Kadi Sarva Vishwavidyalaya.

ME (Sem-I) (Electrical)

Power System Modeling & Simulation

Date: 17/01/2013 **Max. Mark: 70**

Time: 3 Hrs

Instructions:

1. Answer each section in separate Answersheet.
2. Assume suitable data wherever it is necessary.
3. Use of Scientific Calculator is permitted.

Section-I

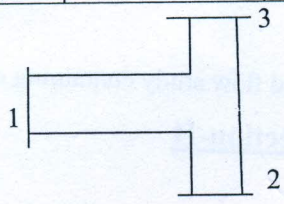
Q-1 **Each Carries equal marks.** **[15]**

[A] **Choose the correct option.**

1. Load flow study is carried out for,
   (a)Load frequency control (b) System planning (c) Stability Studies (d) Fault Calculation
2. Normally Z_{bus} matrix is a _____ matrix.
   (a)Null (b) Sparse (c) Full (d) Unity
3. Transient Phenomenon lasts in power system for a period ranging from, _____ second.
   (a)Few ms to 1 (b) 1 to 2 (c) 2 to 3 (d) more than 3
4. One of the most important objective of power system State estimator is
   (a)Monitoring (b) Contingency Selection (c) Security control (d) None of the above
5. Power System Security analysis program normally uses,
   (a)DC load flow (b) AC load flow (c) AC-DC load flow (d) Any of the above

[B] Form Z_{bus} by building algorithm for the following power system network whose parameters are given below:

Element No.	Self Impedances		Mutual Impedances	
	p-q	Z_{pqpq}	x-y	Z_{pqxy}
1	1-2	0.5	1-3	0.5
2	2-3	0.5	---	---
3	1-3	0.25	---	---



[C] Write Short note: The power Flow Jacobian

OR

[C] Briefly explain concept of optimal power flow and then obtain Solution of Optimal power flow by Gradient method.

Q-2 **[A]** Describe the steps for formulation of $[Y_{bus}]$ using singular transformation method. Also explain when $[Y_{bus}]$ becomes symmetrical and unsymmetrical. **[05]**

[B] Define Following: **[05]**

1. Basic loop matrix 2. Basic cutset matrix 3. Branch Path Incidence matrix.

OR

P.T.O.

Q-2 **[A]** Derive the relationship $Z_{loop} = B\,[Z]\,B^T$. **[05]**
Where Z_{loop}= Loop incidence matrix, B= Basic Loop incidence matrix

[B] How Z_{bus} algorithm is used to add Brach element into existing partial network. Derive all the equations used in algorithm. **[05]**

Q-3 **[A]** Explain Load Flow Solution for PV and PQ buses using Gauss-Seidel Method. **[05]**

[B] The load flow data for the power system are given below. The voltage magnitude at bus 2 is maintained at 1.04 pu. The maximum and minimum reactive power limits of the generator at bus 2 are 0.35 and 0 pu respectively. Determine the set of Load flow equation at the end of first iteration by using Newton Raphson method. **[05]**

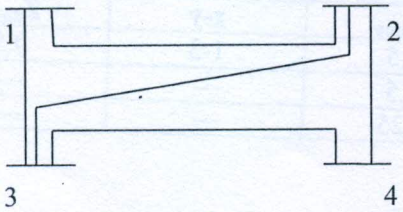
Bus code	Impedance	Admittance
1-2	0.08+j 0.24	0
1-3	0.02+j 0.06	0
2-3	0.06+j 0.18	0

Bus code	Assumed Volatges	Generation		Load	
		MW	MVAR	MW	MVAR
1	1.06 +j0	0	0	0	0
2	1.0 +j0	0.2	0	0	0
3	1.0 +j0	0	0	0.6	0.25

OR

Q-3 **[A]** For the system shown in Fig. A the generators are connected at all four buses, while loads are at buses 2 and 3. Assuming a flat voltage profile, find voltage and bus angles at three buses at the end of the first GS iteration. **[05]**

Bus	P_p	Q_p	V_p	Remarks
1	----	----	1.04 <0	Slack
2	0.5	-0.2	----	PQ bus
3	-1.0	0.5	----	PQ bus
4	0.3	-0.1	----	PQ bus



[B] Explain Newton-Raphson method for load flow study containing only PV bus. **[05]**

Section-II

Q-4 **Each Carries equal marks.** **[15]**

[A] Write a note on: Bad data detection and Identification of bad data.

