CBCS SCHEME

USN | | | | | | | | | | |

18EE71

# Seventh Semester B.E. Degree Examination, June/July 2025
## 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 the following with an example.
i) Tree ii) Basic cutsets iii) Basic loop. **(06 Marks)**

b. With usual notations derive the equation $Y_{Bus} = [A^T] [Y] [A]$. **(06 Marks)**

c. For tree shown in Fig Q1(c). Draw the oriented graph and form the following incidence matrices
i) Bus incidence matrix (A)
ii) Branch path incidence matrix (K)
iii) Basic cut set incidence matrix (B)
iv) Basic loop incidence matrix (C)

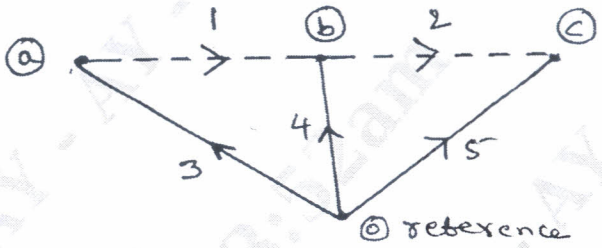


Fig Q1(c) **(08 Marks)**

**OR**

2 a. The bus incidence matrix of 7 elements, 5-nodes system is as shown in Fig Q2(a). Construct the oriented graph, after forming element node incidence matrix and hence single line diagram of the network involved. Indicate generator positions.

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

Fig Q2(a) **(06 Marks)**

b. The bus admittance matrix with ground node 0 as reference of power system network with 4 buses in given below as $Y_{Bus}$. Obtain the admittance diagram. Assume no mutual coupling.

$$Y_{Bus} = \begin{array}{c} \\ 1 \\ 2 \\ 3 \\ 4 \end{array} \begin{array}{c} \begin{array}{cccc} 1 & 2 & 3 & 4 \end{array} \\ \begin{bmatrix} -j15 & j10 & 0 & j5 \\ j10 & -j17 & j5 & 0 \\ 0 & j5 & -j19 & j10 \\ j5 & 0 & j10 & -j15 \end{bmatrix} \end{array}$$

**(06 Marks)**

c. Determine $Y_{Bus}$ using singular transformation method for the primitive admittance of lines are as shown in Fig Q2(c).

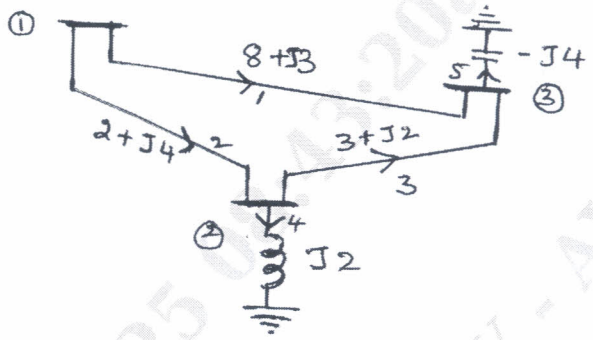


Fig Q2(c) **(08 Marks)**

## Module-2

3 a. Explain the load flow analysis with equations? What are different types of buses considered during power system load flow analysis? Discuss the significance of slack bus in load flow studies. **(10 Marks)**

b. For the system shown in Fig Q3(b). Obtain solution of voltage angles of bus 2 and 3 at the end of first iteration. Using Gauss – Seidel load flow method. Use flat starte line data is in impedance form.

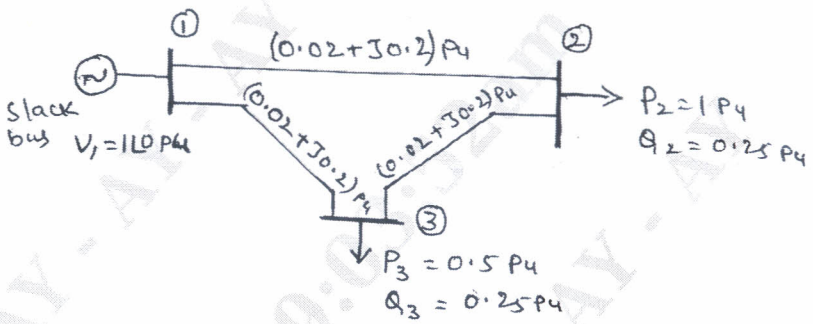


Fig Q3(b) **(10 Marks)**

**OR**

4 a. Develop the Gauss –Seidel load for a power system with bus 1 as slack bus and (n -1) number of PQ buses. Write the flow chart of algorithm. **(10 Marks)**

b. For 3 bus system shown in Fig Q4(b). Assume that voltage start. Find the values of V, δ and Q at the end of first iteration using Gauss – Seidel load flow method. Assume line data as in admittance form.

