Code No: RR320203 **Set No.1**

III B.Tech. II Semester Regular Examinations, April/May -2005
MODELLING OF POWER SYSTEM COMPONENTS
(Electrical & Electronic Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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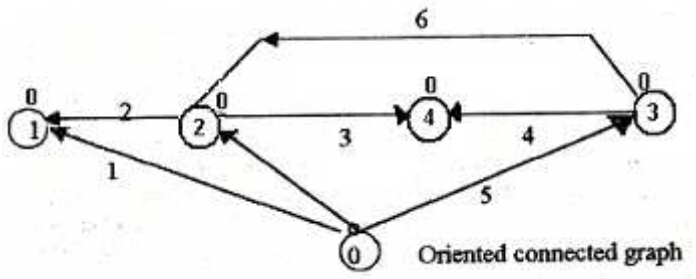
1. (a) Define the following terms with suitable example: Basic
   i. tree
   ii. branches
   iii. Links
   iv. co-tree
   v. loop
   (b) Write the relation among the number of nodes, number of branches, number of Links and number of elements.
   (c) For the graph given in figure below, draw the tree and the corresponding co-tree. Choose a tree of your choice, and hence write the cutest schedule.



2. Derive the expressions for Bus admittance and impedance matrices by singular transformation.

3. How bus impedance matrix is developed by step by step method? Describe the method with algorithm.

4. Discuss the method of modeling a phase shifting transformer in load flow studies. Derive relevant equations that are necessary to modify the elements of Y_{Bus}.

5. (a) Explain the primitive network three phase representation of a component in admittance form.
   (b) For a rotating element, find the sequence impedance matrix from phase impedance matrix using symmetrical component transformation matrix.
   (c) Find z^{012}_{pq} given $z^{abc}_{pq} = \begin{bmatrix} j0.4 & j0.1 & j0.1 \\ j0.2 & j0.6 & j0.2 \\ j0.3 & j0.3 & j0.8 \end{bmatrix}$

6. (a) Clearly explain what you understand by static and dynamic characteristics of a load element.
   (b) Sketch the load characteristics of a typical
      i. lighting load
      ii. heating load.

7. (a) Explain the functions of various blocks of speed governing system.
   (b) Explain the turbine model and hence discuss transfer functions of reheat and non-reheat models.

8. Describe the various blocks of IEEE Type-1 excitation system and develop the mathematical model of the system.

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Code No: RR320203 **Set No.2**

III B.Tech. II Semester Regular Examinations, April/May -2005
MODELLING OF POWER SYSTEM COMPONENTS
(Electrical & Electronic Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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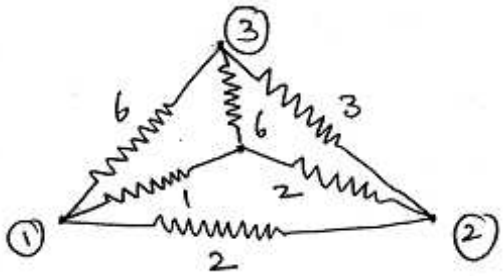
1. (a) For the given network draw the graph and tree. Write the cut set schedule, for a chosen tree branch set.



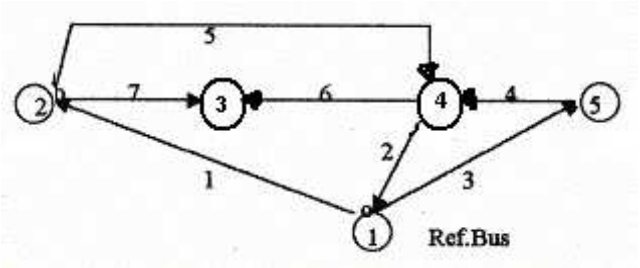
(b) The incidence matrix for an oriented graph is given below. Draw the oriented graph.

Branches →

A =	1	2	3	4	5	6	7	8
	1	0	0	0	1	0	0	1
	0	1	0	0	-1	1	0	0
	0	0	1	0	0	-1	1	-1
	0	0	0	1	0	0	-1	0

2. (a) Derive the expression for the loop impedance Z_{loop} using singular transformation in terms of primitive impedance matrix z and the basic loop incidence matrix C.

(b) Derive an expression for Z_{loop} for the oriented graph shown below

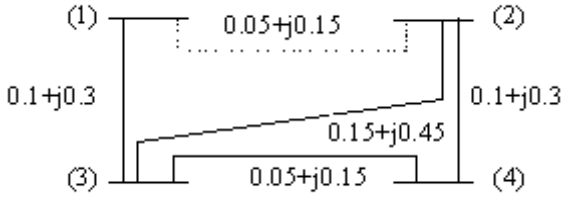


3. Describe the procedure of modification of Zbus by adding and removing the coupled branch from existing bys (p) to new bus (q) and from existing bus (p) to reference.

