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**L 1288**

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2008.

Sixth Semester

Electrical and Electronics Engineering

EE 339 — POWER SYSTEM ANALYSIS

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is a single line diagram?
2. A generator rated 25 MVA, 11 kV has a reactance of 15%. Calculate its per unit reactance for a base of 50 MVA and 10 kV.
3. What is off nominal turns ratio?
4. What is the disadvantage in reactive power compensation by shunt capacitors and how it is overcome?
5. What is bolted fault?
6. Find the fault current in Fig. 1 if the prefault voltage at the fault points is 0.98 p.u.

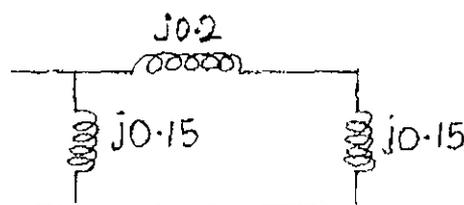


Fig. 1

7. What is the need for slack bus?
8. What is meant by acceleration factor in GS method?
9. State the causes of voltage instability.
10. State equal area criterion.

PART B — (5 × 16 = 80 marks)

11. (a) Draw a single line diagram for the system shown in Fig. 2 and mark all reactance in per unit on 20 MVA, 6.6 kV basis (16)

Generator G1 = 10 MVA, 6.6 kV, 0.1 p.u.

Generator G2 = 20 MVA, 11.5 kV, 0.1 p.u.

Transformer T1 = 10 MVA, 3-phase, 6.6 kV/115 kV, 0.15 p.u.

Transformer T2 = three single phase units, each 10 MVA, 7.5 kV/75 kV, 0.1 p.u.

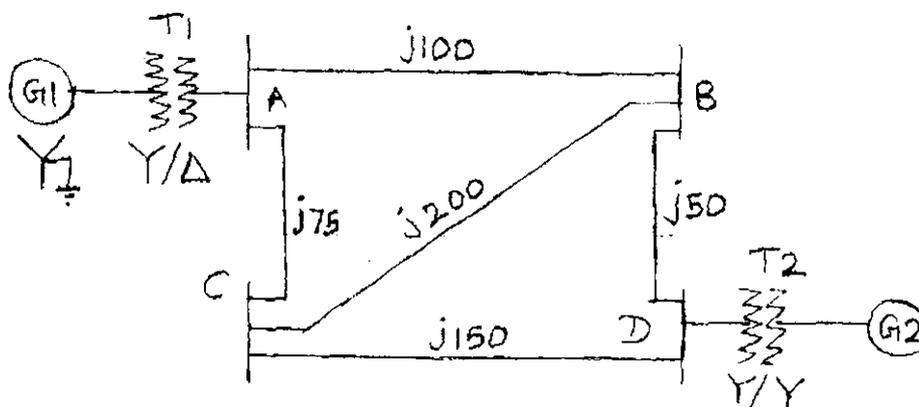


Fig. 2

Or

- (b) Determine the positive, negative and zero sequence networks for the system shown in Fig.3. Assume zero sequence reactance for the generator and synchronous motors as 0.06 p.u. Current limiting reactors of  $2.5 \Omega$  are connected in the neutral of the generator and motor no. 2. The zero sequence reactance of the transmission line is  $j300 \Omega$ . (16)

