CBCS SCHEME

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15EE62

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

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Show that per unit impedance of at transformer is the same when referred to either its primary side or secondary side. **(04 Marks)**

b. Define per unit quantity. Mention the advantages of per unit system. **(04 Marks)**

c. Draw the reactance diagram of the power system show in Fig.Q1(c). Use a base of 100MVA, 220KV in the line circuit to mark the per unit quantities on the reactance diagram. The ratings are :

Generator (G)	: 40MVA, 25KV,	X″ = 20%,
Motor (M)	: 50MVA, 11KV,	X″ = 30%
Y – Y transformer	: 40MVA, 33/220KV,	X = 15%
Y– Δ transformer	: 30MVA, 11Δ|220Y KV,	X = 15%.

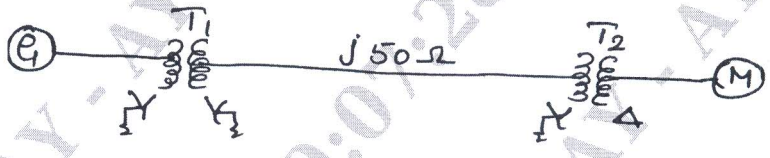

Fig.Q1(c) **(08 Marks)**

OR

2 a. Explain the procedure of drawing per – unit reactance diagram from single line diagram. **(04 Marks)**

b. A 300MVA, 20KV, 3 - ϕ generator has a sub-transient reactance of 20%, the generator supplies two synchronous motors through a 64km, transmission line having transformers at both ends as shown in Fig.Q2(b). T_1 is a 3 - ϕ transformer and T_2 is composed of a 3 single phase transformer of rating 100MVA each, 127|13.2KV, 10% reactance, series reactance of the line is 0.5Ω/km. Draw the reactance diagram, with all the reactance marked in p.u select generator ratings as base values.

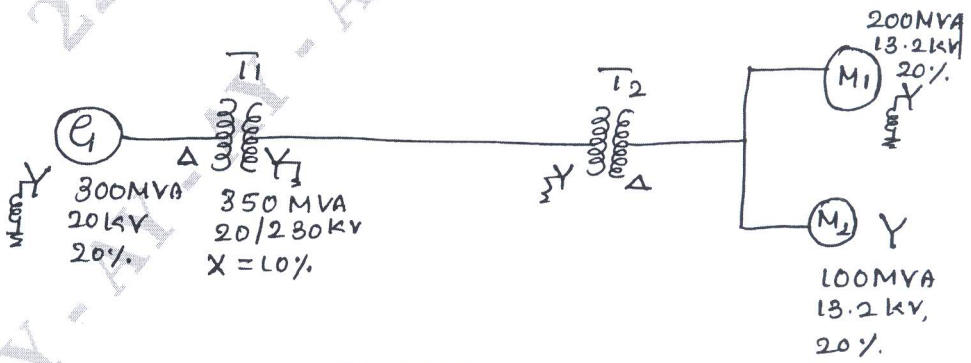

Fig.Q2(b) **(12 Marks)**

Module-2

3 a. Prove that in a synchronous machine $X''_d < X'_d < X_d$. **(08 Marks)**

b. A Synchronous generator and motor are rated 30MVA, 13.2 KV, both have sub transient reactance of 20%. The line connecting them has a reactance of 20%, on the base of machine rating. The motor is drawing 20MW at 0.8pf (lead). The terminal voltage of motor is 12.8KV, when a symmetrical fault occurs at motor terminals, find sub transient current in generator, motor and at the point of fault? **(08 Marks)**

OR

4 a. Write a short notes on selection of circuit breakers. **(06 Marks)**

b. For the radial network shown in Fig.Q4(b), a 3 - ϕ fault occurs at 'F'. Determine the fault current. Choose a base of 100MVA for the entire system and a base of 33KV in the overhead line.

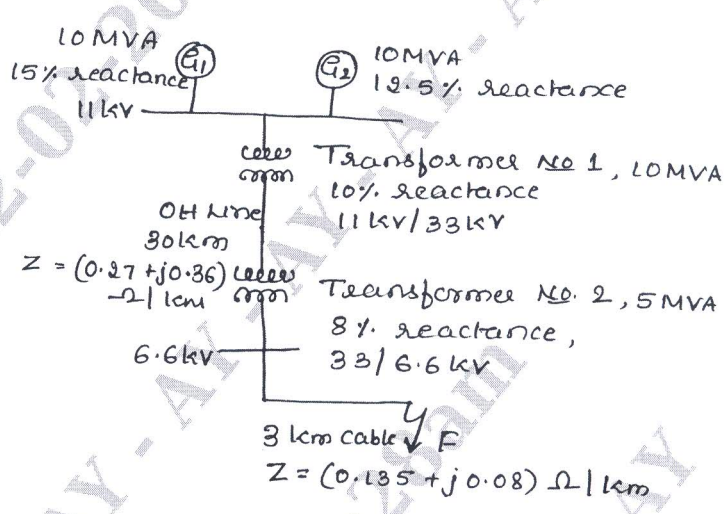

Fig.Q4(b) **(10 Marks)**

Module-3

5 a. Drive an expression for the symmetrical components in terms of phase voltages. **(04 Marks)**

