Name : ....

Roll No. : ....

Invigilator's Signature : ....

CS/M.TECH(EE)/SEM-1/PSM-102/2011-12

2011

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.   5 × 14 = 70

1. a) Write down the flow chart for load flow solution using G.S. method including voltage control buses.   6

    b) The following is the system data for a load flows solution line data :

Bus-to-Bus	Admittance
1 – 2	$2 - j\,8$
1 – 3	$1 - j\,4$
2 – 3	$0 \cdot 666 - j\,2 \cdot 664$
2 – 4	$1 - j\,4$
3 – 4	$2 - j\,8$

Bus data :

Bus	*P*	*Q*	*V*	Remarks
1	—	—	1·06	Slack
2	0·5	0·2	1	*PQ* bus
3	0·4	0·3	1	*PQ* bus
4	0·3	0·1	1	*PQ* bus

Determine the voltages at the end of 1st iteration using

G.S. method. Take $\alpha = 1 \cdot 6$, α = acceleration factor.   8

40362   [Turn over

2. a) What is the significance of Reference bus in load flow solution ? 3

   b) The sample data for load flow is given below. Determine the set of load flow equations at the end of 1st iteration by using N.R. method. 11

   Line date :

Bus-to-Bus	Impedance
1 – 2	$0 \cdot 08 - j\,0 \cdot 24$
1 – 3	$0 \cdot 02 - j\,0 \cdot 06$
2 – 3	$0 \cdot 06 - j\,0 \cdot 18$

   Bus data :

Bus	Voltage	Generation		Load	
		MW	MVAR	MW	MVAR
1	1·06	0·0	0·0	0·0	0·0
2	1·0	0·2	0·0	0·0	0·0
3	1·0	0·0	0·0	0·6	0·25

3. What is the expression for critical receiving end voltage and critical power angle at voltage stability limit for a two bus power system ? 14

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

   b) Determine the ohmic value of the current limiting reactor per phase external to a 30 MVA, 11 KV, 50 Hz, 3-phase synchronous generator which can limit the current on short circuit to 6 times the full load current. The reactance of the synchronous generator is 0·06 p.u.

   7
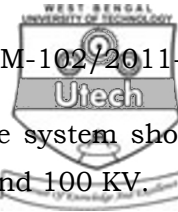
5. Draw the per unit impedance diagram of the system shown in figure. Assume base values are 100 MVA and 100 KV.
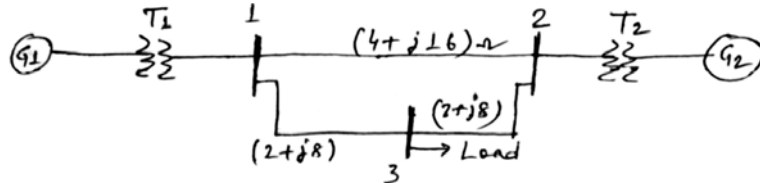
G_1 : 50 MVA, 12·2 KV, X_{G_1} = 0·10 p.u.

G_2 : 20 MVA, 13·8 KV, X_{G_2} = 0·10 p.u.

T_1 : 80 MVA, 12·2/132 KV, X_{T_1} = 0·10 p.u.

T_2 : 40 MVA, 13·8/132 KV, X_{T_1} = 0·10 p.u.

Load : 50 MVA, 0·80 p.f. lagging operating at 124 KV.　　14

6. a) What is small signal stability and what are the various modes of oscillations ?　　2 + 4

   b) Explain the mechanism of tie line oscillations. What are its properties ?　　4 + 4

7. Find the expression for undamped natural frequency of power system oscillation and the damping ratio for a single machine infinite bus system.　　14

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