CBCS SCHEME

USN | | | | | | | | | | | **21EE62**

Sixth Semester B.E. Degree Examination, June/July 2024
Power System Analysis – II

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define the following terms in network topology with example:
 (i) Tree
 (ii) Basic cut-set
 (iii) Bus Incidence matrix. **(06 Marks)**

b. Consider an oriented graph shown below in Fig. Q1 (b). Choose branches d, e and f as twigs. Construct the fundamental cut set matrix and Tie set matrix.

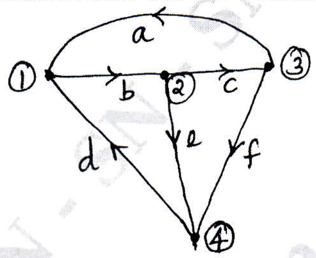

Fig. Q1 (b) **(06 Marks)**

c. A power system consists of four buses. The generators are connected at buses 1 and 3. The transmission lines are connected between buses 1 – 2, 1 – 4, 2 – 3 and 3 – 4 which have reactances of j0.25, j0.5, j0.4 and j0.1 respectively. Develop the bus admittance matrix by inspection method. Choose bus – 1 as the reference. **(08 Marks)**

OR

2 a. With usual notations, derive Y_{BUS} by singular transformation. **(06 Marks)**

b. Obtain Y_{BUS} by singular transformation method for the power system network having the following data : Take bus – 4 as reference bus.

Element No.	1	2	3	4	5
Bus code (p – q)	1 – 2	2 – 3	3 – 4	1 – 4	2 – 4
Admittance (pu)	2	1.5	3	2.5	4

(06 Marks)

c. For the power system shown in Fig. Q2 (c), obtain Y_{BUS} by singular transformation.

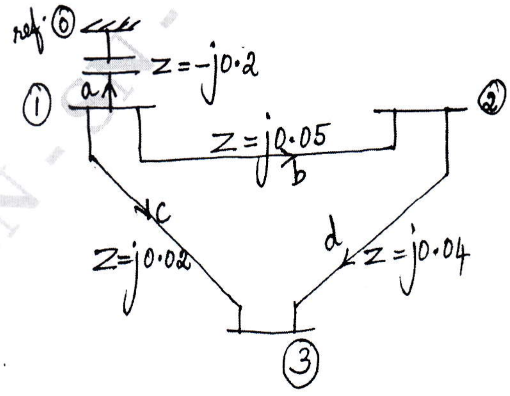

Fig. Q2 (c) **(08 Marks)**

Module-2

3 a. What is load flow study? Derive the load flow equations used in load flow study. **(08 Marks)**

b. For the power system network shown in Fig. Q3 (b), the line reactances are in pu. The bus data are shown in Table Q3 (b). Determine the voltages at bus-2 and bus-3 at the end first iteration using Gauss-Seidel method. Take acceleration factor $\alpha = 1.6$. **(12 Marks)**

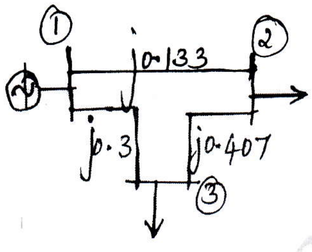

Fig. Q3 (b)

Bus No.	Type	Generation		Load		Bus voltage	
		P_G	Q_G	P_L	Q_L	$\lvert V \rvert$	δ
1	Slack	-	-	-	-	1.05	-
2	PQ	0	0	0.7	0.8	-	-
3	PQ	0	0	0.5	0.2	-	-

Table Q3 (b)

OR

4 a. Explain the algorithm for Gauss-Seidal method to obtain the load flow solution of a power system network. **(10 Marks)**

b. For a 4-bus power system network shown in Fig. Q4 (b), the real and reactive power and the bus data is given in Table Q4 (b). Assuming a flat voltage start compute the unknown variables in all the buses other than the slack bus at the end of first iteration by Gauss-Seidal method. The line data is impedance in pu. **(10 Marks)**

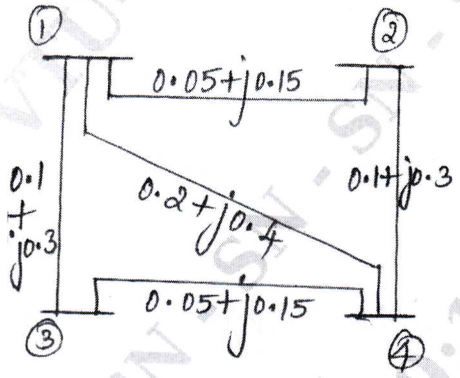

Fig. Q4 (b)

