CBCS SCHEME

USN | | | | | | | | | | | 18EE71

Seventh Semester B.E. Degree Examination, July/August 2022
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. Define the following with example:
   (i) Oriented graph
   (ii) Basic loop
   (iii) Co-tree (06 Marks)

b. Determine Y_{BUS} by singular transformation for the system with data as follows:

Element No.	1	2	3	4	5
Bus code	0 – 1	1 – 2	2 – 3	3 – 0	2 – 0
Self admittance (P_u)	1.4	1.6	2.4	2.0	1.8

(07 Marks)

c. For the power system shown in Fig. Q1 (c), select ground as reference and a tree for which link elements are 1 – 2, 1 – 4, 2 – 3, 3 – 4. Obtain basic cutset and basic loop incidence matrices. Verify the relation $C_b = -B\ell^t$. (07 Marks)

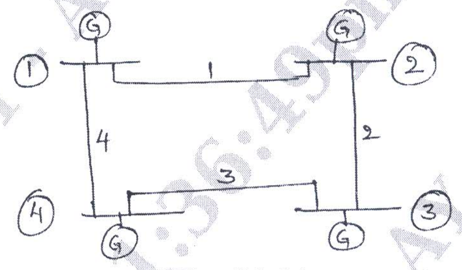

Fig. Q1 (c)

OR

2 a. The oriented connected graph of a system is shown in Fig. Q2 (a). Obtain basic cutset and basic loop incidence matrices. Hence verify the relation (i) $B\ell = A\ell K^t$ (ii) $B^tC = 0$. Take ground as reference. (08 Marks)

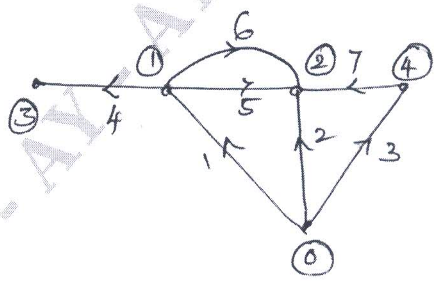

Fig. Q2 (a)

b. With usual notations, prove that $Y_{BUS} = A^T[y]A$ using singular transformation. (06 Marks)

c. For the given power system data, obtain Y_{BUS} (06 Marks)

Element	1	2	3	4	5	6	7
Impedence in pu	j0.4	j0.25	j0.1	– j0.2	j0.5	j0.3	j0.2

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-2

3 a. In the power system network shown in Fig. Q3 (a), the slack bus voltage is $1.04\angle 0^\circ$. Bus 2 is PQ bus with $S_2 = 6 - j1.5$pu and bus 3 is PV bus with voltage magnitude 1.02 pu and real power 0.8 pu. $Z_{12} = 0.04 + j0.6$pu ; $Z_{23} = 0.02 + j0.03$pu . Find the voltage at bus 2 at the end of first iteration using G-S method. **(08 Marks)**

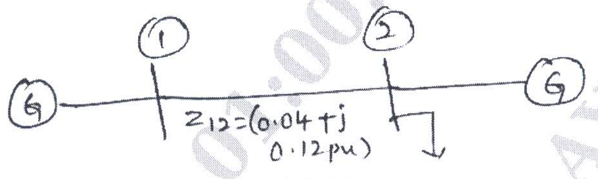

Fig. Q3 (a)

b. Derive the expressions for power flow equations used in load flow analysis. **(06 Marks)**

c. What are the different types of buses considered during load flow analysis? Explain briefly. **(06 Marks)**

OR

4 a. For the 3 bus system shown in Fig. Q4 (a), the elements of Y_{BUS} are as follows:
$Y_{11} = Y_{22} = Y_{33} = 5.868 - j23.514$ pu and $Y_{12} = Y_{13} = Y_{23} = Y_{31} = Y_{32} = -2.934 + j11.767$ pu.
Reactive power limits at bus 3 are $0 \le Q3 \le 1.5$pu . Determine whether bus 3 continues as PV bus and thereafter determine new estimate of voltage at bus 3 using GS method. **(08 Marks)**

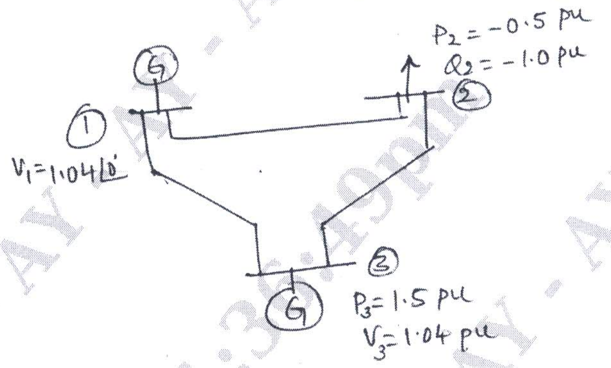

Fig. Q4 (a)

b. What are the data required to conduct load flow analysis? **(08 Marks)**

c. Discuss the operating constraints considered during load flow analysis. **(04 Marks)**

Module-3

5 a. Derive the expressions for diagonal elements of Jacobian matrices in NR method of load flow analysis. **(08 Marks)**

b. Starting from all the assumptions deduce the fast Decoupled load flow model. **(06 Marks)**

c. Compare Gauss-Seidel and NR load flow methods in respect of, (i) time / iteration and number of iterations (ii) Total solution time (iii) Convergence characteristics. **(06 Marks)**