b. Draw the zero sequence networks for different combinations of 3-ϕ transformer bank. **(04 Marks)**

c. In a 3 - ϕ system $I_{a1} = 100\angle 30°A$, $I_{b2} = 40\angle 90°A$ and $I_{c0} = 10\angle -30°A$ Find the line currents. **(08 Marks)**

OR

6 a. Obtain an expression for the complex power interms of symmetrical components. **(04 Marks)**

b. What are the sequence impedances and sequence networks? **(04 Marks)**

c. Draw the positive, negative and zero sequence networks for the power system shown in Fig.Q6(c). Choose a base of 50MVA, 220KV in the 50Ω transmission lines and mark all the reactances. The ratings of the generator and transformer are :

G_1 : 25 MVA, 11KV, X" = 20%

G_2 : 25 MVA, 11KV, X" = 20%

3 - ϕ transformers (each) : 20MVA, 11/220KV, X = 15%. The negative sequence reactance of each synchronous machine is equal to sub-transient reactance. The zero sequence reactance of each machine is 8%. Assume that zero sequence reactances of lines are 250% of their positive sequence reactances.

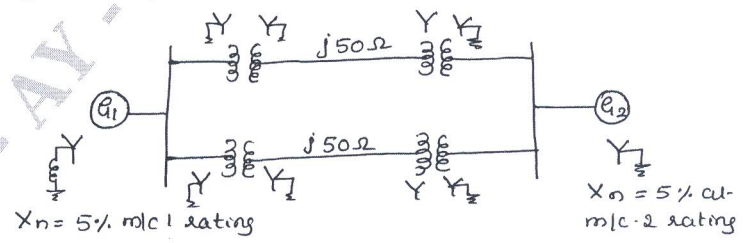

Fig.Q6(c) **(08 Marks)**

Module-4

7 a. Derive an expression for fault current if double line to ground fault occurs through fault impedance Z_f on an unloaded generator. Show the interconnection of sequence networks to represent the fault. **(10 Marks)**

b. A three phase generator with an open circuit voltage of 400V is subjected to an SLG fault through a fault impedance of j2Ω. Determine the fault current if Z_1 = j4Ω, Z_2= j2Ω and Z_0 = j1Ω. **(06 Marks)**

OR

8 a. An alternator is connected to a synchronous motor though transformers and a transmission line as shown in Fig.Q8(a). The constants of all the apparatus are in pu.

Generator : $X_1 = 0.3$, $X_2 = 0.2$ and $X_0 = 0.2$
T_1 and t_2 : $X_1 = X_2 = X_0 = 0.1$ each
Transmission line : $X_1 = X_2 = 0.1$, $X_0 = 0.2$
Synchronous Motor : $X_1 = 0.2$, $X_2 = 0.1$ and $X_0 = 0.1$

A line to ground fault occurs at the middle of the transmission line. The system is on load and the voltage at the fault point before fault is 1.0. Determine fault currents.

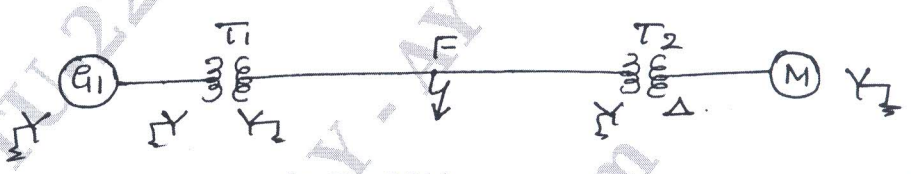

Fig.Q8(a) **(10 Marks)**

b. Write short notes on open conductor faults in power system. **(06 Marks)**

Module-5

9 a. Derive swing equations with usual notations and draw the swing curve. **(08 Marks)**

b. Derive power angle equation of a non salient pole synchronous machine connected to an infinite bus. Draw the power angle curve. **(08 Marks)**

OR

10 a. Define the following :
i) Steady state stability
ii) Transient stability
iii) Steady state stability limit
iv) Transient stability limit. **(08 Marks)**

b. A 2 pole, 50Hz, 11KV turbo alternator has a rating of 100MW, 0.85pf. Lagging. The rotor has a moment of inertia of 10,000 kg-m^2. Calculate M and H. **(08 Marks)**

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