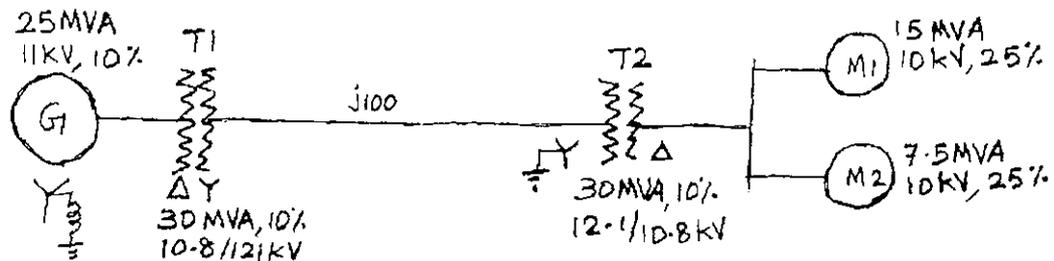


Fig. 3

12. (a) Find the admittance matrix for the system shown in Fig. 4. It is given that all the lines are characterized by a series impedance of  $0, 1 + j0.7 \Omega/\text{km}$  and shunt admittance of  $j0.35 \times 10^{-5} \text{ mho/km}$ . Lines are rated at 220 kV.

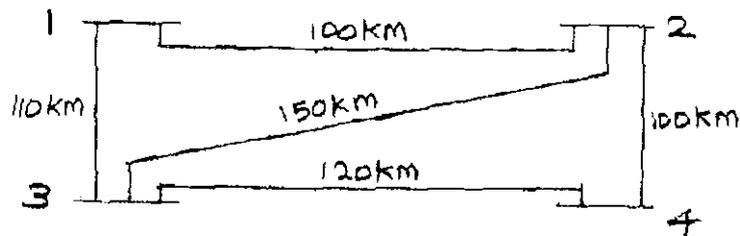


Fig. 4

Use the base values 220 kV and 100 MVA. (16)

Or

- (b) (i) Derive the equations to find  $\pi$  equivalent circuit of transformer with off-nominal tap ratio. (8)
- (ii) Explain the modeling of generator, load, shunt capacitor and transmission line for short circuit studies. (8)

13. (a) Consider the 3 bus system of Fig 5. The generators are 100 MVA, with transient reactance 10% each. Both the transformers are 100 MVA with a leakage reactance of 5%. The reactance of each of the lines to a base of 100 MVA, 110 kV is 10%. Obtain the short circuit solution for a three phase solid short on bus 3.

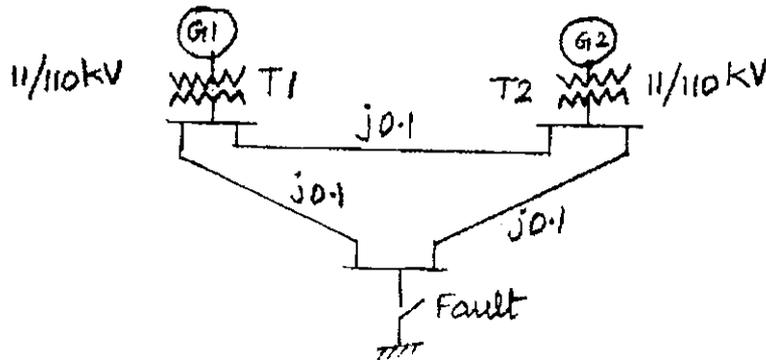


Fig. 5

Assume prefault voltages to be 1 p.u. and prefault currents to be zero.

(16)

Or

- (b) Derive an expression for the +ve sequence current  $I_{a1}$  of an unloaded generator when it is subject to a double line to ground fault. (16)
14. (a) Fig. 6. shows one line diagram of a simple three bus power system with generator at bus 1. The magnitude of voltage at bus 1 is adjusted to 1.05 p.u. The scheduled loads at buses 2 and 3 are marked on the diagram. Line impedances are marked in per unit on a 100 MVA base and the line charging susceptances are neglected.

