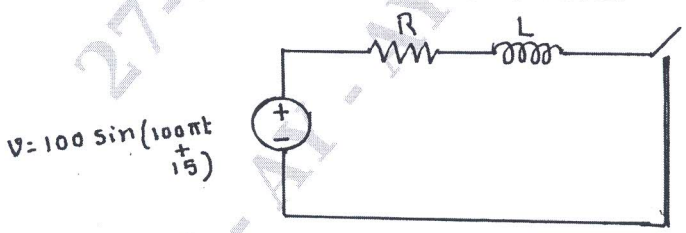

Fig.Q2(b) **(12 Marks)**

3 a. Derive the relation between sequence components of phase and line voltages in star connected systems. **(08 Marks)**

b. A delta connected balanced resistive load is connected across an unbalanced 3 phase supply as shown in Fig.Q3(b). With currents in lines A and B specified, find the symmetrical components of line currents. Also, find the symmetrical components of delta currents (phase-currents).

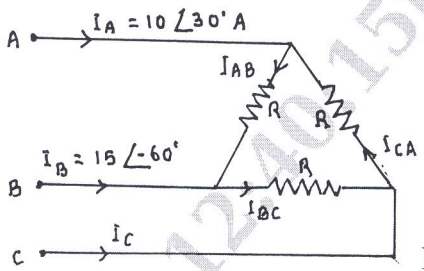

Fig.Q3(b) **(12 Marks)**

4 a. Draw the positive, negative and zero sequence network for the power system shown in Fig.Q4(a). Choose a base of 50 MVA, 220 KV in the j50Ω transmission line and mark all reactances in per unit. The ratings of generators and transformers are
Gen 1: 25 MVA, 11 KV, X″ = 20%
Gen 2 : 25 MVA, 11 KV, X″ = 20%
Transformers (each) : 20 MVA, 11Y/220Y KV, X = 15%. The negative sequence reactance of each synchronous machine is equal to the sub transient reactance. The zero sequence reactance of each machine is 8%. Assume that the zero sequence reactance of lines are 250% of their positive sequence reactance.

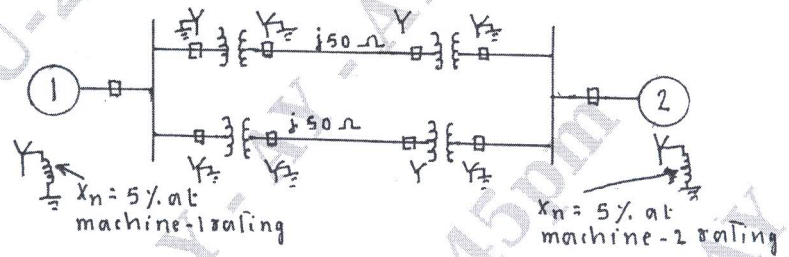

Fig.Q4(a) **(14 Marks)**

b. Derive an expression for complex power in terms of symmetrical components. **(06 Marks)**

PART – B

5 a. Derive an expression for fault current in case of double line to ground fault on an unloaded generator. Draw the interconnection of sequence network. **(10 Marks)**

b. A 3 phase generator with constant internal voltages gave the fault current values 1.4 KA for a L-L fault and 2.2 KA for a L-G fault. If E_{as} = 2 KV, X_1 = 2Ω, determine the reactance X_2 and X_0. **(10 Marks)**

6 a. A salient pole generator without dampers is rated 20 MVA, 13.8 KV and has a direct axis subtransient reactance of 0.25 per unit. The negative and zero sequence reactances are 0.35 and 0.10 per unit respectively. The neutral of the generator is solidly grounded. Determine the subtransient current in the generator and the line to line voltages for subtransient conditions when a single line to ground fault occurs at the generator terminals with the generator operating unloaded at rated voltage. Neglect resistance. **(14 Marks)**

b. Write a note on series type of faults. **(06 Marks)**

7 a. Derive an expression for swing equation. **(10 Marks)**

b. A loss free alternator supplies 50 MW to an infinite bus. The SSSL being 100 MW, determine if the alternator will remain stable if the input to the prime mover of the alternator is abruptly increased by 40 MW. **(10 Marks)**

8 a. Explain equal area criterion when there is sudden change in input. **(10 Marks)**

b. Analyze in detail the 3 phase induction motor with unbalanced voltage. **(10 Marks)**