CBCS SCHEME

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18EE62

Sixth Semester B.E. Degree Examination, July/August 2022
Power System Analysis - I

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Draw the per phase basis, representation of synchronous machine , transmission line 2nd transformer. **(06 Marks)**

b. Derive an equation for per unit impedance if a change of base occurs. **(06 Marks)**

c. The schematic diagram of a radial transmission system is shown in Fig. Q1(c). The ratings and reactance of the various components are shown there in. A load of 60MW at 0.9 p.f. lagging is tapped from 66KV substation which is to be maintained at 60KV. Calculate the terminal voltages of the machine. Represent the transmission line and transformer by series reactance only. **(08 Marks)**

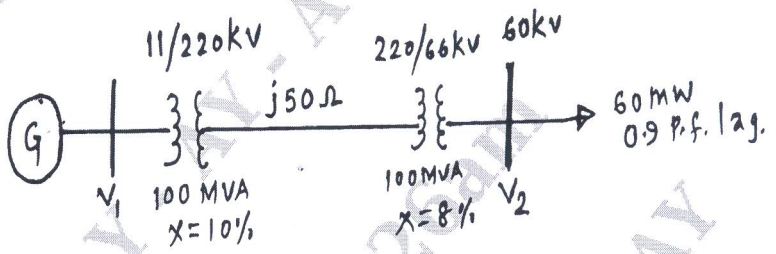


Fig. Q1(c)

OR

2 a. Define per unit quantity. What are the advantages of P.U system? **(06 Marks)**

b. Show that per unit impedance of a transformer is the same irrespective of the side of which it is calculated. **(06 Marks)**

c. Draw the reactance diagram for the system shown if Fig. Q2(c). The ratings of the components are :

Generator G : 15 MVA , 6.6 KV , X" = 12%.
Transformer T_1 : 20 MVA , 6.6/66 KV , X = 8%.
Transformer T_2 : 20 MVA , 6.6/66 KV , X = 8%.
Motors M_1 & M_2 : 5 MVA , 6.6 KV , X" = 20%.
Select the ratings of the generator as base values. **(08 Marks)**

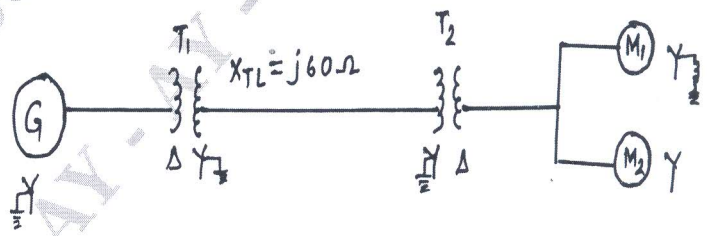


Fig. Q2(c)

Module-2

3 a. What is Doubling effect in transmission line? Substantiate with equations. **(08 Marks)**

b. For the radial network shown in Fig. Q3(b), a three phase fault occurs at F. Determine the fault current and the line voltage at 11KV bus under fault conditions. **(12 Marks)**

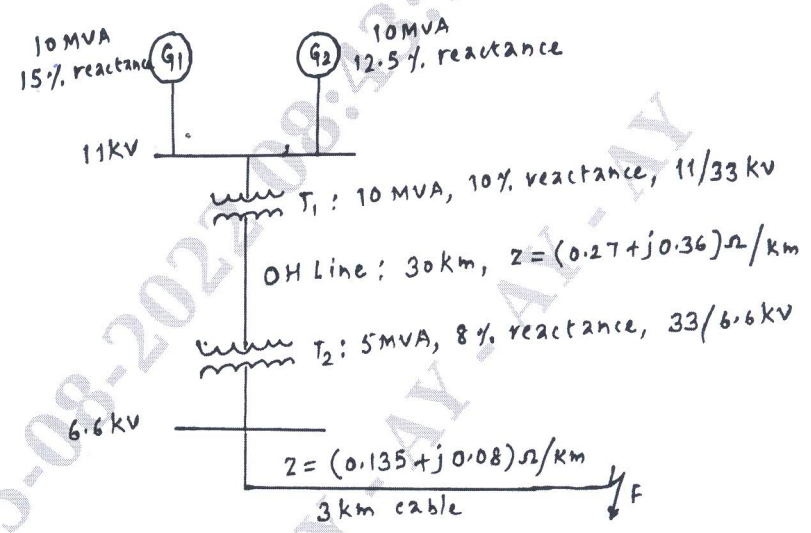


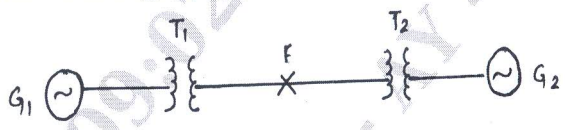
Fig. Q3(b)