[B] Write a note on: Weather sensitive load forecasting.

[C] Write a note on: Modeling of governor Exciter system.

OR

[C] Write a note on: Modeling of tap-changing Transformer.

Q-5 **[A]** Derive the formula for State estimation based on Weighted least Square method. **[05]**

[B] Explain State Estimation by orthogonal decomposition. **[05]**

OR

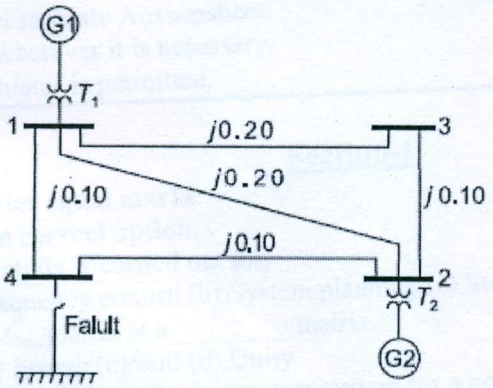
Q-5 **[A]** Explain maximum likelihood concept with proper example. **[05]**

[B[Explain Network observability and Pseudo measurement in state estimation. [05]

Q-6 [A] Draw power system static security level diagram & explain each level. [05]

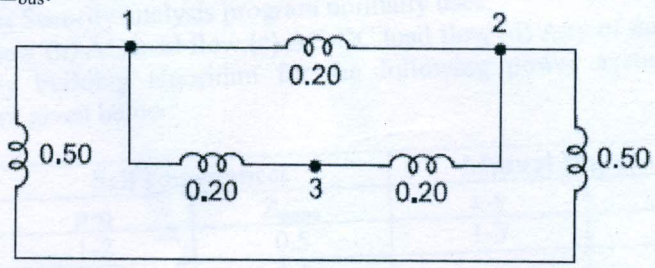
[B] For the network shown in fig., Perform Short circuit studies and determine Fault Current for solid three phase to ground fault at bus 4. Assume pre-fault bus voltage 1 p.u. and pre-fault currents to be zero. Data is given below. [05]

G_1= 11.2 KV, 100 MVA, X'_{G1}=0.08 p.u.
G_2= 11.2 KV, 100 MVA, X'_{G2}=0.08 p.u.
T_1= 11/110 KV, 100 MVA, XT_1=0.06 p.u.
T_2= 11/110 KV, 100 MVA, XT_2=0.06 p.u.



OR

Q-6 [A] Figure shows a three bus network. By using Algorithm for formation of Bus impedance matrix, find Z_{bus}. [05]



Reference bus *r*.

[B] Write a note on: Load forecasting based on discounted multiple regression. [05]

Seat No.: _____ Enrolment No._____

KADI SARVA VISHWAVIDYALAYA

M.E. SEM-I

Subject Name: Power System Modelling and Simulation 23/5/13

Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1

(a) Explain the formulation of Z_{BUS} matrix. Enlist in detail the steps involved [10]

(b) Why Y_{BUS} matrix is a symmetric matrix? Under which conditions it becomes Unsymmetrical? [5]

OR

(b) Why do we need load flow study? Derive static load flow equations [5]

Q.2

(a) Figure 1 shows the one line diagram of a simple three bus power system with generators at buses 1 and 3. The magnitude of voltage at bus 1 and 3 is adjusted to 1.05 pu and 1.04 pu respectively. The real power generation at bus 3 is 200 MW. A load consisting of 400 MW and 250 MVAR is taken from bus 2. Line impedances are marked in pu on a 100 MVA base. Obtain the complex bus bar voltages at bus 2 and 3 at the end of first GS iteration. Assume that bus 3 is a PV bus and its reactive power limits are not violated. [10]

OR

Q.2

(a) Compare NR and GS method of load flow [7]

(b) Explain why load forecasting is required? [3]

Q.3

(a) What is regression analysis? Draw and explain different types of regression curves Also explain different types of regression functions for load forecasting [10]

