CBCS SCHEME

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18EE62

Sixth Semester B.E. Degree Examination, Feb./Mar. 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. Define Per Unit Quantity? Enumerate the advantages of per unit computations. **(05 Marks)**

b. The one line diagram of a radial transmission system is as shown in Fig.Q1(b). The ratings and reactances of the various components are shown there in. A load of 60MW at 0.9 p.f. lagging is tapped from the 66KV substation which is to be maintained at 60KV. Draw the reactance diagram. Calculate the terminal voltage of the machine. Choose a base of 100MVA, 220KV in transmission line.

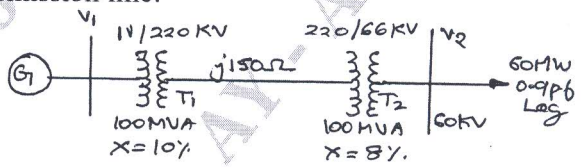

Fig.Q1(b) **(15 Marks)**

OR

2 a. With suitable examples explain one line diagram and discuss the elements represented. **(05 Marks)**

b. With the help of typical electrical power system, explain impedance and reactance diagram. **(05 Marks)**

c. The one line diagram of a power system is as shown in Fig.Q2(c). The motors have rated output of 30MVA, 20MVA and 50MVA at 30KV with 20% subtransient reactance each. Selecting generator rating as base in the generation circuit, draw the per unit reactance diagram.

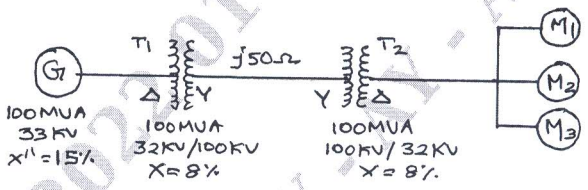

Fig.Q2(c) **(10 Marks)**

Module-2

3 a. What is doubling effect in transmission line? Subtransient with equations. **(06 Marks)**

b. Explain the selection of circuit breakers in a power system. **(04 Marks)**

c. Two generators are connected in parallel to the low voltage side of a three phase Δ-Y transformer as shown in Fig.Q3(c). Generator 1 is rated 50MVA, 13.8KV. Generator 2 is rated 25MVA, 13.8KV. Each generator has a subtransient reactance of 25%. The transformer is rated 75MVA, 13.8Δ/69Y KV, with a reactance of 10%. Before the fault occurs, the voltage on the high tension side of the transformer is 66KV. 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.

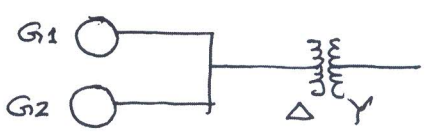

Fig.Q3(c)

Choose a base of 75MVA, 69KV in the high tension side of the transformer. **(10 Marks)**

OR

4 a. Explain in details symmetrical short circuit of a synchronous generator on no load and constant excitation drawing oscillogram. **(10 Marks)**

b. Generators G1 and G2 are identical and rated 11KV, 20MVA, X″ = 0.25pu at own MVA base. The transformers T1 and T2 are also identical and are rated 11KV/66KV, 5MVA, X = 0.06pu to their own MVA base. The tie-line is 50km long : each conductor has reactance of 0.848Ω/km. The three phase fault is assumed at F, 20km from generator G1 as shown in Fig.Q4(b). Find the short circuit current.

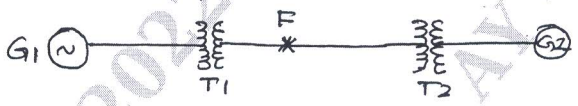

Fig.Q4(b) **(10 Marks)**

Module-3

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

b. Draw the zero sequence network for the following transformer connections as in Fig.Q5(b).

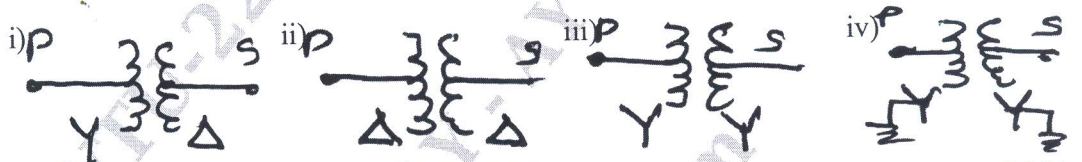

Fig.Q5(b) **(04 Marks)**

c. A delta connected balanced resistive load is connected across an unbalanced three phase supply as shown in Fig.Q5(c). Find the symmetrical component of line current and the delta current.

