

**III B.Tech II Semester Supplementary Examinations,  
November/December 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) Explain the following terms.

- i. Basic loops
- ii. cut-set
- iii. basic cut-set
- iv. loop

by taking an oriented connected graph. Verify the following relations  $A_b k^t$ .  $U$   
 $B_1 \cdot A_1 k^t$

(b) Show the basic loops and the basic cut sets of the Figure 1 shown below and verify the relation asked in (a). (Take 1 -2 -3 -4 as tree) [8+8]

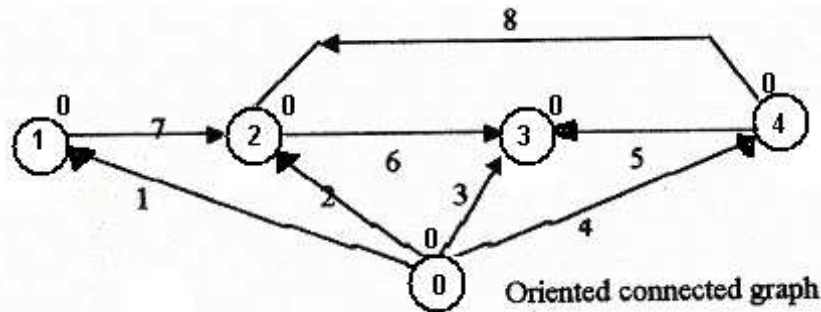


Figure 1:

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 2 below. [8+8]
3. Describe the procedure of modification of  $Z_{bus}$  by adding mutually coupled branch from existing buses (p) and (k). [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 having  $X_T = 0.1$  pu. Generated e.m.f. of generator connected to bus-3 is  $1.25 \angle 0^\circ$  and internal voltage of motor is  $0.85 \angle -45^\circ$ . Line reactances connecting

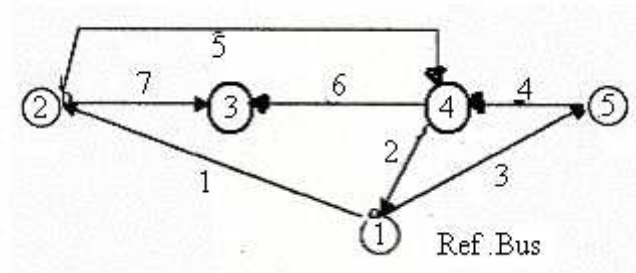


Figure 2:

- 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  $Z_{BUS}$  in three phase network representation for the element which is added between an existing bus and a bus being created. [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]

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