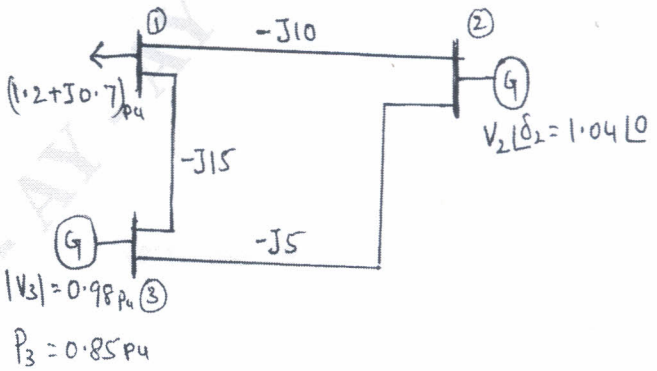


Fig Q4(b) **(10 Marks)**

## Module-3

5 a. In a two bus system shown in Fig Q5(a), bus 1 is slack bus with $V_1 = 1\angle 0$ Pu and bus 2 is load bus with P = 100 MW, Q = 50 MVAR. The impedance is (0.12 + J0.16)Pu on a base of 100 MVA. Using NR method compute ($V_2$) and $\delta_2$ after one iteration.


Fig Q5(a) **(10 Marks)**

b. Explain the algorithm with fast decoupled load flow analysis. Clearly state the assumptions made for FDLF method. **(10 Marks)**

**OR**

6 a. Develop the step by step algorithm for Newton Raphson method of load flow with PQ buses. **(10 Marks)**

b. Consider system network as shown in Fig Q6(b). Apply Newton-Raphson method to derive Jacobbian matrix.

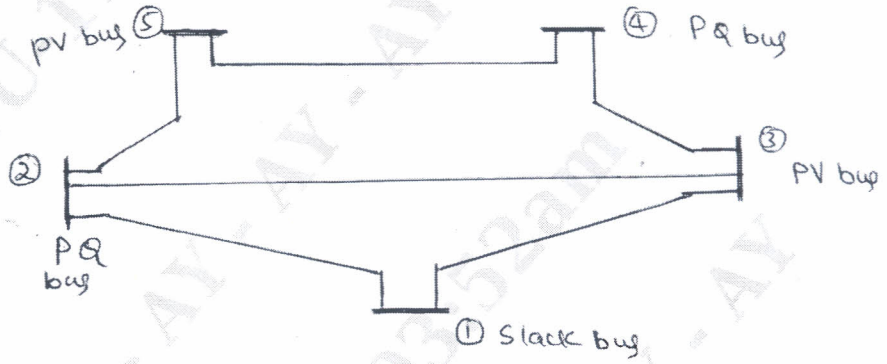


Fig Q6(b) **(10 Marks)**

## Module-4

7 a. The fuel cost functions in $/hr for three thermal plants are given below.

$F_1 = 350 + 7.2\ P_{G_1} + 0.004\ P_{G_1}^2$

$F_2 = 500 + 7.3\ P_{G_2} + 0.0025\ P_{G_2}^2$

$F_3 = 600 + 6.74\ P_{G_3} + 0.003\ P_{G_3}^2$

$P_{G_1}$, $P_{G_2}$ and $P_{G_3}$ are in MW. Find the optional schedule and compare the cost of this to the case when the generators share load equally if $P_D = 800$ MW. **(12 Marks)**

b. Explain the algorithm of priority list method of unit commitment. **(08 Marks)**

**OR**

8 a. With the help of neat figures, explain performance curves of generating unit. **(08 Marks)**

b. Write a short note on :
   i) Unit commitment
   ii) Penalty factor
   iii) Dynamic forward DP approach. **(12 Marks)**

## Module-5

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

b. Determine Z-bus for the power system network shown in Fig Q9(b).

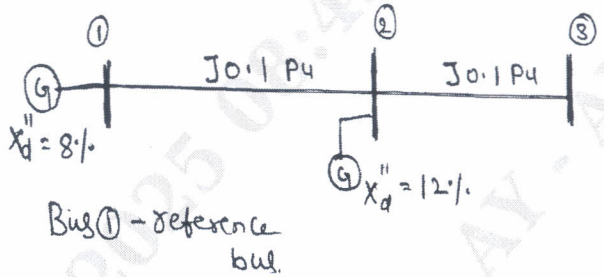


Fig Q9(b) **(10 Marks)**

**OR**

10 a. Derive the generalized algorithm for finding elements of bus impedance matrix $Z_{Bus}$ when impedance added between two existing buses. **(10 Marks)**

b. Explain clearly the steps involved in solving system stability solution of swing equation using Runge – Kutta method. **(10 Marks)**

* * * * *