CBCS SCHEME

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18EE62

Sixth Semester B.E. Degree Examination, Jan./Feb. 2023
Power System Analysis – I

Time: 3 hrs. Max. Marks: 100

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

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Draw single line diagram of power system indicating various components, obtain the reactance diagram for the single line diagram drawn. Explain the assumptions made to obtain the reactance diagram. **(08 Marks)**

b. Obtain the impedance diagram for the electrical power system shown in Fig.Q.1(b). The single line diagram is shown in Fig.Q.1(b) choose a base of 50MVA, 13.8KV in the generator circuit G_1. The ratings are

G_1 : 20MVA, 13.8KV, X″ = 0.2pu
G_2 : 30MVA, 18KV, X″ = 0.2pu
G_3 : 30MVA, 20KV, X″ = 0.2pu
T_1 : 25MVA, 220KV Y/13.8ΔKV, X = 10%
T_2 : 30MVA, 220KV, Y/18KVΔ, X = 10%
T_3 : 35MVA, 220KV, Y/22KVY, X = 10%

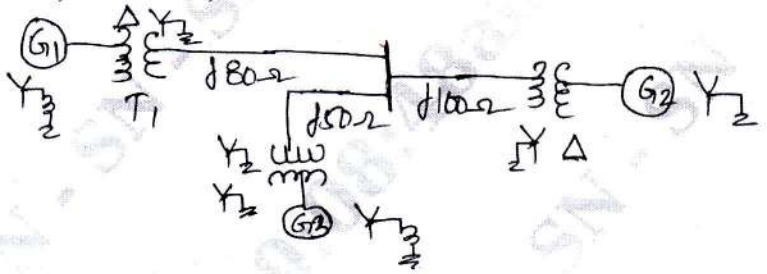

Fig.Q.1(b)

(12 Marks)

OR

2 a. Show that per unit impedance of a transformer is same irrespective of the side which it is calculated. **(05 Marks)**

b. Define per unit and mention the advantage of per unit system. **(05 Marks)**

c. Draw the impedance diagram for the circuit shown in Fig.Q.2(c). Choose a base of 100MVA, 200KV on transmission circuit. **(10 Marks)**

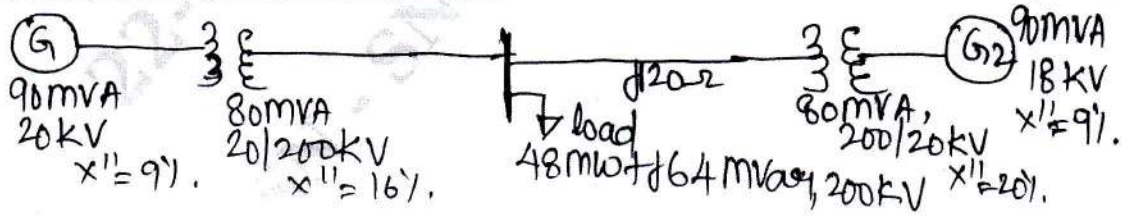

Fig.Q.2(c)

Module-2

3 a. Draw the oscillogram of short circuit current when an unloaded generator is subjected to symmetrical fault. Determine the steady state, transient and sub transient reactance's from the oscillogram. **(10 Marks)**

b. A 3 phase, 5MVA, 6.6KV alternator with a reactance of 8% connected to a feeder of series impedance of 0.12 + j0.48Ω/phase/km. The transformer is rated at 3MVA, 6.6KV/33KV and has a reactance of 5%. Determine the fault current supplied by the generator operating under no load with a voltage of 6.9KV, when 3-phase symmetrical fault occurs at a point F, 15km from the feeder. The diagram of system is shown in Fig.Q.3(b). **(10 Marks)**

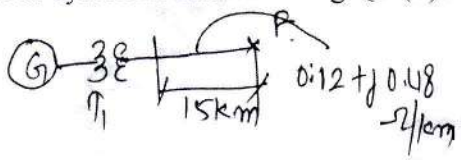

Fig.Q.3(b)