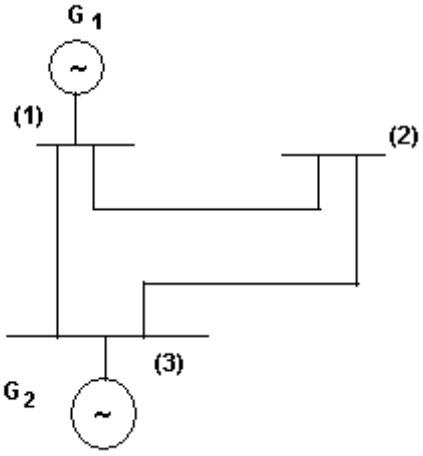
4. Figure shows the one line diagram of a 4-bus system. Impedances in p.u. are indicated in the figure.

   (a) Find Y_{Bus} assuming that the line shown dotted is not connected

   (b) What modifications need to be carried out in Y_{Bus} if the line shown dotted is connected.



5. (a) Obtain the tie-set schedule in three phase representation for the following power system network's.



   (b) Develop the primitive network three phase representation of elements in impedance and admittance forms.

6. (a) For basic types of loads at a bus, develop the mathematical models and represent their characteristics.

   (b) A 2 pole 50 Hz, Turbo generator has a rating of 60 MVA. The Rotor has a mass moment of inertia of 9000 Kgm^2. Calculate its inertia constant in MJ/MVA and its angular momentum in MJ-sec/elec. degree.

7. (a) Explain the turbine speed governing mechanism and hence derive the transfer function of speed governing system.

   (b) Explain what is meant by Cross-coupling between control loops.

8. Explain the characteristics of an excitation system and develop a transfer function of first order for the same.

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Code No: RR320203 **Set No.3**

III B.Tech. II Semester Regular Examinations, April/May -2005
MODELLING OF POWER SYSTEM COMPONENTS
(Electrical & Electronic Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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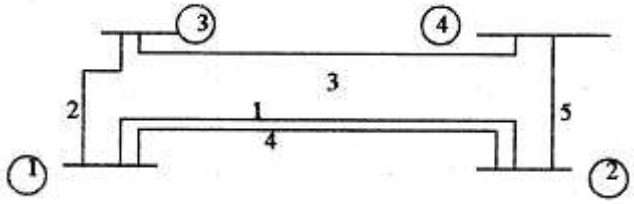
1. For the sample network shown in figure below, form

   (a) The incidence matrices $\hat{A}$, A, K, B, $\hat{B}$, C and $\hat{C}$ and verify the following:

   i. $A_b K^t = U$

   ii. $B_l = A_l K^t$

   iii. $C_b = - B_l^t$



   (b) Retain node 1 as the references, and take 1,2,5 as tree

2. Describe the procedure of modification of Zbus by adding mutually coupled branch from existing bus (p) to new bus (q) and by removing the same from existing bus (p) and (k).

3. (a) Two branches connected between buses 2-3 and 3-1 having impedances equal to j0.25 pu are coupled through mutual impedance Zm = j0.15 pu. Find the nodal admittance matrix for the mutually coupled branches and write the corresponding nodal admittance equations.

   (b) What is primitive admittance and impedance matrix. Bring out the significance of system admittance matrix.

4. (a) Explain how the impedance matrices of stationary and rotating elements are represented in a three phase system.

   (b) Show that the sequence impedance matrices obtained for the above, are diagonalised. Derive the formula used.

5. (a) Prove that when there is no mutual coupling the diagonal and off-diagonal elements of the admittance Y_{Bus} can be computed from

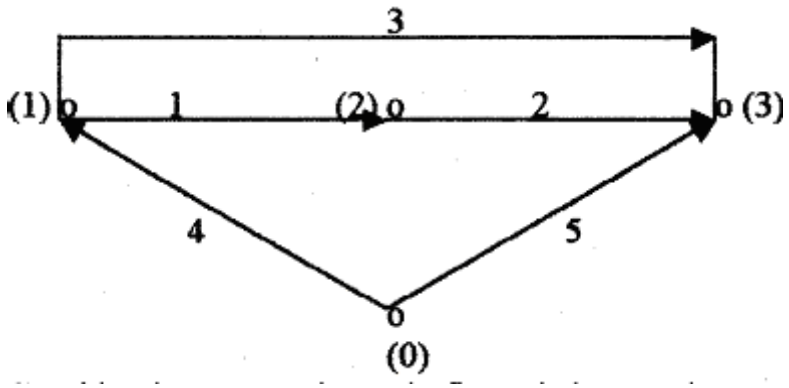
   $Y_{ii} = \sum_{j} Y_{ij}$

   and $Y_{ij} = -Y_{ij}$

   where Y_{ij} is the sum of the admittance of all the lines connecting buses i and j.

