CBCS SCHEME

USN

18EE71

Seventh Semester B.E. Degree Examination, June/July 2023
Power System Analysis – 2

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Explain with an example the following :
(i) Oriented graph (ii) Basic Catsets (iii) Basic loops **(06 Marks)**

b. Form the incidence matrices A, B, C for the graph shown in Fig. Q1 (b). And prove $B^tC = 0$. Select 1, 2, 3 as tree, node ① as reference.

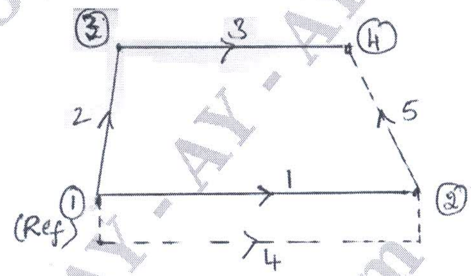

Fig. Q1 (b) **(08 Marks)**

c. What is primitive network? Obtain primitive impedance matrix and primitive admittance matrix for the elements whose data is given in Table Q1 (c).

Table Q1 (c)

Element No.	Self impedance Zpq.pq		Mutual Impedance Zpq.rs	
	Bus code p-q	Impedance in PU	Bus code r-s	Impedance in PU
1	1 – 2	j0.2	-	-
2	2 – 3	j0.4	1 – 2	j0.1
3	1 – 3	j0.3	2 – 3	j0.1

(06 Marks)

OR

2 a. Derive the expression for Y_{BUS} using singular transformation. **(06 Marks)**

b. Fig. Q2 (b) shows the one line diagram of a simple four bus system. Table Q2 (b) gives the line impedances by the buses on which these terminate. Find Y_{BUS} by singular transformation node ⓪ is the reference bus.

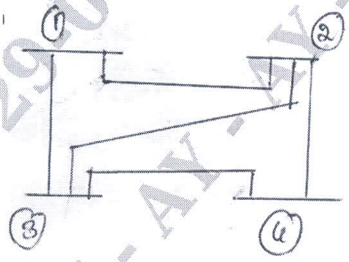

Fig. Q2 (b)

Line From Bus to To Bus	'R' in 'PU'	'X' in 'PU'
1 – 2	0.05	0.15
1 – 3	0.10	0.30
2 – 3	0.15	0.45
2 – 4	0.10	0.30
3 – 4	0.05	0.15

Table Q2 (b)

(08 Marks)

c. The Bus incidence matrix of a power system is shown below :

Elements

Buses

$$A = \begin{matrix} 1 \\ 2 \\ 3 \\ 4 \end{matrix} \begin{pmatrix} 1 & 0 & 0 & -1 & 0 & 0 & 1 \\ -1 & -1 & -1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & -1 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & -1 & -1 \end{pmatrix}$$

Obtain element node incidence matrix. Hence draw the oriented graph. **(06 Marks)**

Module-2

3 a. Explain Bus classification for power flow analysis, what is the significance of slack Bus? **(08 Marks)**

b. Explain the load flow solution procedure of Gauss-Seidel method for a power system having PQ and PV buses with Q limits. **(12 Marks)**

OR

4 a. What is the importance of load flow studies? Derive and explain static load flow equations. **(08 Marks)**

b. For the reactance system of Fig. Q4 (b), determine the voltages at bus-2 and bus-3 at the end of first iteration of Gauss-Seidel load flow analysis. Using an acceleration factor of 1.4. Given that Bus-1 is the slack bus with $V_1 = 1.0\angle 0^0$ PU ; $SG_2 = 0.25 + j0.15$PU and $SL_3 = 0.5 + j0.25$ PU.

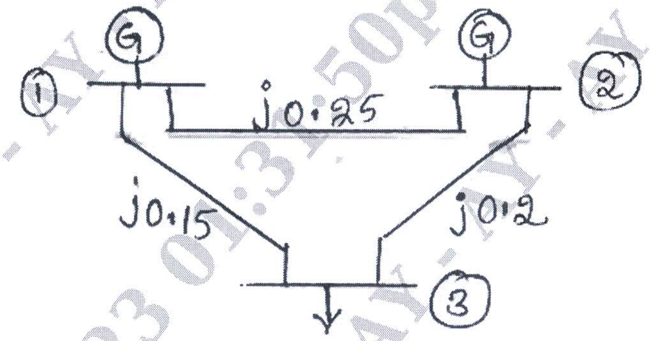

Fig. Q4 (b) **(12 Marks)**

Module-3

5 a. Discuss the algorithm procedure for load flow analysis using Newton-Raphson method in polar coordinates. **(08 Marks)**

b. Find the voltages at the end of first iteration using NR method. The Y_{BUS} matrix is a 3×3 matrix whose each diagonal term is $5.882 - j23.528$ and each off diagonal term is $-2.941 + j11.764$. Given that Bus 1 is a slack bus with $V_1 = 1.04 + j0$, $SG_2 = 0.5 + j1.0$, $S_{L_3} = 1.5 + j0.6$. **(12 Marks)**

OR

6 a. Compare NR and GS method for load flow analysis. **(08 Marks)**

b. Discuss the algorithm for Fast decoupled load flow method and mention the assumptions made. **(12 Marks)**

Module-4

7 a. Derive an expression for economic load schedule for an n-plant system neglecting the transmission losses. **(10 Marks)**

b. Incremental fuel costs in Rupees per MWh for a plant consisting of two units are,

$$\frac{dC_1}{dP_{G_1}} = 0.20P_{G_1} + 40.0$$

$$\frac{dC_2}{dP_{G_2}} = 0.25P_{G_2} + 30.0$$

Assume that both units are operating at all times and total load varies from 40 MW to 250 MW and the maximum and minimum loads on each unit are to be 125 and 20 MW respectively. How will the load be shared between the two units as the system load varies over the full range? **(10 Marks)**

OR

8 a. What are the transmission line loss coefficients? Derive an expression for transmission loss as a function of plant generation for a two plant system. **(10 Marks)**

b. Explain how dynamic programming is applied to obtain unit commitment. **(10 Marks)**

Module-5

9 a. Derive the generalized algorithm for finding the elements of bus impedance matrix when a branch is added. **(10 Marks)**

b. Construct the bus impedance matrix for the network shown in Fig. Q9 (b). Impedance values are in PU. Add the elements in the given order (1, 2, 3, 4, 5)

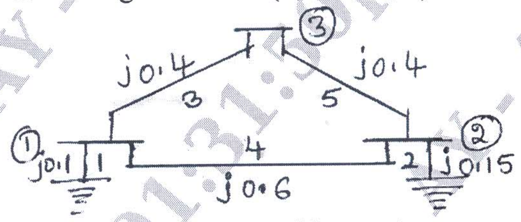

Fig. Q9 (b) **(10 Marks)**

OR

10 a. Explain with necessary equations the solution of swing equation by point by point method. **(10 Marks)**

b. Explain Runge-Kutta method used in solution of swing equation for transient stability analysis. **(10 Marks)**

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