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

III B.Tech II Semester Supplimentary Examinations, Aug/Sep 2007
MODELLING OF POWER SYSTEM COMPONENTS
(Electrical & Electronic Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

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 1 below, draw the tree and the corresponding co-tree. Choose a tree of your choice, and hence write the cutest schedule.

[5+2+9]

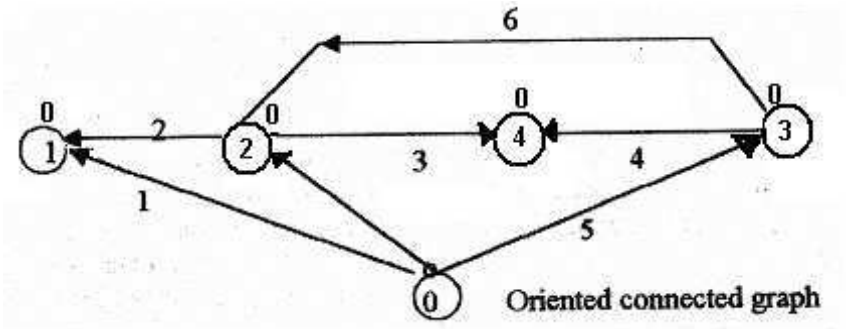

Figure 1

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 in Figure 2below.

[8+8]

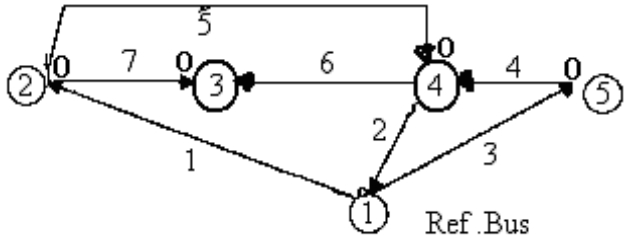

Figure 2

3. Impedances of various branches of the given network are as follows:
$Z_{12} = 10\Omega$, $Z_{10} = 10\Omega$, $Z_{13} = 20\Omega$, $Z_{23} = 10\Omega$, $Z_{20} = 20\Omega$, $Z_{30} = 10\Omega$ Where 'o' is reference node. Develop Zbus matrix for the network using step- by-step method. [16]

4. In a four bus system, a generator connected to bus- 3 and a motor connected to bus-4 having reactance equal to 0.15 pu are connected through their respective transformers havingX_T= 0.1 pu. Generated e.m.f. of generator connected to bus-3 is 1.25 $\angle 0^0$ and internal voltage of motor is 0.85 $\angle -45^0$. Line reactances connecting buses are $X_{31} = X_{23} = 0.25pu, X_{21} = 0.125pu, X_{24} = 0.2pu, X_{14} = 0.4$ pu. Develop the nodal admittance matrix for each of the network branches and then write the nodal admittance equations of the system. [16]

5. Develop the expressions for formation of three phase Z_{BUS} for the element which is added between two existing buses in a partial network. [16]

6. Clearly explain how a synchronous generator is modeled for steady state analysis. Draw the phasor diagram and obtain the power angle equation for a non salient pole synchronous generator connected to an infinite bus. Sketch the power angle curve. [16]

7. (a) Develop the mathematical model of hydraulic value actuator in speed governing system.
   (b) Two generators rated 200Mw and 400Mw are operating in parallel. The droop characteristics of their governors are 4% and 6% respectively from no-load to full-load. Assuming that the generator are operating at 50Hz, how a load of 500Mw be shared between them. [8+8]

8. Explain the functional blocks of Automatic voltage regulator. [16]

⋆ ⋆ ⋆ ⋆ ⋆

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

III B.Tech II Semester Supplimentary Examinations, Aug/Sep 2007
MODELLING OF POWER SYSTEM COMPONENTS
(Electrical & Electronic Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. For the system shown in figure 1 below, form the bus incidence matrix A and Branch path incidence matrix K and also predetermine the basic cut set incidence matrix B and the basic loop incidence matrix C and hence show that [16]

   (a) $A_b K^t = \mathrm{U}$,

   (b) $B_L = A_L K^t$.