   (b) Consider the linear graph shown below, which represents a 3-bus transmission system with all the shunt admittance lumped together. Each line has a series impedance of (0.02 + J0.08) and half line charging admittance of J0.02,

   i. Compute Y_{Bus} by inspection
   ii. Compute Z_{Bus} analytically
   iii. Verify Y_{Bus} Z_{Bus} = U



6. Derive the relevant models for steady state and transient modes of operation of synchronous generator with relevant phasor diagrams and equations. Take saliency into consideration.

7. (a) Explain the turbine model and represent as a block diagram and obtain transfer function of the models.

   (b) Explain the mathematical model of a speed governor and hence derive the transfer function.

8. Explain the functions of an excitation and develop the block diagram for voltage regulator scheme. Develop the transfer function model of each block.

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Code No: RR320203 **Set No.4**

III B.Tech. II Semester Regular Examinations, April/May -2005
MODELLING OF POWER SYSTEM COMPONENTS
(Electrical & Electronic Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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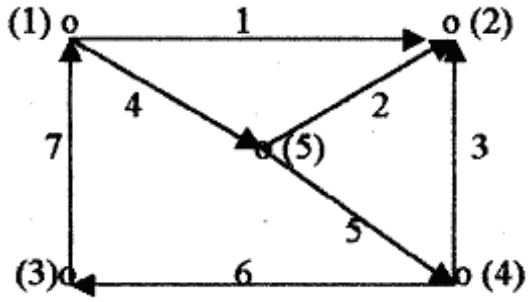
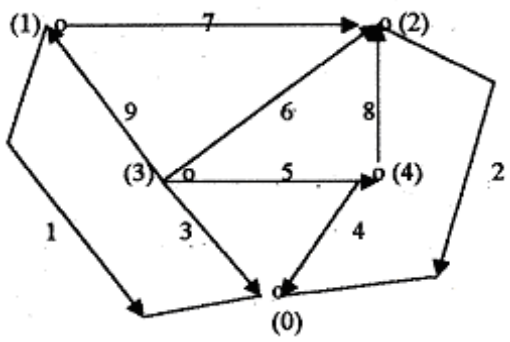
1. For the graph shown in figure below selecting tree T (2,4,5,6)
   (a) Write the fundamental loop matrix C and the fundamental cut set matrix B. Verify the relation $B_l = A_l K^t$ and $C_b = -B_l^t$
   (b) Write the augmented incidence matrix and incidence matrix A, by choosing (4) as reference node. Arranging matrix A as [A_b! A_1] corresponding to the tree T(2,4,5,6) and verify B_l = - A_l A_b^{-1}.



2. (a) Derive the expression for bus admittance matrix Y_{Bus} in terms of primitive admittance matrix and bus incidence matrix.
   (b) Find the Y Bus using singular transformation for the system shown in figure below



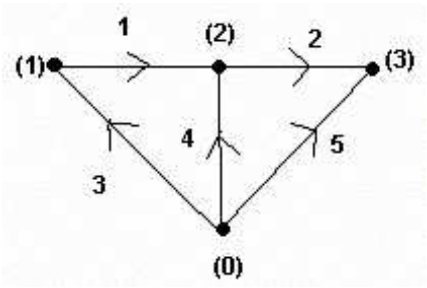
and Y = dia [Y_{10} Y_{20} Y_{30} Y_{40} Y_{34} Y_{23} Y_{12} Y_{24} Y_{13}]

3. Impedances connected between various buses are as follows:
   $X_10 = j1.25, X_30 = j1.25, X_12 = j0.25, X_23 = j0.4, X_24 = j0.125, X_43 = j0.2$, where'0' is reference node. All impedances are in pu. Determine bus impedance matrix for the network connecting above impedances. Preserve all buses.

4. Derive necessary equations to model a single phase transformer with off-nominal transformer tap settings and phase shifting.

5. (a) Develop the expressions for performance equation in three phase representation for balanced and unbalanced excitations.

   (b) Obtain the basic cutset incidence matrix in three phase representation of a power system network whose graphics:



   Choose 3, 4, 5 as elements of spanning tree.

6. For steady state analysis, obtain the basic models of a synchronous machine with relevant equations

   (a) for cylindrical rotor machine and

   (b) for a salient pole machine. Draw relevant phasor diagrams.

7. (a) Give a complete block diagram representation of speed governing mechanism. Explain various time constants in the block diagram?

   (b) Derive the swing equation.

8. (a) Explain the fundamental characteristics of an excitation system?

   (b) What is an exciter? Why it is necessary for Synchronous Generator?

   (c) Explain IEEE type-1 model of an excitation system and hence derive the transfer function.

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