Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/M.Tech (EE)/SEM-1/PSM-102/2012-13

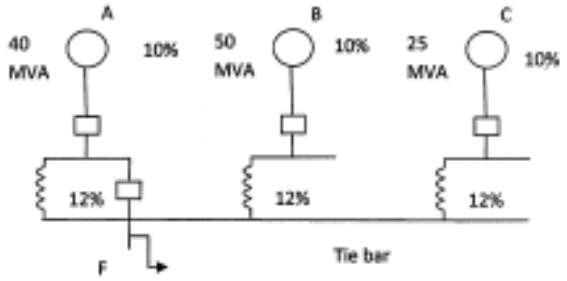
2012
POWER SYSTEM ANALYSIS

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

Answer any *five* questions.

1. a) There 6·6 kV generators A, B and C, each of 10% leakage reactance and MVA ratings 40, 50 and 25, respectively are interconnected electrically, as shown in figure, by a tie bar through current limiting reactors, each of 12% reactance based upon the rating of the machine to which it is connected. A three-phase feeder is supplied from the bus bar of generator A at a line voltage of 6·6 kV. The feeder has a resistance of 0·06 Ω/phase and an inductive reactance of 0·12 Ω/phase. Estimate the maximum MVA that can be fed into a symmetrical short circuit at the far end of the feeder.



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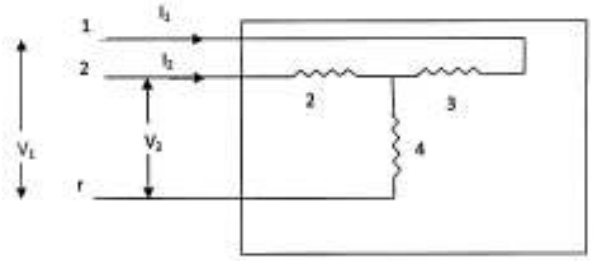
b) Consider the network of the figure shown below with three buses one of which is a reference. Evaluate Z_{BUS}.



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2. a) The voltage at the terminals of a balanced load consisting of three 20 ohm Y-connected resistors are $200\angle 0^\circ$, $100\angle 255{\cdot}5^\circ$ and $200\angle 151^\circ$ V. Find the line currents from the symmetrical components of the line voltages if the neutral of the load is isolated. What relation exists between the symmetrical components of the line and phase voltage ? Find the power expanded in three 20 ohm resistors from the symmetrical components of currents and voltages. 7

b) Consider a 5-bus power system network with generator at bus 1, 2 and 3 is connected. Bus 1, with its voltage set at $1{\cdot}06\angle 0^\circ$ pu, is taken at the slack bus. Line impedances are given below. Calculate the Y-bus matrix.

Bus to Bus	Impedance value in per unit
1-2	0·02+j0·06
1-3	0·08+j0·24
2-3	0·06+j0·18
2-4	0·06+j0·18
2-5	0·04+j0·12
3-4	0·01+j0·03
4-5	0·08+j0·24

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3. What do you mean by static load flow solution ? What are the advantages to calculate Y-bus matrix instead of Z-bus matrix ? Describe the algorithm for Gauss-Seidel load flow solution. Compare G-S method to N-R method of load flow solution. 2 + 3 + 5 + 4

4. Write down the sequential steps of decouple load flow solution. Consider a 4-bus system having bus voltage magnitudes for the buses 1, 3, 4 as 1·03, 1 and 1 with angle 0° respectively. The complex powers for buses 2, 3, 4 are 0·5-j0·2, –1+j0·2 and 0·5-j0·5 respectively. Admittance values for each transmission line are shown in the table below. Determine the value of the voltage magnitude for bus-2 after second iteration.

Bus to Bus	Admittance value in per unit
1-2	–2 + j4
1-3	–1 + j6
2-3	–0·67 + j2
2-4	–1 + j3
3-4	–2 + j6

6 + 8

5. What is the expression for critical receiving end voltage and critical power angle at voltage stability limit for a two-bus power system by considering shunt compensated line. 14

6. a) Why do small oscillations appear in power system network ? What are the main governing factors in generating small oscillations ? 2 + 3

   b) What do you mean by stability of a dynamic system ? 5

   c) Explain the mechanism of tie line oscillations. 4

7. a) Derive the relation between voltage and reactive power at a node in a power system. 4

   b) Derive a direct indicator of voltage stability and its implication on voltage stability margin. 10