CBCS SCHEME

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15EE62

Sixth Semester B.E. Degree Examination, Aug./Sept.2020
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. What is per unit quantity? Mention the advantages of per unit quantity. **(06 Marks)**

b. Draw the impedance diagram for the circuit shown in Fig.Q1(b). The rating of the components are as follows:

G_1 = 30 MVA, 13.8 KV, X″ = 0.1 pu
G_2 = 30 MVA, 18 KV, X″ = 0.2 pu
T_1 = 25 MVA, 13.8 KV/220 KV, X = 0.1 pu
T_2 = 15 MVA, 18 KV/220 KV, X = 0.1 pu
T_3 = 25 MVA, 220 KV/6.6 KV, X = 0.1 pu
Load L_A = 20 + j60Ω, load L_B = 8 + j60Ω
Assume a base of 30 MVA, 13.8 KV on G_1.

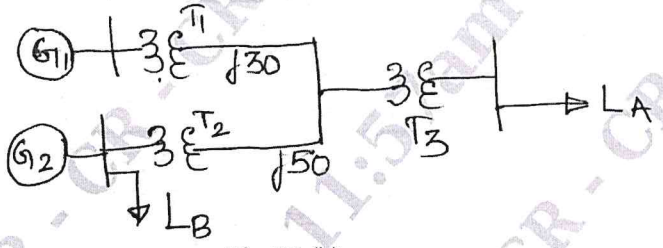

Fig.Q1(b) **(10 Marks)**

OR

2 a. Show that per unit impedance of a two winding transformer on either of its sides is equal. **(06 Marks)**

b. Draw the impedance diagram for the circuit shown in Fig.Q2(b). The rating of different components are:

G_1 = 20 MVA, 6.9 KV, X″ = 0.2 pu
G_2 = 15 MVA, 18 KV, X″ = 0.25 pu
G_3 = 15 MVA, 22 KV, X″ = 0.15 pu
T_1 = 25 MVA, 6.9 KV/132 KV, X = 0.1 pu
T_2 = 15 MVA, 132 KV/18 KV, X″ = 0.1 pu
T_3 = 20 MVA, 132 KV/22 KV, X = 0.12 pu
Select a base of 15 MVA 18KV on G_2.

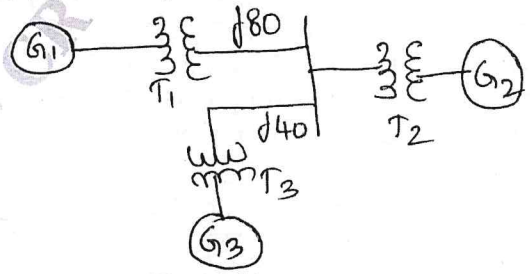

Fig.Q2(b) **(10 Marks)**

Module-2

3 a. With the oscillogram of short circuit current of a synchronous machine, define the direct axis synchronous reactance, transient and subtransient reactance. **(08 Marks)**

b. Two generators are connected on parallel to the low voltage side of a three phase transformer as shown in Fig.Q3(b). G_1 rating is 100 MVA, 13.8 KV, X″ = 25%. G_2 rating is 50 MVA, 13.8 KV, X″ = 25%. Transformer is rated 150 MVA, 13.8 KVΔ/69KVY with a reactance of 10%. Before the fault occurs, voltage on the high tension side of transformer is 66 KV. Transformer is not loaded and there is no circulating current between generators. Find the subtransient current in each generator and in high tension side of transformer when a 3ϕ - short circuit occurs on high tension side of transformer. Select a base of 150 MVA, 69 KV on high tension side of transformer.

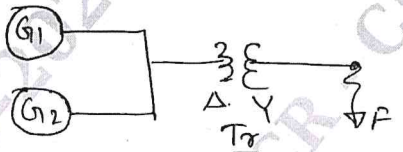

Fig.Q3(b) **(08 Marks)**

OR

4 a. Prove that the reactance in the synchronous generator are Xd″ < Xd′ < Xd, with an equivalent circuit diagram. **(08 Marks)**

b. A synchronous generator and motor are rated 20 MVA, 13.8 KV, X″ = 20%. The line connecting them has a reactance of 0.15 pu on the base of machine rating. Motor draws 15 MVA, 0.8 pf lag and the terminal voltage of the motor is 13 KV. When symmetrical three phase fault occurs at motor terminal, find the subtransient current in generator, motor and at fault point. **(08 Marks)**

