USN

10EE71

Seventh Semester B.E. Degree Examination, July/August 2022

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. Explain with an example the following:
(i) Oriented graph
(ii) Basic cutsets
(iii) Basic loops (06 Marks)

b. For the power system shown in Fig.Q1(b) choose node-1 as reference and verify the following relations: (i) $AbK^t = U$ (ii) $B\ell = A\ell K^t$

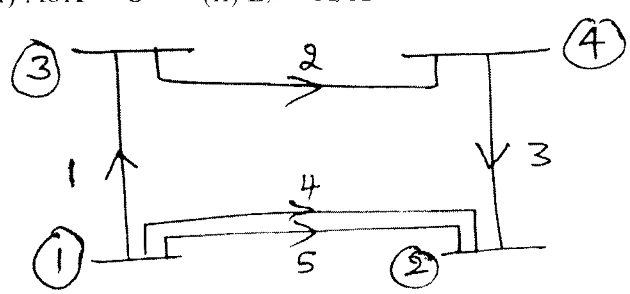

Fig.Q1(b) (10 Marks)

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.

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

(04 Marks)

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

b. Find the bus admittance matrix for the system shown in Fig.Q2(b).

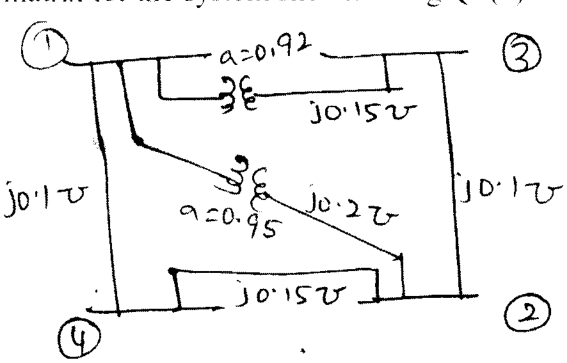

Fig.Q2(b) (06 Marks)

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 impedances of elements are marked on the diagram. Add elements in the order specified.

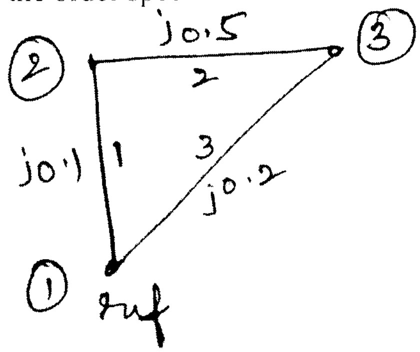

Fig.Q2(c) **(08 Marks)**

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 with a slack bus and (n – 1) number of PQ buses. Give the flowchart of the algorithm. **(08 Marks)**

c. For a three bus system, Y_{Bus} (with ground as reference) is

$$Y_{Bus} = \begin{bmatrix} -j32 & j10 & 0 \\ j10 & -j15 & j5 \\ 0 & j5 & -j6 \end{bmatrix}$$

Bus 1 is slack with voltage (1.02 + j0) pu. The real and reactive power injections in pu at buses 2 and 3 are $P_2 = -0.5$; $Q_2 = -0.1$; $P_3 = -0.3$; $Q_3 = 0.0$. Assuming (1 + j0) pu voltage at buses 2 and 3, determine its voltages at the end of first iteration using G-S method. **(07 Marks)**

4 a. Derive the expression in polar form for the typical diagonal elements of the submatrices of the Jacobian in Newton Raphson method of load flow analysis. **(08 Marks)**

b. Compare Gauss-Seidel and Newton Rephson load flow methods in respect of:
(i) Time per iteration and number of iterations
(ii) Total solution time
(iii) Convergence characteristics **(06 Marks)**

c. Explain briefly fast decoupled load flow solution method for solving the nonlinear load flow equations with assumptions. **(06 Marks)**

PART – B

5 a. Derive necessary condition for optimal operation of thermal power plants with the transmission losses considered. **(10 Marks)**

b. The fuel costs of 2 units are given by

$$f_1 = 1.5 + 20p_1 + 0.1p_1^2 \text{ Rs/hr}$$

$$f_2 = 1.9 + 30p_2 + 0.1p_2^2 \text{ Rs/hr}$$

where p_1 and p_2 are in MW. Neglecting losses find the optimal scheduling when the total demand is 200 MW and the corresponding total cost in Rs/hr. If the total load is shared equally by the generating units, find the difference in total cost in Rs/hr. **(10 Marks)**

6 a. Indicating the assumptions made, derive the equations for general loss formula coefficients and the transmission loss. **(10 Marks)**

b. For a system, one line diagram is shown in Fig.Q6(b). Assume $I_1 = 1$ pu, $I_2 = 0.8$ pu voltage at bus 3 is $V_3 = 1$ pu, find loss coefficients and power loss.
$Z_a = 0.04 + j0.16$, $Z_b = 0.03 + j0.12$ and $Z_c = 0.02 + j0.08$ pu

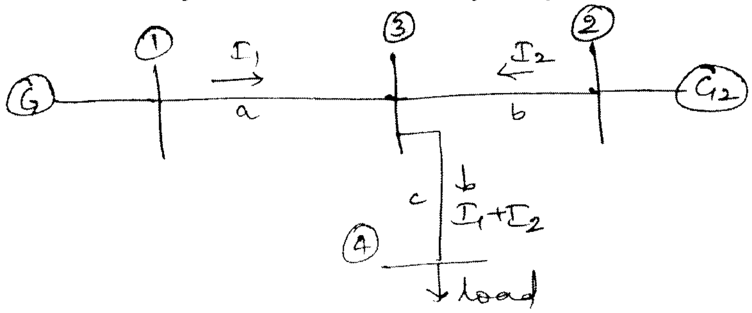

Fig.Q6(b) **(10 Marks)**

7 a. Explain the solution of swing equation by point-by-point method. **(10 Marks)**

b. Explain the method of finding the transient stability of a power system based on Runge-Kutta method. **(10 Marks)**

8 a. Explain:

(i) Network performance equation.

(ii) Load models employed in multi-machine stability studies. **(10 Marks)**

b. Explain the modified Euler's method used in solution of swing equation under transient stability studies. **(10 Marks)**

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