Reg. No. :

Question Paper Code : 60509

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2016.

Sixth Semester

Electrical and Electronics Engineering

EE 2351/10133 EE 601/EE 61 — POWER SYSTEM ANALYSIS

(Regulations 2008/2010)

(Common to PTEE 2351/10133 EE 601 — Power System Analysis for BE (Part-Time) Fourth Semester — EEE — Regulations 2009/2010)

Time : Three hours   Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is single line diagram?

2. Define Bus impedance matrix?

3. What is the need for slack bus?

4. Write the Static Load Flow Equations (SLFE).

5. What is meant by a symmetrical fault?

6. What is short circuit capacity?

7. Name the faults which do not have zero sequence currents flowing.

8. Draw the connection of sequence networks for line to line fault.

9. Define steady state stability.

10. What do you understand by critical clearing angle?

PART B — (5 × 16 = 80 marks)

11. (a) The one line diagram of an unloaded power system is shown in Figure 11(a). Reactances of the two sections of transmission line are shown on the diagram.

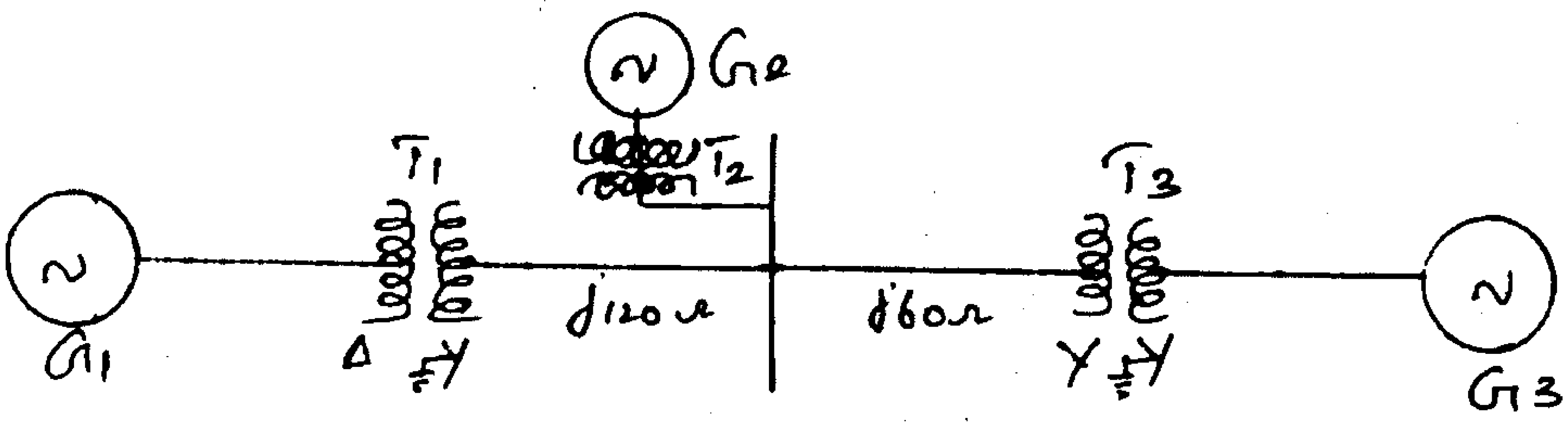

Figure 11 (a)

The generators and transformers are rated as follows.

Generator 1 : 25 MVA, 11 kV, X" =0.15 p.u.

Generator 2 : 15 MVA, 11 kV, X" = 0.15 p.u.

Generator 3 : 30 MVA, 22 kV, X" = 0.15 p.u.

Transformer T1: 30 MVA, 11 Δ /110 Y kV, x = 0.1 p.u.

Transformer T2 : 17 MVA, 11 Δ /110 Y kV, x = 0.1 p.u.

Transformer T3 : Single phase units with each rated 10 MVA, 7.5 /75 kV, x = 0.1 p.u.