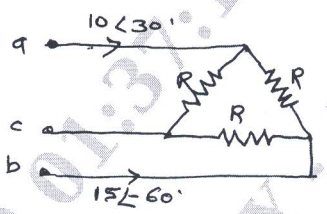

Fig.Q5(c) **(10 Marks)**

OR

6 a. Explain the concept of phase shift of symmetrical components in star delta transformer bank. **(08 Marks)**

b. Draw the positive, negative and zero sequence networks of power system shown in Fig.Q6(b). Choose a base of 50MVA, 220KV is the 50Ω transmission line and mark all rectances in p.u. The ratings are as follows :

Generator 1 : 25MVA, 11KV, X″ = 20%

Generator 2 : 25MVA, 11KV, X″ = 20%

Three phae transformer (each) : 20MVA, 11Y/220Y KV, X = 15%.

The negative sequence reactance of each synchronous machine is equal to the sub transient reactance. The zero sequence reactance of each machine is 8%. Assume that zero sequence reactance of lines are 250% of their positive sequence reactances.

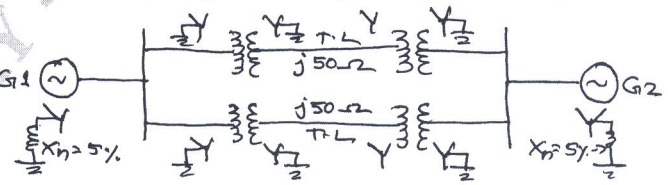

Fig.Q6(b) **(12 Marks)**

Module-4

7 a. Derive an expression for the fault current when a double line to ground fault occurs at terminals of generator. Draw the sequence the sequence networks to represent the fault. **(10 Marks)**

b. Draw the interconnection of sequence networks for :
i) single line to ground fault ii) line to line fault. **(04 Marks)**

c. A three phase generator with an open circuit voltage of 400V is subjected to an LLG fault through a fault current of $Z_1 = j4\Omega$, $Z_2 = j2\Omega$, $Z_0 = j1\Omega$. **(06 Marks)**

OR

8 a. Explain the series types of faults in a power system. **(06 Marks)**

b. A synchronous motor is receiving 10MW of power at 0.8pf lag at 6KV. An LG fault takes place at the middle point of the transmission line as shown in Fig.Q8(b). Find the fault current
Generator : 20MVA, 11KV, $X_1 = 0.2$pu, $X_2 = X_0 = 0.1$pu
Transformer T1 : 18MVA, 11.5KV/34.5KV, $X = 0.1$pu
Transmission line : $X_1 = X_2 = 5\Omega$, $X_0 = 10\Omega$
Transformer T2 : 15MVA, 6.9KV/34.5KV, $X = 0.1$pu
Motor : 15MVA, 6.9KV, $X_1 = 0.2$pu, $X_2 = X_0 = 0.1$pu
Choose generator as base.

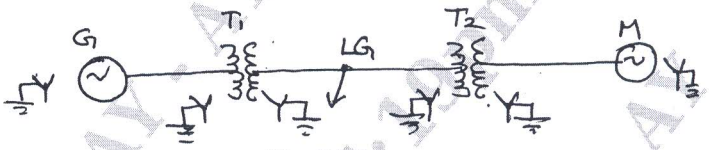

Fig.Q8(b) **(14 Marks)**

Module-5

9 a. Define power system stability and differentiate between steady stat stability and transient stability. **(05 Marks)**

b. Derive the swing equation with usual notations. **(05 Marks)**

c. A turbo generator 6pole, 50Hz, 80MW capacity working at 0.8pf 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) If the above acceleration is maintained for a duration of 6 cycles, calculate the change in torque angle and the rotor speed at the end of 6 cycles. **(10 Marks)**

OR

10 a. Explain equal area criterion when a power system is subjected to sudden change in mechanical input. **(08 Marks)**

b. Write a note on multi-machine system stability. **(05 Marks)**

c. A loss free alternator supplies 50MW to an infinite bus, the steady state stability limit being 100MW. Determine if the alternator will remain stable if the input to the prime mover of the alternator is abruptly increased by 40Mw. **(07 Marks)**

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