Seventh Semester B.E. Degree Examination, December 2010
Computer Techniques in Power System Analysis

Time: 3 hrs.　　　　　　　　　　　　　　　　　　　　　Max. Marks:100

Note: *Answer any FIVE full questions, selecting*
at least TWO questions from each part.

PART – A

1. a. Define primitive network. Give primitive element representations in impedance and admittance forms, defining all variables. **(05 Marks)**

   b. For the power system shown in Fig.Q1(b), obtain the incidence matrices A, B, C and K, with ground node as reference. Hence verify the identities i) $B_f = A_f K^t$　ii) $B^t C = 0$. **(10 Marks)**

   c. The bus incidence matrix for a network graph containing six elements and four nodes (including reference node) is given below. Reconstruct the oriented graph. **(05 Marks)**

   $$A = \begin{bmatrix} -1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -1 \\ 1 & -1 & 0 \\ 0 & 1 & -1 \\ 1 & 0 & -1 \end{bmatrix}$$
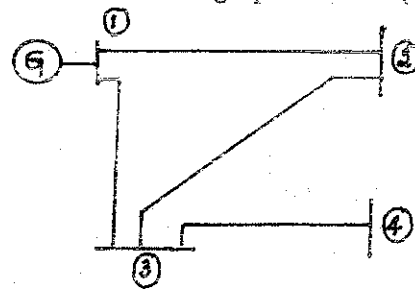

Fig.Q1(b)

2. a. With usual notations, prove that $[Y_{BUS}] = A^t [y] A$ for singular transformations. **(06 Marks)**

   b. For the network graph shown in Fig.Q2(b), obtain $[Y_{BUS}]$ with node 1 as reference, using singular transformation. Neglect mutual coupling. Self impedance of elements are marked on the diagram. **(06 Marks)**

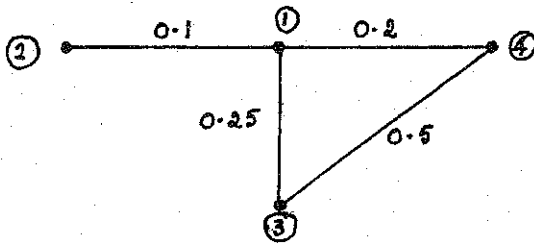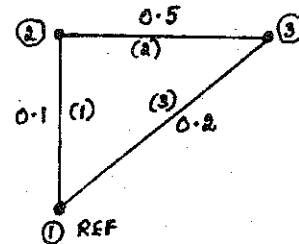
Fig.Q2(b)　　　　　　　　　　　　　　Fig.Q2(c)

   c. For the network graph shown in Fig.Q2(c), determine $[Z_{BUS}]$, with node 1 as reference, using building algorithm. Neglect mutual coupling. Self impedance of elements are marked on the diagram. Add elements in the order specified. **(08 Marks)**

3. a. Give the bus classification for load flow, explaining the significance. **(05 Marks)**

   b. Develop the Gauss-Seidel load flow model for a power system a slack bus and (n – 1) numbers of PQ type buses. Give the flowchart of the algorithm. **(08 Marks)**

c. In the power system shown in Fig.Q3(c), line 1-2 has the series impedance of (0.04+j0.12)pu with negligible line charging. The generation and load data is given in the table.

Bus No.	Type	Generation (pu)		Load (pu)	
		Real	Reactive	Real	Reactive
1	SLACK	-	-	-	-
2	PV	0.3	-	0.6	0.2

The slack bus voltage is (1+j0). The voltage magnitude at bus 2 is to be maintained at 1.05 pu and the generator at this bus has Q-generation limits between 0 and 0.5 pu. With (1+j0) pu initial voltage at bus 2, determine its voltage at the end of first iteration, using the Gauss-Seidel load flow model.

