B.E/ B.Tech. Degree Examination, Nov / Dec 2008
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 the need for system analysis in planning and operation of power system?
2. How are the base values chose in per unit representation of a power system?
3. Draw the π equivalent circuit of a transformer with off-nominal tap ratio and admittance Y.
4. Define bus incidence matrix.
5. Mention two objectives of short circuit analysis.
6. Draw the zero sequence network of a star connected generator with zero sequence impedance Z_{go} when the neutral is ground through an impedance Z_n.
7. What are the three classes of buses of a power system used in power flow analysis? What are the quantities to be specified and to be computed for each class during power flow solution?
8. Compare Gauss-Seidel method and Newton-Raphson method with respect to number of iterations taken for convergence and memory requirement.
9. Define critical clearing time.
10. Write the power angle equation of a synchronous machine connected to an infinite bus and also the expression for maximum power transferable to the bus.

Part B – (5 × 16 = 80 marks)

11. Obtain the per unit impedance (reactance) diagram of the power system

G_1: 20 MVA, 10.5 KV, X” = 1.4 Ω, X_{n1} = 0.5 Ω,
G_2: 10 MVA, 6.6 KV, X” = 1.2 Ω, X_{n2} = 0.5 Ω,
T_1 (3 phase): 10 MVA, 33 / 11 KV, X = 15.2 Ω per phase on high tension side.
T_2 (3 phase): 10 MVA, 33 / 6.6 KV, X = 16 Ω per phase on high tension side.
Transmission line: 22.5 Ω per phase. Choose a common base of 20 MVA.

12. (a) Determine Z_{Bus} using bus impedance matrix building algorithm by adding the lines as per increasing element number. The reactance diagram of the system is shown in given figure.

(OR)

(b) Explain the modeling of generator, load and transmission line for short circuit, power flow and stability studies.

13 (a) Derive the formula for fault current, fault bus voltages and current through the lines for a 3 phase symmetrical fault at a bus in a power system using ZBus. State the assumptions made in the derivations.

(OR)

(b) A single line to ground fault occurs on bus 4 of the system shown in given figure.

(i) Draw the sequence networks. (12)

(ii) Compute the fault current. (4)

Generator 1 & 2: 100 MVA, 20 KV with $X_1 = X_2 = 20$ %, $X_0 = 4$ %, $X_n = 5$ %,

Transformer 1 & 2: 100 MVA, 20 KV / 345 KV, $X_{leakage} = 8$ % on 100 MVA,

Transmission line: $X_1 = X_2 = 15$ % nad $X_0 = 50$ % on a base of 100 MVA, 20 KV.

14 (a) Explain clearly the algorithmic steps for solving load flow equations using Newton-Raphson method (polar form) when the system contains all types of buses. Assume that the generators at the PV buses have enormous Q limits and hence Q limes need not be checked.

(OR)

(b) The system data for a load flow problem are given in Table 1 and Table 2.

(i) Compute Y_{bus}. (6)

(ii) Determine bus voltages at the end of 1st iteration by Gauss-Seidal method. Take acceleration factor as 1.6. (10)

Table 1

Bus Code	Admittances (p.u)
1 – 2	2 – j8
1 – 3	1 – j4
2 – 3	0.6 – j2.6

Table 2

Bus Code	P_D in p.u	Q_D in p.u	V in p.u	Remarks
1	–	–	$1.06\angle 0^{\circ}$	Slack
2	0.5	0.2	–	PQ
3	0.4	0.3	–	PQ

15 (a) (i) Write the swing equation describing the rotor dynamics of a synchronous machine connected to infinite bus through a double circuit transmission line. (8)

(ii) Explain the step-wise procedure of determining the swing curve of the above system using Modified Euler's method. (8)

(OR)

(b) In the system shown in given figure a three phase fault occurs at point p closer to bus 2.

Find the critical clearing angle for clearing the fault with simultaneous opening of the breakers 1 & 2. The reactance values of the various components are $X_g = 0.15$ p.u, $X_{L1} = 0.5$ p.u, $X_{L2} = 0.4$ p.u. The generator is delivering 1.0 p.u power at the instant preceding the fault.