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06EE71

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) $B_l = A_l \cdot K^t$ 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)**

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

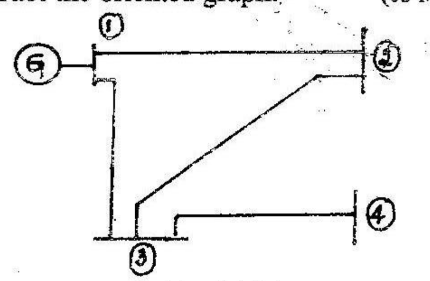

Fig.Q1(b)

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)**

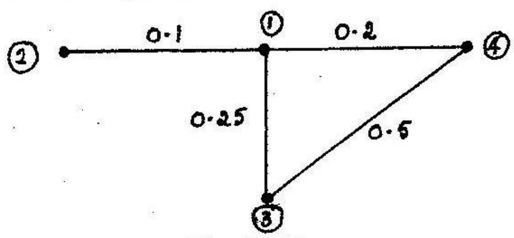

Fig.Q2(b)

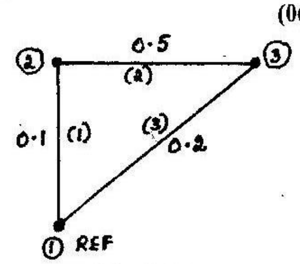

Fig.Q2(c)

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)

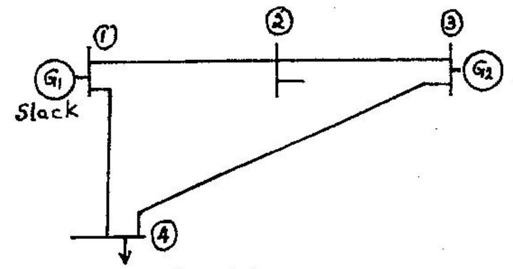

Fig.Q4(b)

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:

$dF_1/dP_1 = 0.0255P_1 + 15$ and $dF_2/dP_2 = 0.05P_2 + 20$ **(07 Marks)**

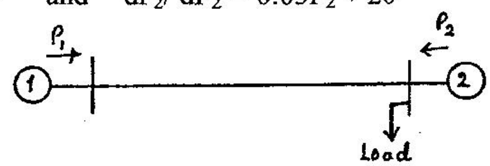

Fig.Q6(b)

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

$$dF_1/ dP_1 = 0.008P_1 + 8 \quad \text{and} \quad dF_2/ dP_2 = 0.0096P_2 + 6.4$$

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 :

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

At t = 0, $\delta = 0.523$ radian and $\omega = 277$ 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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