(07 Marks)

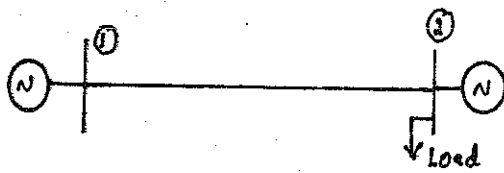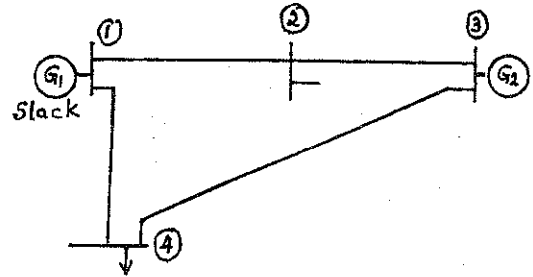

Fig.Q3(c)

Fig.Q4(b)

4 a. Deduce the fast decoupled load flow (FDLF) model, clearly stating all the assumptions made and give the flow chart.

(08 Marks)

b. For the system shown in Fig.Q4(b), bus 1 is slack.
   i) Write the voltage equations for the Gauss-Seidel interative solution assuming buses 2, 3 and 4 as load buses.
   ii) Give the NRLF model assuming the bus 3 as PV and 2 & 4 as load busses. (12 Marks)

PART – B

5 a. Derive the condition for minimum total fuel cost in a system comprising of K-thermal generating units, considering transmission losses.

(07 Marks)

b. Explain with a flow chart, the iterative technique for automatic load dispatch. (07 Marks)

c. A power system has two generating plants and power is being dispactched economically with P_1 = 140 MW and P_2 = 250 MW. The loss coefficients are B_{11} = 0.001 MW^{-1}, B_{12} = -0.001 MW^{-1} and B_{22} = 0.0013 MW^{-1}.

To raise the total load demand on the system by 1.0 MW will cost an additional Rs. 1200 per hour. Determine i) Transmission loss ii) Penalty factor for plant 1 iii) Additional cost/hour to increase the output of the plant 1 by 1.0 MW.

(06 Marks)

6 a. Derive expressions for loss coefficients and transmission loss in terms of generation in an interconnected system.

(07 Marks)

b. A two bus system is shown in Fig.Q6(b). When a load of 125 MW is transmitted from plant 1 to the load, a loss of 15.625 is incurred. Determine the economic generation schedule and load demand if the cost of the received power is Rs.24/MWh. The incremental fuel cost of the plants (in Rs./MWh) are:

$$dF_1/dP_1 = 0.0255P_1 + 15 \quad \text{and} \quad dF_2/dP_2 = 0.05P_2 + 20$$

(07 Marks)

Fig.Q6(b)

c. The incremental fuel cost (in Rs/MWh) for a plant consisting of two units are:

$dF_1/ dP_1 = 0.008P_1 + 8$ and $dF_2/ dP_2 = 0.0096P_2 + 6.4$

Determine the economic operation schedule if the maximum and minimum loading on each unit is 625 MW and 100 MW respectively. The load demand is 900 MW. Neglect transmission losses.

(06 Marks)

7 a. Explain with phasor diagrams and necessary expressions, the various synchronous machine models employed in the transient stability studies.

(12 Marks)

b. The swing equations of a synchronous generator following a disturbance are give as :

$d\delta / dt = (\omega - 377)$ radians/sec ; $d\omega / dt = 32[1 - 0.4\sin(\delta)]$

At t = 0, δ = 0.523 radian and ω = 277 radian/sec. Determine the value of δ and ω at the end of 0.2 second, usin the modified Euler method. Take $\Delta t = 0.1$ second.

(08 Marks)

8 a. With the necessary equations, explain the solution of swing equation by point by point method. Mention the assumptions made.

(07 Marks)

b. What are the network performance equations? Explain how $[Y_{BUS}]$ is modified to include machine and load models for the network solution.

(06 Marks)

c. Describe in detail, giving a flow chart, the transient stability algorithm, using modified Euler method, assuming classical synchronous machine models.

(07 Marks)

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