CBCS SCHEME

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18EE62

Sixth Semester B.E. Degree Examination, June/July 2025
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. Define per unit quantity. What are the advantages of per unit systems? **(08 Marks)**

b. Draw the reactance diagram of the system shown in Fig.Q.1(b). The ratings of the components are,
G : 15 MVA, 6.6 KV, $X^{11} = 12\%$
T_1 = 20 MVA, 6.6/66 KV, X = 8%
T_2 = 20 MVA, 66/6.6 KV, X = 8%
M_1 and M_2 : 5 MVA, 6.6 KV, $X^{11} = 20\%$

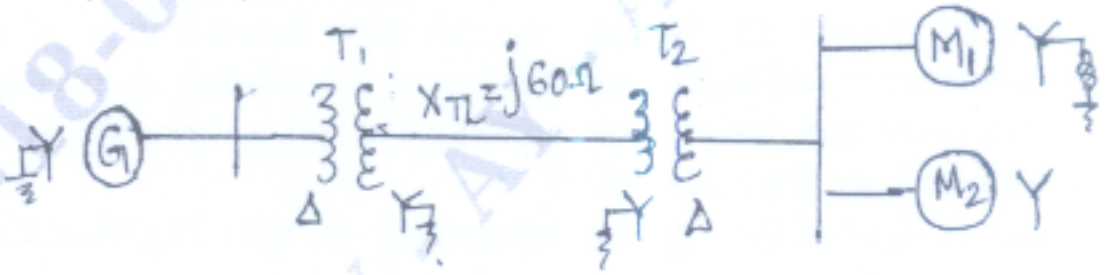

Fig.Q.1(b)

Choose base power $(MVA)_B$ = 15 MVA
Base voltage on generator = 6.6 KV. **(12 Marks)**

OR

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

b. The one line diagram of an unloaded generator is shown in Fig.Q.2(b). Draw the impedance diagram. Choose a base of 50 MVA, 13.8 KV in the circuit of generator G_1.

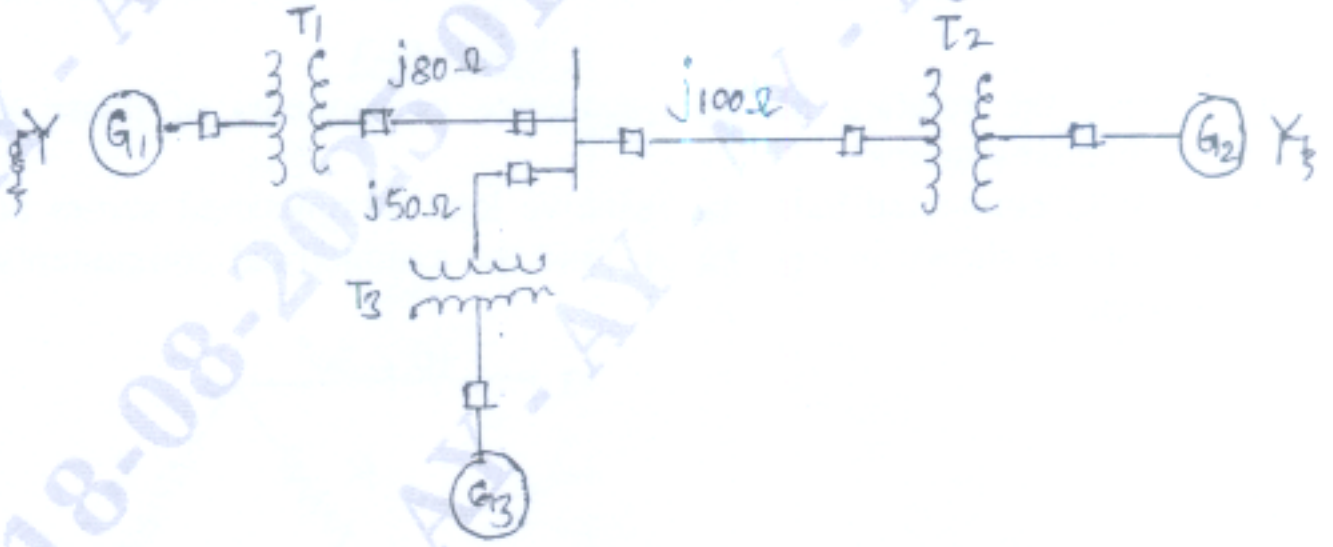

Fig.Q.2(b)

G_3 = 30 MVA, 20 KV, X^{11} = 0.2 PU
T_3 = 35 MVA, 220 KV / 22 KV, X = 10%
The generators and transformer ratings are:
G_1 = 20 MVA, 13.8 KV, X^{11} = 0.2 PU
G_2 = 30 MVA, 18 KV, X^{11} = 0.2 PU
T_1 = 25 MVA, Y 220 KV/13.8 KV Δ, X = 10%
T_2 = 3 1ϕ units each rated 10 MVA, 127/18 KV, X = 10% **(14 Marks)**