Draw the impedance diagram with all reactances marked in p.u. and with letters to indicate points corresponding to the one line diagram. Choose a base of 30 MVA, 11 kV in the circuit. (16)

Or

(b) Draw the reactance diagram for the power system shown in Figure 11(b). The ratings of generator, motor and transformers are given below. Neglect resistance and use a base of 50 MVA, 138 kV in the 40 Ω line.

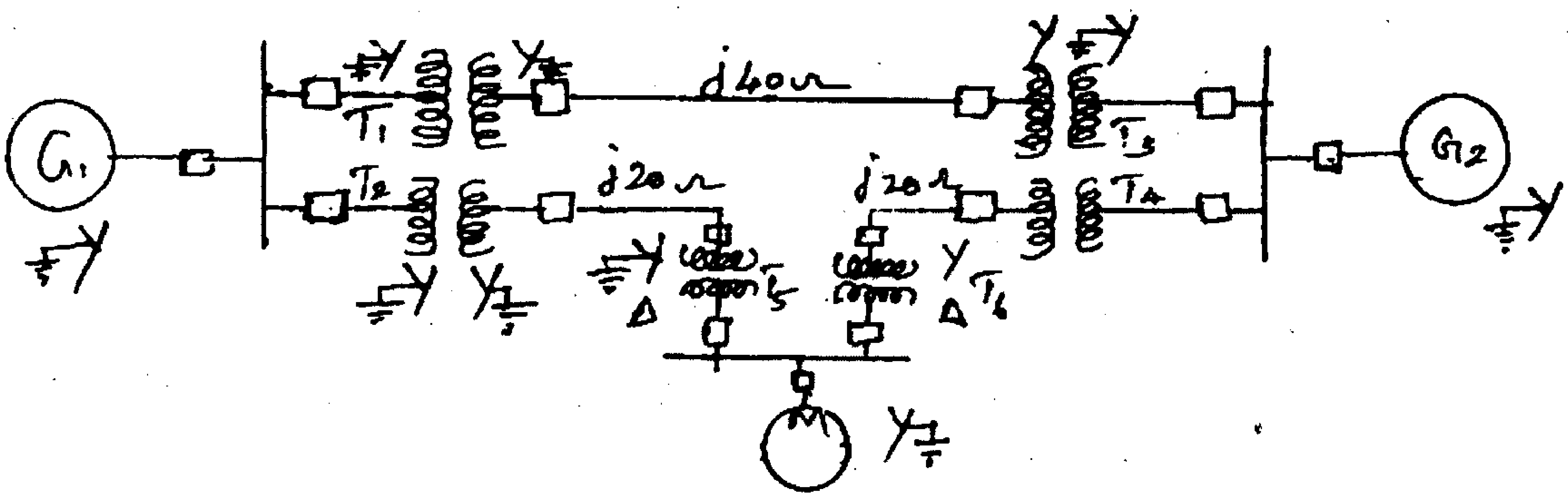

Figure 11(b)

Generator G 1: 20 MVA, 18 kV, X" = 20%

Generator G 2 : 40 MVA, 18 kV, X" 20%

Synchronous motor : 30 MVA, 13.8 kV, X" = 20%

3ϕ Y — Y Transformer: 20 MVA, 138/20 kV, X = 10%

3ϕ Y — Y Transformer: 15 MVA, 138/13.8 kV, X = 10%. (16)

12. (a) For the transmission line with the following data, form the bus admittance matrix. (16)

Bus code p-q	Impedance (z_{pq})	Line charging $y'_{pq}/2$
1–2	0.15 + j0.6	j0.02
1–3	0.10 + j0.4	j0.02
1–4	0.15 + j0.6	j0.025
2–3	0.05 + j0.2	j0.01
2–4	0.05 +j0.2	j0.01

Or

(b) Derive load flow algorithm using Newton - Rapson method with flow chart and discuss the advantages of the method. (16)