OR

6 a. For a 3 bus system, the elements of Y_{BUS} are as follows :
$Y_{11} = Y_{22} = Y_{33} = 24.23\underline{|-75.95}$ pu ; $Y_{12} = Y_{13} = Y_{21} = Y_{23} = Y_{31} = Y_{32} = 12.13\underline{|104.04}$ pu.
The bus voltage are $V_1 = 1.04 + j0$ pu (slack), $V_2 = 1 + j0$ pu (PQ bus), $V_3 = 1.04 + j0$ pu (PV bus). Determine the elements of sub matrix J_1 and J_4 of Jacobian matrix in NR load flow method. **(08 Marks)**

b. Explain with flow chart and equation how the load flow analysis is carried out using Newton Raphson method. **(08 Marks)**

c. Describe Fast Decoupled load flow method with a flow chart. **(04 Marks)**

Module-4

7 a. Derive an expression for transmission loss as a function of plant generation for a two plant system. **(06 Marks)**

b. A two bus system is shown in Fig. Q7 (b). If 75 MW of power is imported to bus 1, a loss of 5 MW is incurred. Find the required generation for each plant and the power received by load when the plant incremented cost is 20 Rs./Mwh. The incremental fuel cost of two plants are given by $\frac{dF_1}{dP_1} = 0.03P_1 + 15$; $\frac{dF_2}{dP_2} = 0.05P_2 + 18$ **(08 Marks)**

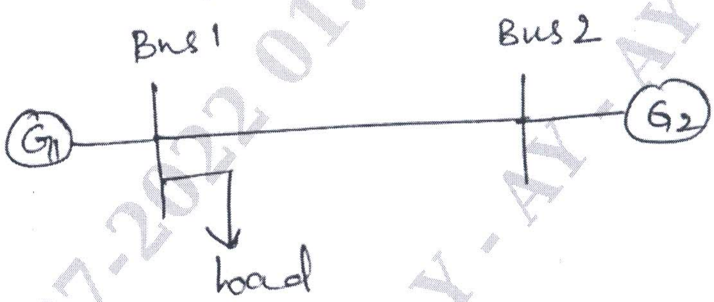

Fig. Q7 (b)

c. Define unit commitment. Explain dynamic programming method of unit commitment solution. **(06 Marks)**

OR

8 a. Deduce the condition for optimal load dispatch considering transmission losses in a system. **(06 Marks)**

b. The operating cost of F_1 and F_2 in Rs./h of two generating units each of 100 MW are $F_1 = 0.2PG_1^2 + 40PG_1 + 120$; $F_2 = 0.25PG_2^2 + 30PG_2 + 150$. Find (i) The optimal generation of 2 units for total demand of 180 MW and the corresponding total cost (ii) Saving in Rs./h in this case, as compared to equal sharing between the two generators. **(08 Marks)**

c. Explain prior list method of unit commitment solution with a flow chart. **(06 Marks)**

Module-5

9 a. Form Z_{bus} using Building algorithm of the system shown in Fig. Q9 (a). Self impedances of the elements are marked on the diagram. **(06 Marks)**

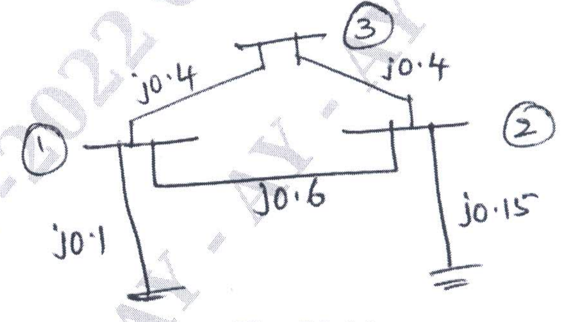

Fig. Q9 (a)

b. Explain the steps involved in solving power system stability solution of swing equation using point-by-point method. **(08 Marks)**

c. The swing equation of a synchronous generator is $\frac{d\delta}{dt} = \omega - 377$ r/s ; $\frac{d\omega}{dt} = 23[1 - 0.4\sin\delta]$.
At t = 0 s ; $\omega = 377$ r/s and $\delta = 0.523$ r. Determine the values of ω and δ at 0.1 s using modified Euler method. Assume $\Delta t = 0.05$ s. **(06 Marks)**

OR

10 a. Obtain Z_{bus} for the power system shown in Fig. Q10 (a). **(06 Marks)**

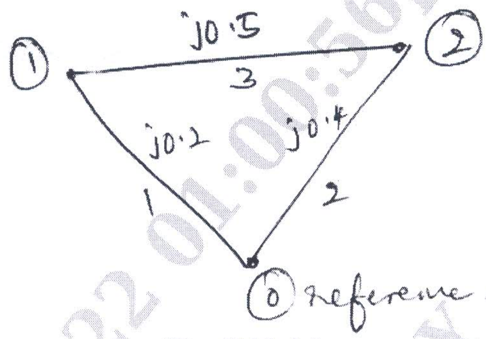

Fig. Q10 (a)

b. Explain Runge Kutta method for the solution of swing equation. **(06 Marks)**

c. Explain the algorithm for short circuit analysis using Bus Impedance matrix. **(08 Marks)**

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