   Take 1, 5, 4 as tree

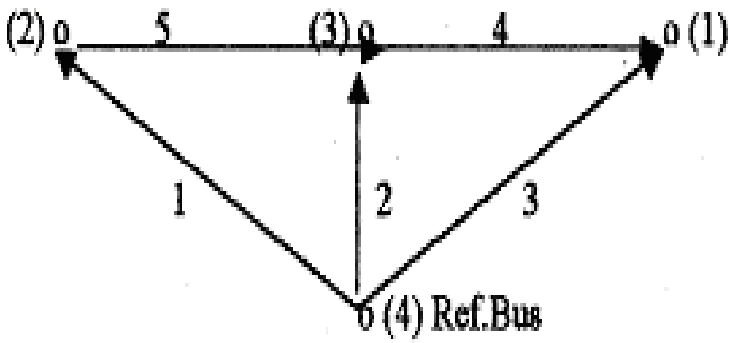

Figure 1

2. Derive the expressions for Bus admittance and impedance matrices by singular transformation. [16]

3. Describe the procedure of modification of Zbus by adding mutually coupled branch from existing buses (p) and (k). [16]

4. (a) Write a detail note on tap-changing and regulating transformer.

   (b) Explain the necessity of transformer modelling for power system studies. [10+6]

5. (a) Explain the primitive network three phase representation of a component in impedance form.

   (b) Show that for a stationary element, the phase impedances matrix of a component is diagonalised using symmetrical component transformation.

   (c) Define the bus incidence matrix of a Power system network whose graph is shown in figure 5. [6+6+4]

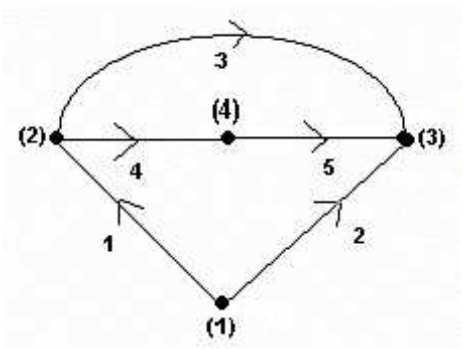

Figure 5

6. (a) Derive the relation between the inertia constant H, and angular momentum M. State the units of H & M.

   (b) What is the importance of swing Equation in determining the stability of the system.

   (c) A 50 Hz, 4 pole Turbo generator rated 25 KVA, 11 KV has an inertia constant H=9 KJ/KVA. Find the acceleration, if the input less the rotational losses is 25000 HP. The Electric Power developed is 14.5 MW. [4+6+6]

7. (a) Develop the mathematical model of primary and secondary Control Loops and derive the transfer functions of each block.

   (b) Determine the primary Automatic load frequency control loop parameters for the following system data:

Total rated area capacity	=	2000 Mw
Normal operating load	=	1000 Mw
Inertia constant	=	5 sec.
Regulation	=	2.4 hz/ p.u. Mw

   Assume load frequency depending is linear. [10+6]

8. Explain the functional blocks of Automatic voltage regulator. [16]

⋆ ⋆ ⋆ ⋆ ⋆

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

III B.Tech II Semester Supplimentary Examinations, Aug/Sep 2007
MODELLING OF POWER SYSTEM COMPONENTS
(Electrical & Electronic Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

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 1 below, draw the tree and the corresponding co-tree. Choose a tree of your choice, and hence write the cutest schedule. [5+2+9]

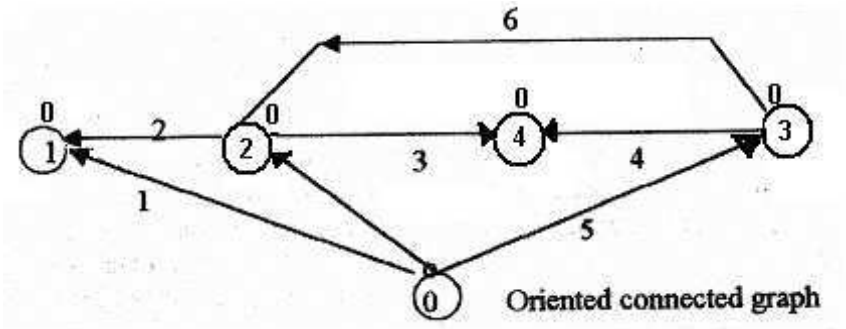

Figure 1

2. Derive the expressions for Bus admittance and impedance matrices by singular transformation. [16]

3. Describe the procedure of modification of existing Zbus by adding branch from new bus (p) to ref node, from new bus (p) to existing bus (k) , form existing bus (k) to ref node and between existing buses (j) and (k). [16]

4. (a) Write a detail note on tap-changing and regulating transformer.
   (b) Explain the necessity of transformer modelling for power system studies. [10+6]

5. (a) Explain the primitive network three phase representation of a component in impedance form.
   (b) Show that for a stationary element, the phase impedances matrix of a component is diagonalised using symmetrical component transformation.