13. (a) A 3-phase transmission line operating at 33kV and having a resistance of 5 Ω and reactance of 20 Ω is connected to the generating station through 15,000 kVA step-up transformers. Connected to the bus-bars are two alternators one of 10,000 kVA with 10% reactance and another of 5,000 kVA with 7.5% reactance. Draw the single line diagram and calculate the short circuit kVA for a symmetrical fault between phases at the load end of the transmission line. (16)

Or

(b) For the network shown in Figure 13(b), Find the subtransient current in per unit from generator 1 and in line 1-3 and the voltages at bus 1 and 2 for a three phase fault on bus 3. Assume that no current is flowing prior to the fault and that the prefault voltage at bus 3 is 1 p.u. Use (i) bus impedance method (ii) network reduction method for the calculations. (16)

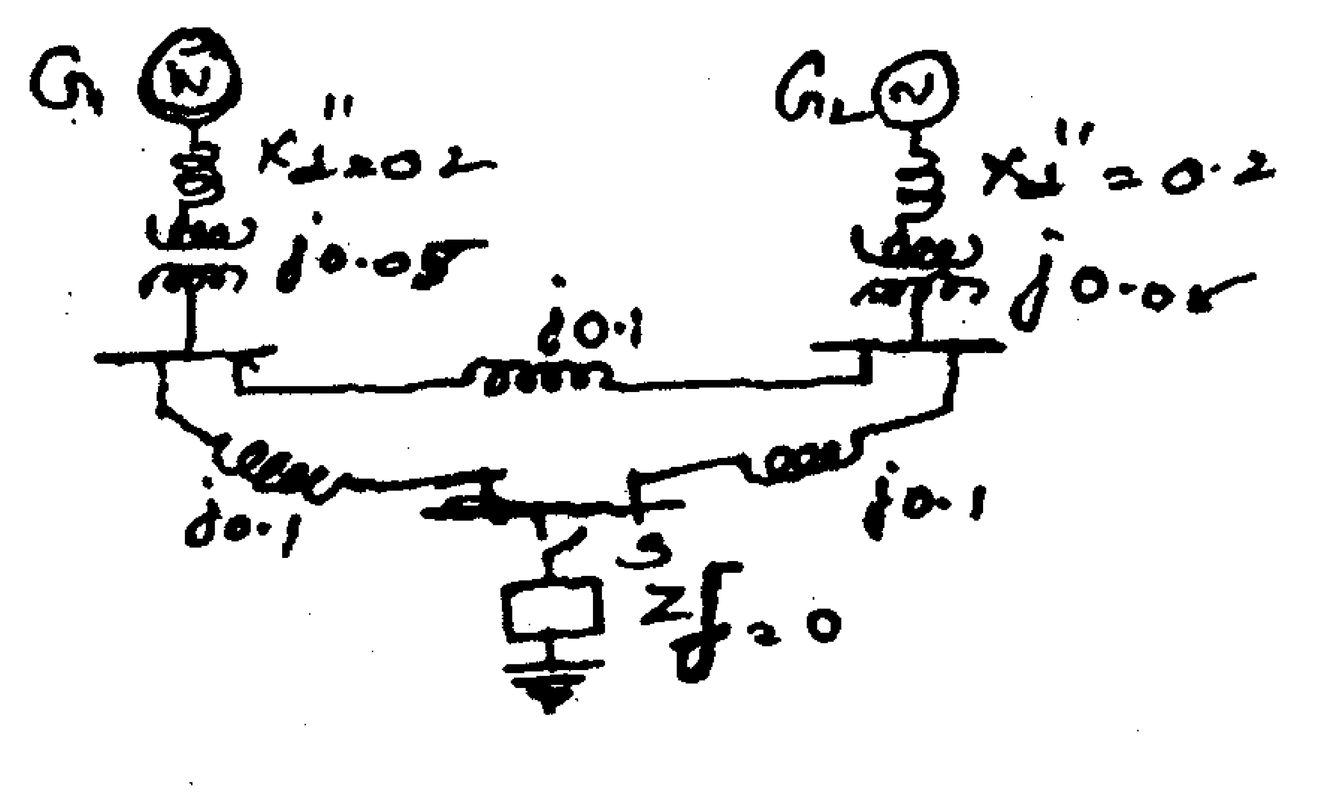

Figure 13 (b)