OR

4 a. With the Oscillogram of the short circuit current of synchronous machine, define direct axis synchronous reactance , transient and subtransient reactance. **(08 Marks)**

b. Generator G_1 amd G_2 are identical and rated 11KV, 20 MVA and have transient reactance of 0.25 p.u. at own base. The transformer T_1 and T_2 are also identical and are rated 11/66 KV, 5MVA and have a reactance of 0.06 p.u. to their own MVA base. The tie – line is 50km long each conductor has a reactance of 0.848Ω/km. The three – phase fault is assumed at F, 20 km from generator G_1 as shown in Fig. Q4(b). Find the short circuit current. **(12 Marks)**

Fig. Q4(b)



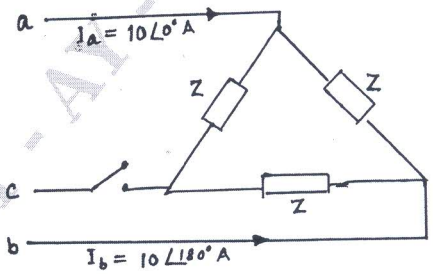
Module-3

5 a. Derive an expression for phase voltage in terms of symmetrical components. **(06 Marks)**

b. Derive an expression for complex power interms of symmetrical components. **(04 Marks)**

c. A balanced delta connected load is connected to three phase symmetrical supply. The line currents are each 10A in magnitude. If fuse in one of the lines blows out, determine the sequence components of line currents. **(10 Marks)**

Fig. Q5(c)



OR

6 a. Explain the concept of phase shift in star – delta transformer bank. **(06 Marks)**

b. What are Symmetrical components? Explain how they are useful in solving the power system problems. **(04 Marks)**

c. A single – phase resistive load of 100 KVA is connected across line bC of a balanced supply of 3KV. Compute the symmetrical components of line currents. **(10 Marks)**

Module-4

7 a. Discuss "Open Conductor Faults". **(10 Marks)**

b. Derive an expression for L – L – G fault occurs through the fault impedance (Z_f) in a power system. Show the inter connection of sequence network. **(10 Marks)**

OR

8 a. Derive an expression for fault current when an line – to – line (L-L) fault occurs on the terminals of an unloaded generator. **(08 Marks)**

b. A 25 MVA, 11KV, three phase generator has a sub transient reactance of 20%. The generator supplies two motors over a transmission line with transformer at both ends as shown in Fig. Q8(b). The motors have rated input of 15 and 7.5 MVA, both 10KV with 25% sub transient reactances. The three phase transformers are both rated 30MVA, 10.8/121 KV, connection Δ - Y with leakage reactance of 10% each. The series reactance of line is 100Ω. Calculate the fault current when L – G fault occurs at F. The motors are loaded to draw 15 and 7.5 MW at 10KV and 0.8 p.f loading. Assume that the negative sequence reactance is equal to positive sequence reactance. The zero sequence reactances are shown in the Fig. Q8(b). Omit resistance. **(12 Marks)**

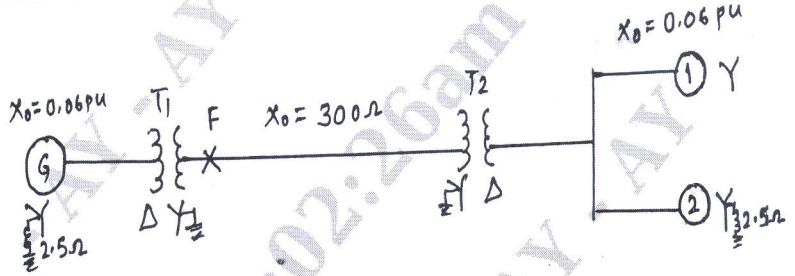


Fig. Q8(b)

Module-5

9 a. Briefly explain : i) Steady state stability ii) Transient stability. **(06 Marks)**

b. State and explain Equal Area Criterion. What are the assumptions made in applying EAC? Discuss. **(06 Marks)**

c. The transfer reactances between a generator and an infinite bus bar operating at 200 KV under various conditions on inter connection are :

Prefault : 150 Ω per phase.

During fault : 400 Ω per phase.

Post fault : 200 Ω per phase.

If the fault is cleared when the rotor has advanced 60° electrical from the prefault position, determine the maximum load that could be transferred without loss of stability. **(08 Marks)**

OR

10 a. Derive an expression for Swing equation. **(06 Marks)**

b. A two pole, 50Hz , 11KV turbo alternator has a rating of 100MW, power factor 0.85 lagging. The rotor has a moment of inertia of 10,000 kg.m^2. Calculate H and M. **(08 Marks)**

c. Derive Power Angle equation of non – salient pole synchronous machine connected to an infinite bus. Draw the power angle curve. **(06 Marks)**

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