CBCS SCHEME

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15EE62

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

Time: 3 hrs. Max. Marks: 80

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 P.U system? **(06 Marks)**

b. The single line diagram of an unloaded generator is shown in below Fig Q1(b). Draw the per unit impedance diagram, choose a base of 50MVA, 13.8kV in the generator G_1 circuit. The generator and transformer rating are as follows :

G_1 : 20MVA, 13.8kV $X'' = 0.2$ PU
G_2 : 30MVA, 18 kV $X'' = 0.2$ PU
G_3 : 30MVA, 20 kV $X'' = 0.2$ PU
T_1 : 25MVA 220/13.8kV $X = 10\%$
T_2 : Bank of 3 – single phase units each rated 10MVA, 127/18kV $X = 10\%$
T_3 : 35MVA 220/22 kV $X = 10\%$.

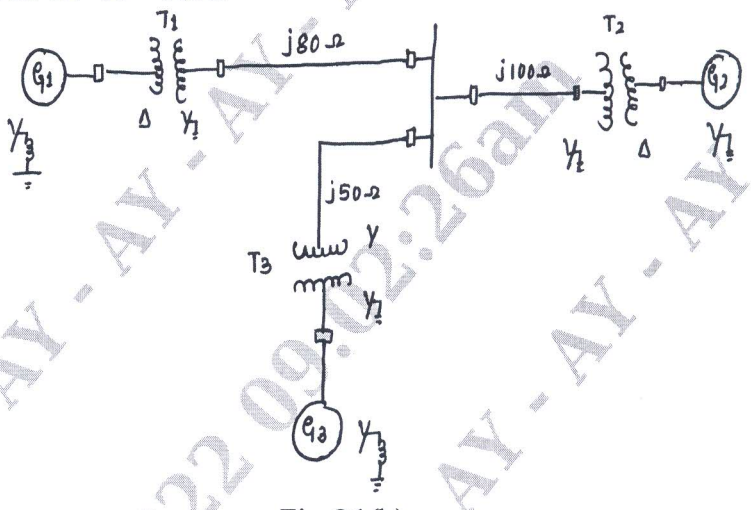

Fig Q1(b) **(10 Marks)**

OR

2 a. Show that the per-unit impedance of a transformer is the same when referred to either its primary side or the secondary side. **(06 Marks)**

b. A single line diagram of a three phase power system as shown in Fig Q2(b). Choose 13.8kV generator voltage as base voltage and 25MVA as the base MVA on generator side. Draw per unit reactance diagram.

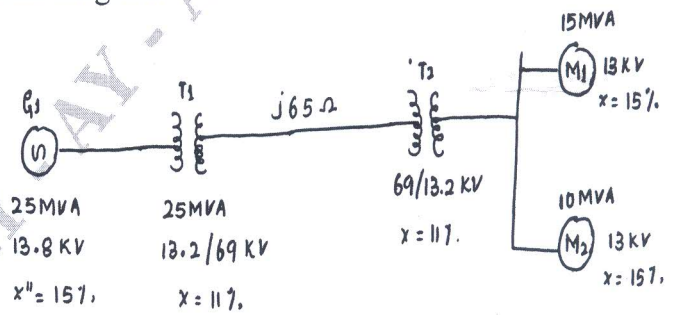

Fig Q2(b) **(10 Marks)**

Module-2

3 a. Explain in detail the transient on a transmission line. **(08 Marks)**

b. For the radial network shown in Fig Q3(b) a three phase faults occurs at F. Determine the fault current. [Select system base as 100MVA and 11KV on G/r bus.].

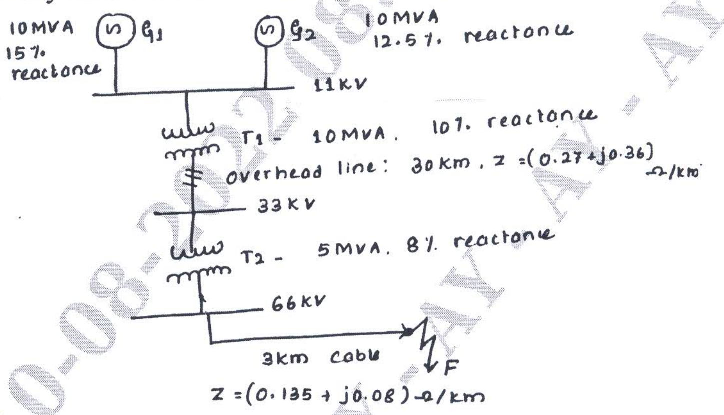

Fig Q3(b) **(08 Marks)**

OR

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

b. Explain the selection of circuit breaker. **(06 Marks)**

Module-3

5 a. Prove that a balanced set of 3-phase voltage will have only positive sequence components of voltage only. **(04 Marks)**

b. Draw the positive, negative and zero sequence network for the power system shown in Fig Q5(b).