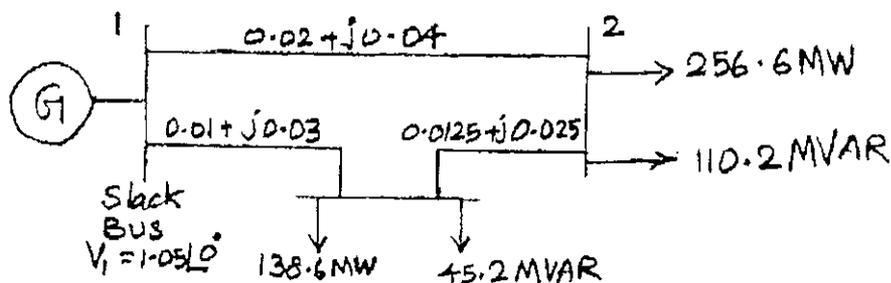


Fig. 6

- (i) Using the Gauss-Seidel method, determine the phase values of the voltage at the load buses 2 and 3 (P-Q buses) accurate to four decimal places. (10)
- (ii) Find slack bus real and reactive powers. (2)
- (iii) Determine the line flows and line losses. Construct a power flow diagram showing the direction of line flow. (4)

Or

- (b) Explain clearly with detailed flow chart the computational procedure for load solution using N.R. method when the system contains all types of buses. (16)

15. (a) (i) Two turbo alternators with ratings given below are interconnected via a short transmission line

Machine 1 : 4 pole, 50 Hz, 60 MW, power factor 0.8 lagging, Moment of inertia 30000 kg-m<sup>2</sup>

Machine 2 : 2 pole, 50 Hz, 80 MW, power factor 0.85 lagging, Moment of inertia 10000 kg-m<sup>2</sup>

Calculate the inertia constant of the single equivalent machine on a base of 200 MVA. (8)

- (ii) The generator shown in Fig. 7 is delivering power to infinite bus. Take  $V_t = 1.1$  p.u. Find the maximum power that can be transferred when the system is healthy. (8)

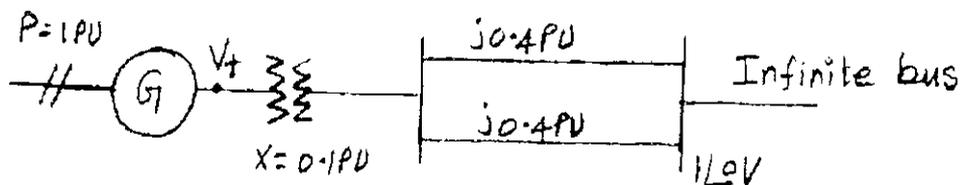


Fig. 7

Or

- (b) (i) Derive the swing equation of a synchronous machine swinging against an infinite bus. Clearly state the assumptions in deducing the swing equation. (8)

- (ii) A three phase fault is applied at the point P as shown in Fig. 8. Find the critical angle for clearing the fault with simultaneous opening of the breakers 1 and 2. The reactance values of various components are indicated in the diagram. The generator is delivering 1 p.u. power at the instant preceding the fault. (8)

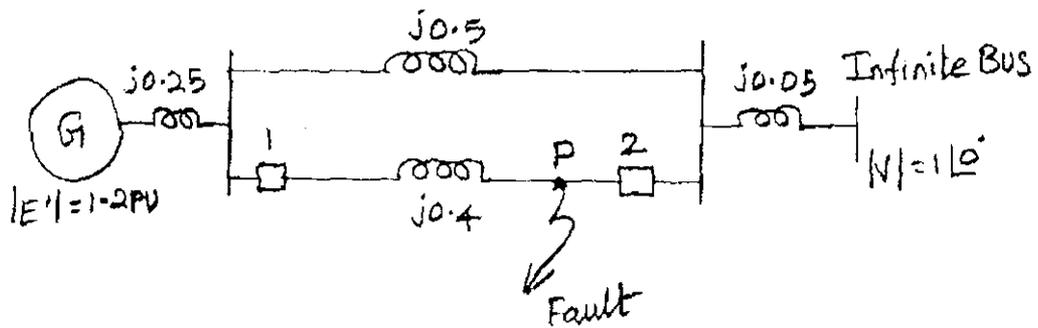


Fig. 8