B.E. / B.Tech. Degree Examination, April / May 2010
Sixth Semester

Electrical and Electronics Engineering

EE 1352 – Power System Analysis

(Regulation 2008)

Time: Three hours Maximum: 100 marks

Answer all questions

Part A – (10 × 2 = 20 marks)

1. What is one line diagram?
2. Write the equation for converting the p.u. impedance expressed in one base to another base.
3. Describe primitive network. Give an example.
4. Compare Gauss-Seidel and N-R method.
5. What are the models used to represent generators in short circuit analysis?
6. The three-phase fault level of 220 KV bus is 40 p.u. on 100 MVA base. What is the positive sequence Thevenin impedance looking into the bus in Ohms? Neglect resistance.
7. Draw the equivalent sequence network for a L-L bolted fault in power system.
8. Draw the zero sequence network for Y/Δ connected transformer.
9. Define steady state stability.
10. What are the causes of oscillatory and non-oscillatory instabilities in power systems?

Part B – (5 × 16 = 80 marks)

11. (a) (i) The subtransient reactance of a 500 MVA, 18 KV generator is 0.25 p.u. on its ratings. It is connected to a network through a 20 / 400 KV transformer. Find out the subtransient reactance of the generator on a base of 100 MVA and 20 KV. (4)

(ii) A transformer interconnects a strong 400 KV and a weaker 200 KV system and is provided with a tap changer on the 400 KV side. What is the effect of setting the tap such that the voltage ratio is 410 / 200 KV on the 400 and 220 KV sides? (4)

(iii) Draw the p.u. reactance diagram of a three-winding transformer whose three-phase ratings are: primary (P), wye-grounded, 15 MVA, 66 KV; secondary (S), wye-grounded, 10 MVA, 13.2 KV; tertiary (t), delta connected, 5 MVA, 2.3 KV. Mark the appropriate values of the impedances. The measured data for impedances are Z_{PS} = 7 % on 15 MVA and 66 KV; Z_{PT} = 9 % on 15 MVA and 66 KV; Z_{ST} = 8 % on 10 MVA and 13.2 KV. (8)

(OR)

(b) The data for the system whose single-line-diagram is shown in given figure is as follows:

T_1: 5 MVA, 13.2 Δ / 132 Y KV, X = 10 %,

T_2: 10 MVA, 138 Y / 69 Δ KV, X = 8 %,

Transmission Line: Z_L = 10 + j100 Ω/phase, Load: Z_{Load} = 300 Ω/phase.

Choose the base power as 10 MVA and appropriate base voltage for different parts. Draw the impedance diagram with values of per unit impedances of various components clearly marked. Also find the generator current, the transmission line current, the load current and the load voltage.

12 (a) The parameters of a 4-bus system are as under:

Line no.	Line starting bus	Line ending bus	Line impedance (p.u.)	Line charging admittance (p.u.)
1	1	2	0.2 + j0.8	j0.02
2	2	3	0.3 + j0.9	j0.03
3	2	4	0.25 + j1.0	j0.04
4	3	4	0.2 + j0.8	j0.02
5	1	3	0.1 + j0.4	j0.01

Draw the network and find bus admittance matrix.

(OR)

(b) For a network shown in given figure form the bus admittance matrix.

Z_a = j0.6; Z_b = j0.4; Z_c = j0.5 = Z_d; Z_e = j0.2; Z_m = j0.1. All data are in p.u.

13 (a) For the three-bus system given in the Table, formulate the Z_{bus} using the Z_{Bus}building algorithm. Take bus 1 as reference.

Element No.	From Bus	To Bus	Impedance (p.u.)
1	1	2	j 0.1
2	2	3	j 0.1
3	3	1	j 0.1
4	1	0	j 0.25
5	2	0	j 0.25

(OR)

(b) Two synchronous motors are connected to the bus of large system through a short transmission line as shown in given figure. The ratings of the various components are:

Motor (each): 1 MVA, 440 V, 0.1 p.u. transient reactance,

Line: 0.05 Ω (reactance,

Large system: Short circuit MVA at its bus at 440 V is 8.

When the motors are operating at 400 V, calculate the short circuit current (symmetrical) fed into a three-phase fault at motor bus.

14 (a) Derive the relationship for fault currents in terms of symmetrical components when there is a line-to-ground (L-G) fault on phase ‘a’.

(OR)

(b) (i) Show that for a three phase transmission line the sequence networks (positive, negative and zero) are not decoupled if the mutual impedance between the lines is not equal. (8)

(ii) Show that positive and negative sequence currents are equal in magnitude but out of phase by 180 degree in a line-to-line fault. (8)

15 (a) The given figure shows transmission network. The p.u. reactances of the equipments are as shown. The voltage behind transient reactance of generator is 1.2 p.u. The generator is delivering 1.0 p.u. power under prefault condition. Determine,

(i) Transfer reactance for prefault, during fault and post fault conditions and.

(ii) Critical clearing angle.

(OR)

(b) The synchronous machine shown in given figure is generating 100 MW and 75 MVAr. The voltage of the infinite bus 'q' is 1 + j0 p.u. The generator is connected to the infinite bus through a line of reactance 0.06 p.u. on a 100 MVA base. The machine transient reactance is 0.2 p.u. and the inertia constant is 6 p.u. on a 100 MVA base. A 3- fault occurs at bus 'p' for a duration of 0.1 sec. Compute the rotor angle at t = 0.03 sec (Δt = 0.03 sec) using modified Euler method. The frequency of the supply is 60 HZ.