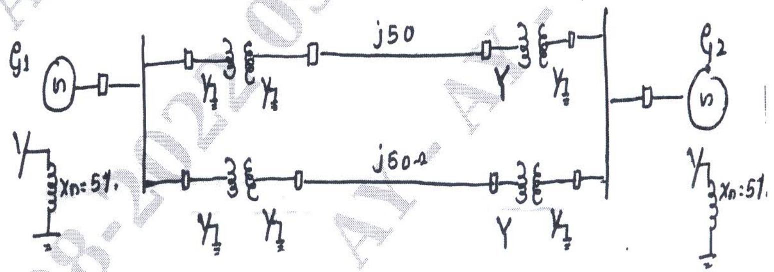

Fig Q5(b)

Choose a base of 50MVA, 220KV in the 50Ω tx-lines and mark all reactances in P.U. The rating of the generator and transformer are : Generator G_1 and G_2 : 25MVA, 11KV, $X'' = 20\%$

All transformers (each) : " 20MVA 11Y/220Y KV, X = 15%. The negative sequence reactance of each generator is equal to the subtransient reactance and zero sequence reactance of each generator is 8%. Assume that the zero sequence reactance of lines are 250% of their positive sequence reactance. **(12 Marks)**

OR

6 a. The phase voltage of a three phase systems are $V_a = 200\angle 0$, $V_b = 200\angle 245$ and $V_c = 200\ \angle 105$ **(06 Marks)**

b. Obtain the expression for power interms of sequence components. **(06 Marks)**

c. Draw the zero sequence equivalent circuit for the following conditions of transformers. (Refer Fig Q6(c))

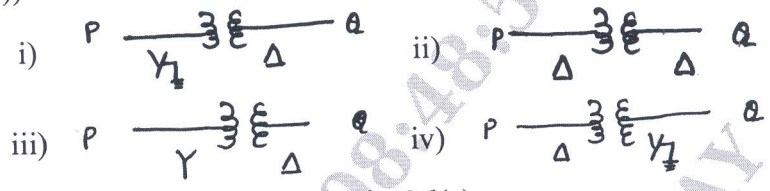

Fig Q6(c) **(04 Marks)**

Module-4

7 a. Derive an expression for fault current when a single line to ground fault occurs on the terminals of an unloaded generator. **(08 Marks)**

b. A three phase generator with line-to-line voltage of 400V 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. **(08 Marks)**

OR

8 a. Obtain the interconnection of sequence networks for the following open conductor faults on power systems. i) One conductor open ii) Two conductor open. **(06 Marks)**

b. Draw the sequence networks for the system shown in Fig Q8(b). Determine the fault current if a line to line occurs at F. The P.U reactance all referred to the same base are as follows. Both the generators are generating 1.0 P.U.

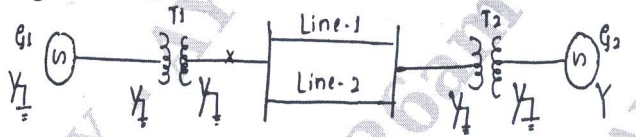

Fig Q8(b)

Component	X_0	X_1	X_2
G_1	0.05	0.30	0.20
G_2	0.03	0.25	0.15
Line – 1	0.70	0.30	0.30
Line – 2	0.70	0.30	0.30
Transformer – 1	0.12	0.12	0.12
Transformer – 2	0.10	0.10	0.10

(10 Marks)

Module-5

9 a. Explain the following terms as applicable to a power system
i) Stability ii) Steady state stability iii) Dynamic stability iv) Transient stability. **(08 Marks)**

b. Derive the swing equation of a synchronous machine with usual notation. **(08 Marks)**

OR

10 a. Explain the equal area criterion application for sudden change in input mechanical power to the single machine connected to infinite bus. **(08 Marks)**

b. A turbo generator 6-pole, 50Hz of capacity 80mW working at 0.8p.f has an inertia of 10MJ/MVA.
i) Calculate the energy stored in the rotor at synchronous speed
ii) Find rotor acceleration if the mechanical input is suddenly raised to 75mW for an electrical load of 60mW.
iii) Supposing the above acceleration is maintained for duration of 6 cycles. Calculate the change in torque angle and the rotor speed at the end of 6 cycles. **(08 Marks)**

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