(c) Define the bus incidence matrix of a Power system network whose graph is shown in figure 5. [6+6+4]

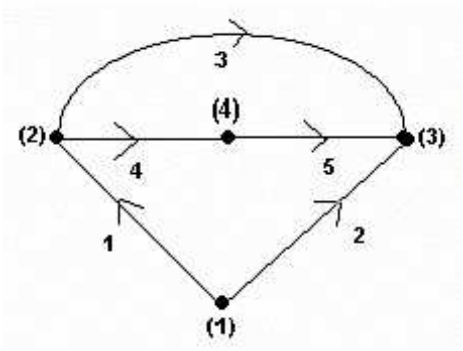

Figure 5

6. A synchronous generator is connected to an infinite bus through a transmission line. Neglecting the resistances draw the phasor diagram and derive the

   (a) Relation between active power and power angle.

   (b) Relation between reactive power and power angle. [8+8]

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+8]

8. (a) Explain about the various performance requirements of excitation system.

   (b) Explain the elements of an excitation system. [8+8]

⋆ ⋆ ⋆ ⋆ ⋆

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

III B.Tech II Semester Supplimentary Examinations, Aug/Sep 2007
MODELLING OF POWER SYSTEM COMPONENTS
(Electrical & Electronic Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

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 1 below, draw the tree and the corresponding co-tree. Choose a tree of your choice, and hence write the cutest schedule. [5+2+9]

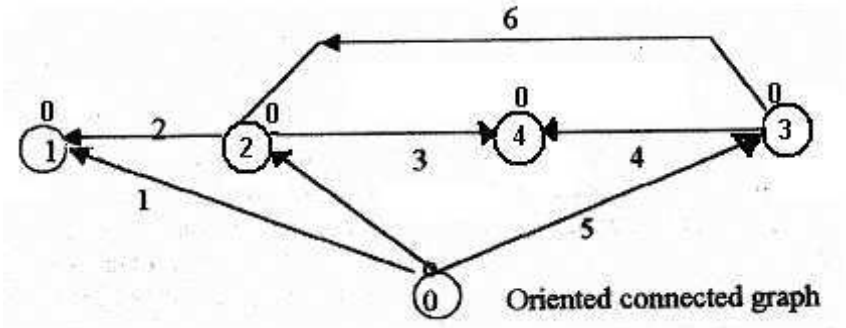

Figure 1

2. Derive the expressions for Bus admittance and impedance matrices by singular transformation. [16]

3. Describe the procedure of modification of Zbus by adding mutually coupled branch from existing buses (p) and (k). [16]

4. (a) Write a detail note on tap-changing and regulating transformer.
   (b) Explain the necessity of transformer modelling for power system studies. [10+6]

5. (a) Derive the performance equations of a three phase network element in impedance and admittance forms.
   (b) Find the sequence impedance matrix of an element whose phase component matrix is [10+6]

$$\left[z_{pq}^{abc}\right] = \begin{bmatrix} j0.6 & j0.2 & j0.1 \\ j0.1 & j0.7 & j0.4 \\ j0.2 & j0.3 & j0.8 \end{bmatrix}$$

6. Clearly explain how a synchronous generator connected to infinite bus through a reactance can be modeled for transient analysis. Draw the phasor diagram and derive the necessary equations, when saliency is neglected and constant flux linkages. [16]

7. (a) Explain the complete block diagram of speed governing system and derive transfer function.

   (b) Two generators are supplying power to a system. Their rating are 50 and 500Mw respectively. The frequency is 50Hz and each generator is half loaded. The system load increased by 110Mw and as a result frequency drops to 49.5Hz. What must be the individual regulations be if two generators should increased their turbine powers in properties to their ratings. Also express the regulation in p.u.Hz and p.u.Mw. [11+5]

8. (a) Explain about the various performance requirements of excitation system.

   (b) Explain the elements of an excitation system. [8+8]

⋆ ⋆ ⋆ ⋆ ⋆