OR

4 a. Explain the transient that occur in transmission line when a transmission line has short circuit at far end. Derive an expression for maximum momentary current. **(10 Marks)**

b. A 75MVA, 6.6KV generator connected through a 5 cycle breaker, having reactance of $X''_d = 9\%$ $X'_d = 15\%$ and $X_d = 100\%$. It operates on no load and at rated terminal voltage. When short circuit occurs behind circuit breaker, find: i) Sustained short circuit current ii) Initial symmetrical rms current iii) Maximum possible decomponent of short circuit current after 5 cycle iv) Interrupting MVA. **(10 Marks)**

Module-3

5 a. Obtain an expression for symmetrical component of voltages in terms of phase voltages. **(06 Marks)**

b. Prove that a balanced set of three phase voltages will have only positive sequence components of voltages only. **(06 Marks)**

c. The symmetrical component of phase currents are $I_{a_1} = 100\angle 30$ Amp, $I_{b_2} = 40\angle 90$ Amp and $I_{c_0} = 10\angle -30$ Amp, evaluate the phase currents I_a, I_b and I_c. **(08 Marks)**

OR

6 a. Derive an expression for three phase complex power on term of symmetrical components. **(07 Marks)**

b. Prove that positive and negative sequence current will not flow through the neutral even when neutral is grounded for a balanced system. **(06 Marks)**

c. The current flowing to a Δ connected load though line a is 10A, with current on line a as reference and assuming that line C is open find the symmetrical component of line currents. **(07 Marks)**

Module-4

7 a. Derive an expression for the fault current if LLG fault occurs at the terminals of unloaded synchronous generator. Show the connection of sequence network to represent fault. **(10 Marks)**

b. A, 3ϕ, 400V, Y connected neutral grounded generator is subjected to various faults. Find positive, negative and zero sequence impedances, also compute the fault current if LLG fault occurs. The fault current for : 3ϕ fault is 120A, LL fault is 160A, for LG fault it is 240A. **(10 Marks)**

OR

8 a. Derive an expression for the fault current when a LG fault occurs through a reactance of Z_f in any one phase of an unloaded synchronous generator. Show the connection of sequence network to represent fault. **(10 Marks)**

b. Draw the positive, negative and zero sequence network for power system shown in Fig.Q.8(b) and compute fault current if fault occurs at F. The reactances are in pu with respect to same base. **(10 Marks)**

Comp	X_0	X_1	X_2
G_1	0.05	0.3	0.2
G_2	0.03	0.25	0.15
L_1	0.7	0.3	0.3

Comp	X_0	X_1	X_2
L_2	0.7	0.3	0.3
T_1	0.12	0.12	0.12
T_2	0.1	0.1	0.1

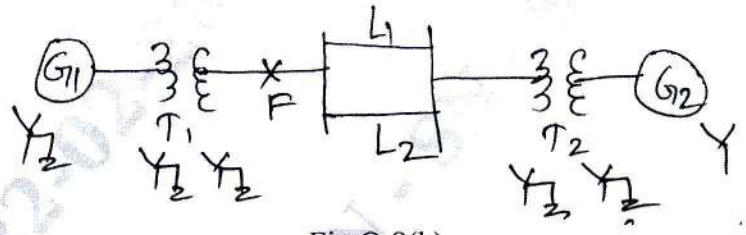

Fig.Q.8(b)

Module-5

9 a. Derive an expression for power angle equation for salient pole synchronous machine connected to infinite bus. Also draw the power angle curve. **(10 Marks)**

b. A, 2 pole, 50Hz, 60MVA. Turbo generator has a moment of inertia of 9×10^3kg-m^2, calculate:

i) Kinetic energy in MW-sec at rate speed
ii) Inertia constant M and H
iii) Inertia constant M on 50MVA base. **(10 Marks)**

OR

10 a. Derive an expression for swing equation of a generator when generator connected to infinite bus. **(06 Marks)**

b. Explain the equal area criterion for investigating the stability of power system. **(06 Marks)**

c. 50Hz, 4 pole turbo generator rated 100MVA, 11KV has an inertia constant of 8mJ/MVA, i) Find stored energy in rotor at synchronous speed ii) If the mechanical input is suddenly raised to 80MW for an electrical load of 50MW find rotor acceleration neglecting mechanical and electrical losses. **(08 Marks)**

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