CBCS SCHEME

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21EE53

Fifth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.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 and mention the advantages of p.v. system. **(06 Marks)**

b. Show that the per unit impedance of two winding transformer will remain same referred to primary as well as secondary. **(08 Marks)**

c. Draw the impedance diagram for:
(i) Two winding transformer
(ii) Transmission line
(iii) Three winding transformer **(06 Marks)**

OR

2 a. Draw the impedance and reactance diagram for a typical power system. Mention the assumptions made. **(10 Marks)**

b. Obtain the per unit impedance (reactance) diagram of the power system shown in Fig.Q2(b).

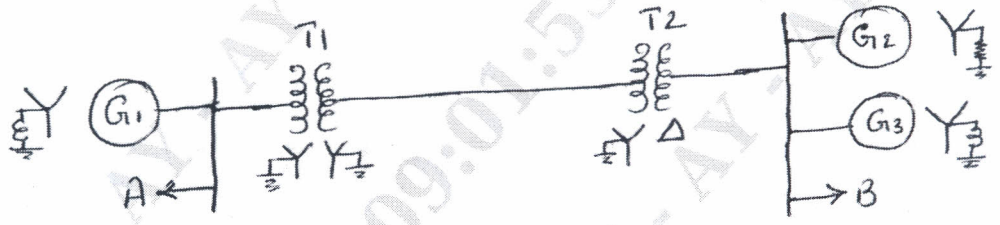

Fig.Q2(b)

The reactance data of the elements are:
G1 : 30 MVA, 10.5 KV, X″ = 1.6 Ω
G2 : 15 MVA, 6.6 KV, X″ = 1.2 Ω
G3 : 25 MVA, 6.6 KV, X″ = 0.56 Ω
T1 : 15 MVA, 33/11 KV, X = 15.2 Ω per phase on H.T. side
T2 : 15 MVA, 33/6.2 KV, X = 16 Ω per phase on H.T. side
Transmission line 20.5 ohms/phase
Load A : 40 MW, 11 KV, 0.9 p.f. (lag)
Load B : 40 MW, 6.6 KV, 0.85 p.f. (lag) **(10 Marks)**

Module-2

3 a. Describe the method of get doubling effect in a transmission line. **(10 Marks)**

b. A synchronous generator and motor are rated 30 MVA, 13.2 KV. Bothe have subtransient reactance of 10%. The line connecting them has a reactance of 10% on the base of machine rating. The motor is drawing 15 MW at 0.8 p.f.(lead). The terminal voltage of motor is 12.8 KV. When a symmetrical fault occurs at motor terminals, find subtransient current in generator and motor. **(10 Marks)**

OR

4 a. With the help of waveform at the time of 3 phase symmetrical fault on synchronous generator, explain steady state, transient and subtransient reactances. **(10 Marks)**

b. Two generators are connected in parallel to the LV side of a 3-phase Δ-Y transformer. The ratings of the machines are:

G1: 50 MVA, 13.8 KV, $X''_d = 25\%$

G2: 25 MVA, 13.8 KV, $X''_d = 25\%$

Transformer T : 75 MVA, 13.8 Δ - 69 Y KV, X = 10%

Before the fault occurs, the voltage on the HV side of the transformer is 66 KV. Find the subtransient current in each generator when a 3-phase fault occurs on the high voltage side of the transformer. **(10 Marks)**

Module-3

5 a. Draw the circuit of fully transposed transmission line carrying unbalanced currents. Write KVL equations and hence draw sequence diagram. **(09 Marks)**

b. Solve: (i) $1 + \alpha + \alpha^2$ (ii) $\alpha - \alpha^2$ (iii) $\alpha^2 - \alpha^3$ **(03 Marks)**

c. Draw the zero sequence network for different combination of 3-phase transformer bank. **(08 Marks)**

OR

6 a. Prove that balanced set of 3-phase voltages will have only positive sequence components of voltages. **(10 Marks)**

b. A delta connected balanced resistive load is connected across an unbalanced 3-phase supply as shown in Fig.Q6(b). With currents in lines A and B specified, find the symmetrical components of line currents.

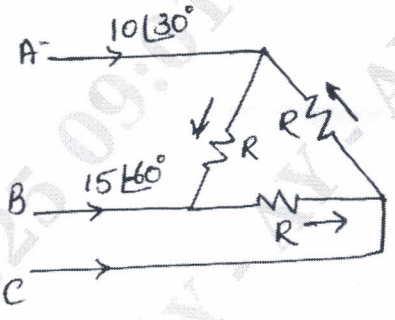

Fig.Q6(b) **(10 Marks)**

Module-4

7 a. Derive an expression for fault current if single line to ground fault occurs through fault impedance Z_f in power system. Show the connection of sequence networks to represent the fault. **(10 Marks)**

b. Draw the sequence networks for the system shown in Fig.Q7(b). Determine the fault current if line-line fault occurs at f.

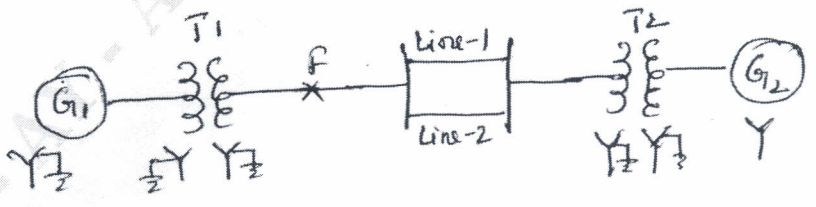

Fig.Q7(b)

Both generators are generating 1.0 pu. The pu reactances referred to same base as given:

Component	X_0	X_1	X_2
G1	0.05	0.3	0.2
G2	0.03	0.25	0.15
Line 1	0.7	0.3	0.3
Line 2	0.7	0.3	0.3
T1	0.12	0.12	0.12
T2	0.10	0.10	0.10

(10 Marks)

OR

8 a. Write a detailed note on open-conductor faults. **(10 Marks)**

b. Derive an expression for fault current if LLG fault occurs through a fault impedance Z_f in power system. Show the connection of sequence network to represent fault. **(10 Marks)**

Module-5

9 a. Derive the power angle equation of a salient pole synchronous machine connected to an infinite bus. Draw the power angle curve. **(12 Marks)**

b. Explain Equal Area Criterion to achieve stability of power system. **(08 Marks)**

OR

10 a. Derive swing equation governing the rotor dynamics of synchronous machine. **(10 Marks)**

b. A turbo generator, 6 pole, 50 Hz, of capacity 80 MW working at 0.8 p.f. has an inertia of 10 MJ/MVA.

(i) Calculate the energy stored in the rotor at synchronous speed.

(ii) Find rotor acceleration if the mechanical input is suddenly raised to 75 MW for an electrical load of 60 MW. **(10 Marks)**

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