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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belgaum)

Seventh Semester, B.E. - Electrical and Electronics Engineering

Semester End Examination; Dec - 2016/Jan - 2017

Computer Techniques in Power Systems

Time: 3 hrs *Max. Marks: 100*

***Note**: Answer **FIVE** full questions, selecting **ONE** full question from each unit.*

UNIT - I

1 a. Define the following with examples : 6

i) Oriented Graph ii) Basic cutest iii) Basic loop.

b. The basic incidence matrix is given below. Draw the oriented graph. Obtain loop incidence matrix. 8

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

c. The oriented connected graph is shown in Fig. Q1(c). Obtain basic cutest incidence B and basic loop incidence matrix C. 6

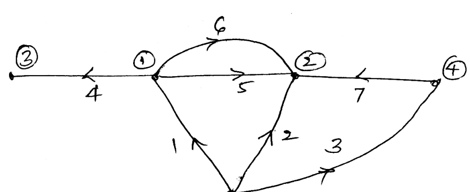

Fig. Q 1(c)

2 a. Define the following terms with example : 6

i) Tree and Co-Tree ii) Primitive network iii) Augmented cutest Incidence matrix.

b. For the network shown in Fig. Q 2(b), consider elements (1, 2, 3) are tree branches and node-4 as reference. Obtain; 8

i) Bus incidence matrix ii) Branch path incidence matrix K and hence verify $A_b K^t = U$

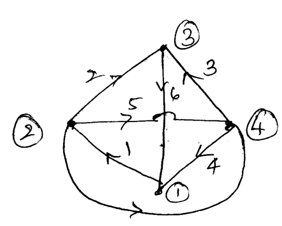

Fig Q 2(b)

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c. Draw the oriented graph for the incidence matrix given in Table 2(c) below. Mark the relevant elements on the diagram. Also obtain $\hat{A}$. 6

Table 2(c)

Bus\e	1	2	3	4	5	6	7
P	1	0	0	-1	0	0	1
Q	-1	-1	-1	0	0	0	0
R	0	0	1	0	-1	1	0
S	0	0	0	0	0	-1	-1

UNIT - II

3 a. Derive the expression for bus admittance matrix using singular transformation technique. 6

b. For the power system shown in Fig. Q 3(b), Obtain Y_{bus} by singular transformation and verify the result by inspection method. 8

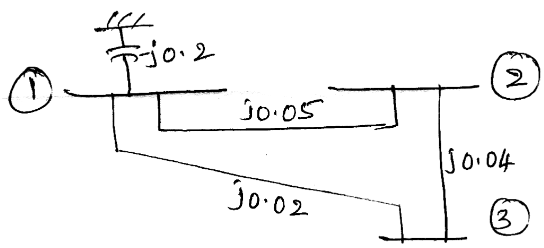

fig. Q 3(b)

c. Obtain the equivalent circuit of the transformer with off-nominal turns ratio. 6

4 a. Derive an expression for diagonal element Z_{qq} of bus impedance matrix using building algorithm when branch is added to the partial network. 6

b. The series impedances of the lines are shown in Fig Q4(b). Taking the elements in the order develop Z_{bus} by building algorithm method. 8

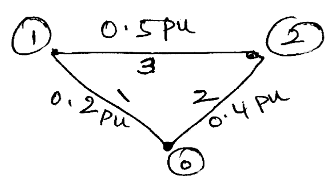

fig. Q 4(b)

c. For the network graph shown in Fig. 4(c) obtain Y_{bus} with node 1 as reference using singular transformation. Neglect mutual coupling self impedance of elements are marked on the diagram. 6

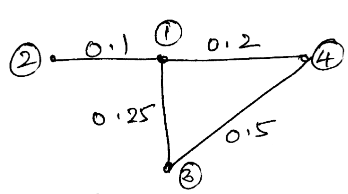

fig Q 4(c)

UNIT - III

5 a. Give the bus classification for load flow analysis, explaining the significance. 8

b. Obtain the load flow solution at the end of first iteration, with data given below. Assume all buses except bus 1, as PQ buses. Assume $V_1 = 1.04\angle 0^{\circ}$ pu 12

i) Line Data

Bus Code	R(pu)	X(pu)
1 - 2	0.05	0.15
1 - 3	0.1	0.3
2 - 3	0.15	0.45
2 - 4	0.1	0.3
3 - 4	0.05	0.15

ii) Bus Data

Bus No.	P_i(pu)	Q_i (pu)
1	-	-
2	0.5	-0.2
3	-1.0	0.5
4	-0.3	-0.1

6 a. Derive the expression in polar form for the typical diagonal elements of the sub matrices of the Jacobian in Newton-Raphson method of load flow analysis. 8

b. Write notes on Fast Decoupled load flow analysis with assumptions. 6

c. Compare NR and GS method of load flow solution with respect to, 6

i) Time per iteration ii) Total Solution time iii) Acceleration of convergence.

UNIT - IV

7 a. Draw and explain the performance curves of thermal plant. 6

b. Explain and derive the necessary condition for economic operation of generators with transmission loss considered. 8

c. The incremental fuel cost (in Rs/MWh) for a plant consisting of two units are,

$$\left(\frac{dF_1}{dP_1}\right) = 0.008P_1 + 8 \; and \; \left(\frac{dF_2}{dP_2}\right) = 0.0096P_2 + 6.4$$

Determine the economic operation schedule, if the maximum and minimum loading on each unit is 625 MW and 100 MW respectively. The load demand is 900 MW neglect transmission losses. 6

8 a. Derive the necessary conditions for optimal operations of thermal power plants with transmission losses neglected. 6

b. With usual notation, derive the generalized transmission loss formula and B-coefficients. 8

c. In a system comprising two generating plants, the fuel coats (in Rs/hr) are

$$F_1 = 0.004P_1^2 + 8P_1 + 10$$
$$F_2 = 0.006P_2^2 + 9P_2 + 15$$

The system is operating on economic load despatch with $P_1 = P_2 = 500\,MW$ and $\frac{\partial P_L}{\partial P_2} = 0.2$. 6

Find the penalty factor of plant 1.

UNIT - V

9 a. Explain with necessary equations the solution of swing equation by point-by-point method. 10

b. With necessary equations describe the solution of swing equation using modified Euler's method. 10

10 a. Explain the method of finding the transient stability of a given power system using Runge Kutta method. 10

b. Explain with necessary expressions, the various synchronous machine models employed in the transient stability studies. 10

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