Module-3

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

b. The sequence component of live current are $Ia_1 = 20\angle 10°$, $Ia_2 = 6\angle 60°$, $Ia_0 = 3\angle 30°$. Find the line current. **(05 Marks)**

c. A balanced Δ connected load is connected to a three phase symmetrical supply. The line current in each phase is 10A. If fuse of one of the lines is blown out, find the sequence component of line current. **(05 Marks)**

OR

6 a. Prove that a balanced 3ϕ voltage has only positive sequence component. **(06 Marks)**

b. Draw the positive and zero sequence network for the circuit shown in Fig.Q6(b). The system data is

G_1 50 MVA, 11 KV, $X_1 = 0.25$ pu, $X_0 = 0.05$ pu
G_2 50 MVA, 11 KV, $X_1 = 0.2$ pu, $X_0 = 0.05$ pu
T_1 50 MVA, 11/220 KV, $X_1 = 0.06$ pu, $X_0 = 0.06$ pu
T_2 50 MVA, 11/220 KV, $X_1 = 0.07$ pu, $X_0 = 0.07$ pu
L_1 100 MVA, 220 KV, $X_1 = 0.1$ pu, $X_0 = 0.03$ pu
L_2 100 MVA, 220 KV, $X_1 = 0.1$ pu, $X_0 = 0.03$ pu
Take a base of 100 MVA and 11 KV on G_1.

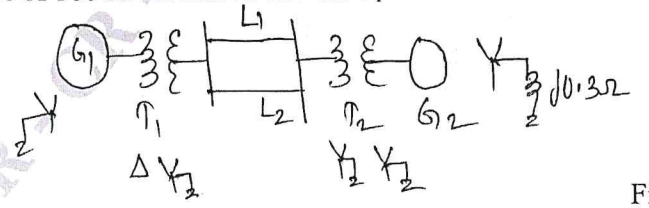

Fig.Q6(b) **(10 Marks)**

Module-4

7 a. Derive an expression for fault current for L-L fault on unloaded generator. **(08 Marks)**

b. 50 MVA, 11 KV, 3ϕ synchronous generator was subjected to different types of fault. The fault currents are LG : 4200 A, L-L fault: 2600 A, 3ϕ-symmetrical fault – 2000 A. Generator neutral is solidly grounded. Find per unit value of sequence reactance of generator. **(08 Marks)**

OR

8 a. Derive an expression for fault current when single LG fault occurs on phase of unloaded generator. **(08 Marks)**

b. Two generators rated 11 KV, 220 MVA operates in parallel as shown in Fig.Q8(b). Positive negative and zero sequence of each generator is j0.18pu, j0.15pu and j0.11pu respectively. Star point of one of the generator is isolated and that of other is earthed through 2Ω resistor. A single LG fault occurs at terminal of one of generator. Find: (i) fault current (ii) current in ground resistor (iii) voltage across ground resistor.

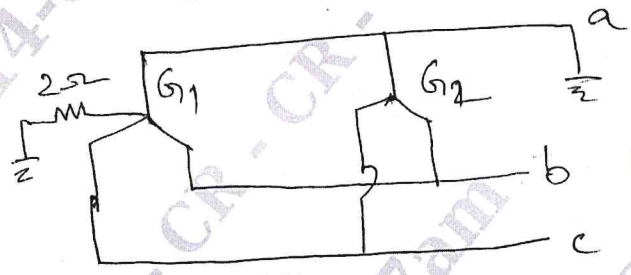

Fig.Q8(b) **(08 Marks)**

Module-5

9 a. Derive an expression for swing equation. **(06 Marks)**

b. 60 Hz, 4 pole turbo generator rated 400 MVA, 11 KV has inertia constant H = 7.5 MW-sec/MVA, find (i) Kinetic energy stored in ratio at synchronous speed (ii) Angular acceleration if electrical power developed is 350 MW, when input less rotational losses is 7,40,000 HP (iii) moment of inertia. **(10 Marks)**

OR

10 a. Derive power angle equation for non salient pole machine. **(08 Marks)**

b. A synchronous generator is connected to infinite bus and steady state stability limit is 100 MW initial torque angle is 30°. Initial load on generator is 50 MW. If load suddenly increases by 30 MW find whether system is stable. **(08 Marks)**

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