OR

Q.3

(a) Explain why it is necessary to carry out three phase load flow studies in some cases? [3]

(b) Explain Newton Raphson method of load flow [7]

Q.4

(a) Discuss concentric relaxation and bounding with respect to power system security [10]

(b) Draw and explain in brief the generic model of steam turbine [5]

OR

(b) Draw and explain governor model for hydraulic turbine [5]

Q.5

(a) In d.c circuit of fig. 2 the meter readings are $Z_1 = 9.01A$, $Z_2 = 3.02A$, $Z_3 = 6.98V$ $Z_4 = 5.01V$. Assign the measurement weights $w_1 = 100$, $w_2 = 100$, $w_3 = 50$ and $w_4 = 50$. Determine the least squares estimation of V_1 and V_2. Assume that the coefficient matrix is given by [10]

$$H = \begin{bmatrix} 0.625 & -0.125 \\ -0.125 & 0.625 \\ 0.375 & 0.125 \\ 0.125 & 0.375 \end{bmatrix}$$

OR

Q.5

(a) Explain the procedure to identify bad data in measurements [5]

(b) Explain network observability and pseudo measurements [5]

Q.6

(a) Using the chi square test of inequality, check for the presence of bad data in the measurements which are given by $[Z_1\ Z_2\ Z_3\ Z_4]^T = [8.97\ 2.95\ 6.94\ 4.98]$ and the estimated errors are [0.00877 0.00456 -0.02596 -0.00070]. Choose $\alpha = 0.01$ and $f^{est} = 9.21$ Assume that measurement weights are 100, 100, 50 and 50 [4]

(b) Explain in brief the algorithm for optimal power flow based on Newton's method [6]

OR

Q.6

(a) Define and explain linear sensitivity factors. With the help of flowchart explain contingency analysis using sensitivity factors. [10]

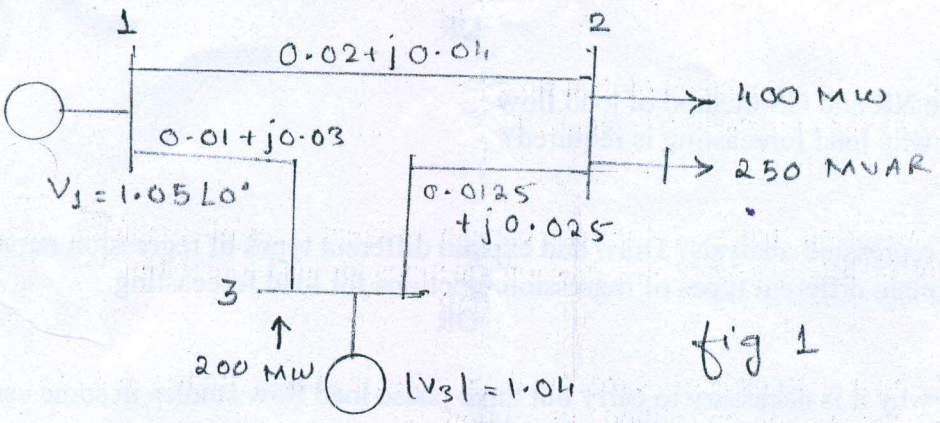


fig 1

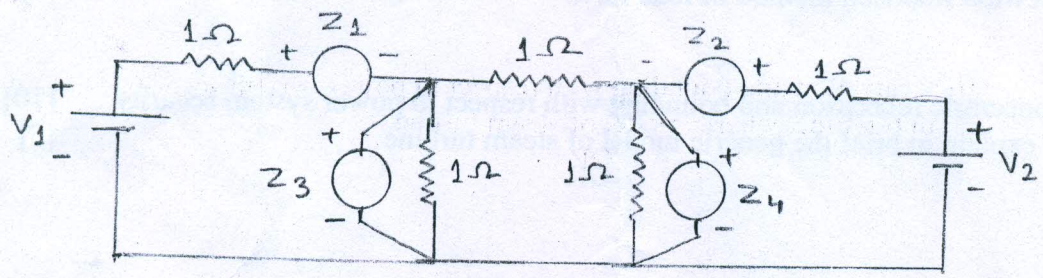


fig 2