14. (a) Derive the expression for the fault current for a double line to ground fault. (16)

Or

(b) A 50 Hz, 50 MVA, 13.2 kV star grounded alternator is connected to a line through a Δ-Y transformer as shown in Figure 14(b). The positive, negative, zero sequence impedances of the alternator are j0.1, j0.1, j0.05 respectively. The transformer rated at 13.2 kVΔ / 120 kV Y, 50 Hz with Y solidly grounded has the sequence impedances of $X'' = X_2 = X_0 = j0.1$ p.u. The line impedances between Q and R are $X_1'' = j0.03$, $X_2 = j0.03$, $X_0 = j0.09$. Assuming that the fault to be takes place at Q, determine the subtransient fault current for a (i) 3ϕ fault (ii) L-G fault (iii) L-L fault (iv) L-L-G fault. Draw the connection diagram for the sequence diagram in each fault. (16)

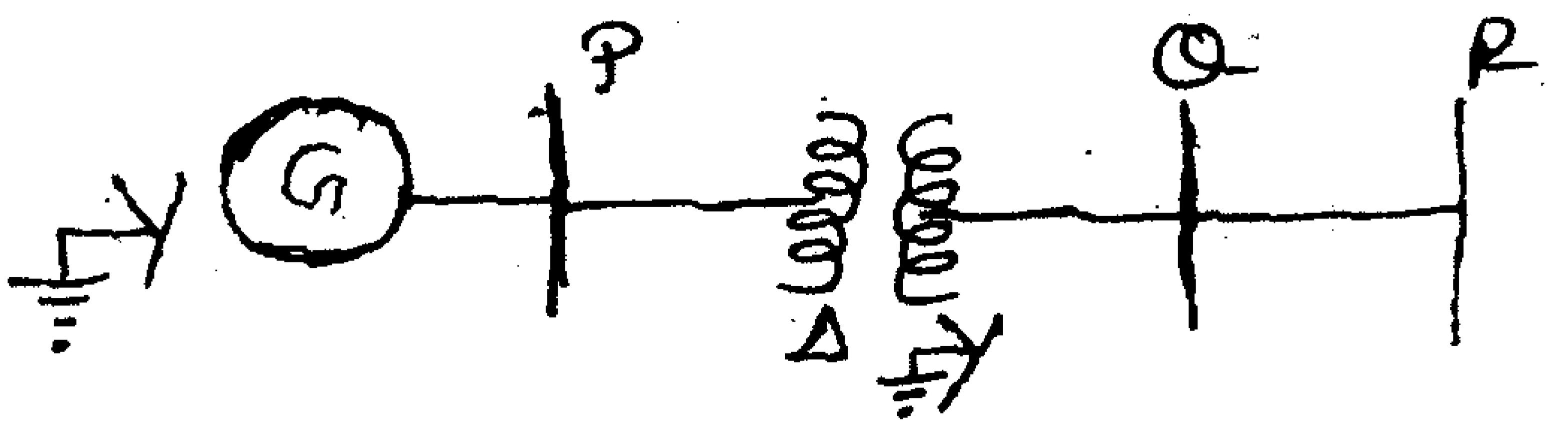

Figure 14(b)

15. (a) A 60Hz generator is supplying 0.6 p.u power to an infinite bus system through a reactive network. The maximum power which the generator can deliver to the infinite bus system is 1.0 pu. A fault occurs and reduces the output of the generator to zero. The fault gets cleared after 3-cycles. In the post fault period, the maximum power which the generator can deliver to the infinite bus system is 0.8 p.u. The inertia constant H of the generator is 5 seconds. Compute swing curve up to 0.15 second. (16)

Or

(b) Draw the flow chart of modified Euler's method and explain its algorithm. (16)