Bus No.	P_i(pu)	Q_i(pu)	V_i(pu)
1	-	-	$1.05\angle 0^\circ$
2	0.5	-0.2	-
3	-1.0	0.5	-
4	0.3	-0.1	-

Table Q4 (b)

Module-3

5 a. Compare Gauss-Seidal and Newton-Raphson method of load flow solution with respect to various parameters. **(08 Marks)**

b. List out the assumptions of FDLF method and derive the expressions for the Jacobian elements of FDLF method of load flow solution. **(12 Marks)**

OR

6 a. Explain the algorithm of Newton-Raphson method for the load flow solution of a power system network. **(10 Marks)**

b. In a two bus power system network shown in Fig. Q6 (b), bus-1 is a slack bus with $V_1 = 1\angle 0^0$ pu and bus-2 is a load bus with P_2 = 100 MW ; Q_2 = 50 MVAr. The line impedance is (0.12+j0.16)pu on a base of 100 MVA. Using NR method of load flow solution, compute the elements of the Jacobian matrix. **(10 Marks)**

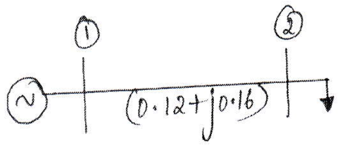

Fig. Q6 (b)

Module-4

7 a. Draw and explain the following performance curves related to thermal plants:
(i) Input and output curve
(ii) Heat-rate curve. **(04 Marks)**

b. Derive the expressions for transmission loss co-efficient in terms of plant generation capacities for two units delivering a load. **(08 Marks)**

c. The fuel cost function in Rs/hr for three thermal plants are given by,

$F_1 = 350 + 7.2\, P_{G1} + 0.004\, P_{G1}^2$ Rs/hr

$F_2 = 500 + 7.3\, P_{G2} + 0.0025\, P_{G2}^2$ Rs/hr

$F_3 = 600 + 6.74\, P_{G3} + 0.003\, P_{G3}^2$ Rs/hr

Determine the optimal generation scheduling neglecting the losses for a load of 450 MW. Also, calculate the cost of production of 450 MW for the obtained schedule. **(08 Marks)**

OR

8 a. Obtain the Economic generation scheduling for a system by considering transmission losses and neglecting generator limits. **(06 Marks)**

b. In a system with two plants, the incremental fuel costs are given by,

$\dfrac{dF_1}{dP_{G1}} = 0.01P_{G1} + 20$ Rs/MWhr ; $\dfrac{dF_2}{dP_{G2}} = 0.015P_{G2} + 22.5$ Rs/MWhr

The system is running under optimal schedule with $P_{G1} = P_{G2} = 100$ MW. If $\dfrac{\partial P_L}{\partial P_{G2}} = 0.2$.

Find $\dfrac{\partial P_L}{\partial P_{G1}}$ and plant penalty factors. **(06 Marks)**

c. With usual notations and formulas, explain the flowchart of forward dynamic programming (DP) approach of unit commitment solution. **(08 Marks)**

Module-5

9 a. Explain the modification of Z_{bus} in Z_{bus} building algorithm when a branch is added to the partial network without mutual coupling. **(10 Marks)**

b. Explain the numerical solution of swing equation by point by point method. **(10 Marks)**

OR

10 a. Construct the bus impedance matrix Z_{bus} by bus building algorithm for the system shown in Fig. Q10 (a). All impedances are in pu. Take ground node ⊚ as the reference node. Add the elements in the order bus 1 to ref.bus, bus 2 to ref.bus, bus 3 to bus 1, bus 2 and bus 1, bus 3 and bus 2. **(10 Marks)**

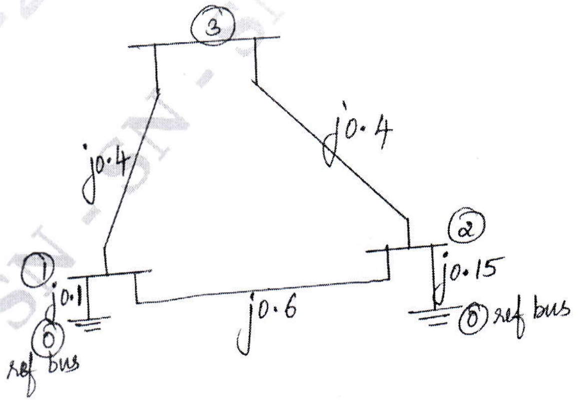

Fig. Q10 (a)

b. Explain the numerical solution of swing equation by Runge-Kutta method. **(10 Marks)**

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