Module-2

3 a. With the oscillogram of the short circuit current-of synchronous machine, define direct axis synchronous reactance and subtransient reactance. **(10 Marks)**

b. A three-phase, 5 MVA, 6.6 KV alternator with reactance of 8% is connected to a feeder of series impedance of (0.12 + j0.48) ohms/phase per km. The transformer is rated at 3 MVA, 6.6 KV/33 KV and has a series reactance of 5%. Determine the fault current supplied by the generator operating under no load with a voltage of 6.9 KV, when a three-phase symmetrical fault occurs at a point 15 km along the feeder. Choose generator rating as base values. **(10 Marks)**

OR

4 a. Explain in detail the transients on a transmission line due to short circuit. **(10 Marks)**

b. Two generators are connected in parallel to the low voltage side of a three phase Δ-Y transformer as shown in Fig.Q4(b). Generator 1 is rated 50,000 KVA, 13.8 KV. Generator 2 is rated 25,000 KVA, 13.8 KV. Each generator has a subtransient reactance of 25%. The transformer is rated 75,000 KVA, 13.8 Δ / 69 Y KV, with a reactance of 10 %. Before the fault occurs, the voltage on the high tension side of the transformer is 66 KV. The transformer is unloaded and there is no circulating current between the generators. Find the subtransient current in each generator when a three phase short circuit occurs on the high tension side of the transformer.
Select as base in the high tension circuit 69 KV, 75,000 KVA.

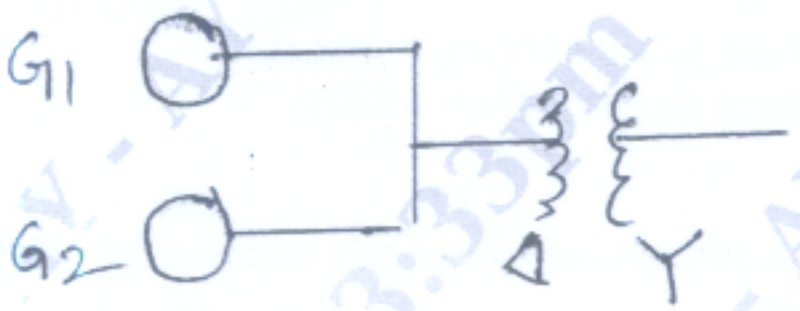

Fig.Q.4(b)

(10 Marks)

Module-3

5 a. Derive the relation between sequence components of phase and line voltages in star connected systems. **(10 Marks)**

b. A delta connected balanced resistive load is connected across an unbalanced three phase supply as shown in Fig.Q.5(b). Find the symmetrical components of line current and delta current.

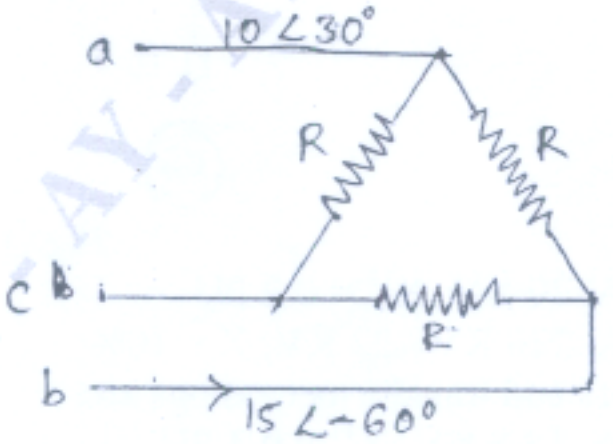

Fig.Q.5(b)

(10 Marks)

OR

6 a. Derive an expression for complex power in terms of symmetrical components. **(10 Marks)**

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

Module-4

7 a. Derive an expression for fault current when a Line to Line (LL) fault occurs on the terminals of an unloaded generator. **(10 Marks)**

b. A salient-pole generator without dampers is rated 20 MVA, 13.8 KV and has a direct axis sub transient reactance of 0.25 PU. The negative and zero-sequence reactances are, respectively, 0.35 and 0.10 per unit. 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. **(10 Marks)**

OR

8 a. Derive an expression for LLG fault occurs through fault impedance (z_f) in a power system. Show the interconnection of sequence networks. **(10 Marks)**

b. A three phase generator with line-line voltages of 400 V is subjected to an LLG fault. If $z_1 = j2\ \Omega$, $z_2 = j0.5\ \Omega$ and $z_0 = j0.25\ \Omega$, determine the fault current and terminal voltages. **(10 Marks)**

Module-5

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

b. Explain equal area concept when power system is subjected to sudden change in input. **(10 Marks)**

OR

10 a. Explain power angle equation of a non-salient pole synchronous machine. **(10 Marks)**

b. Explain equal area concept when a power system is subjected to sudden loss of one of the parallel lines. **(10 Marks)**

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