SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

COIMBATORE-35

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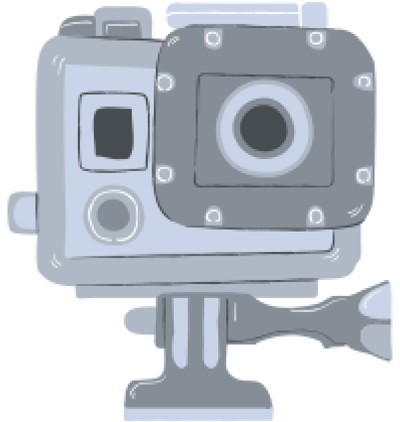
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

UNIT 1

Singular Transformation

16EE304 – Power System Analysis
III year / VI Semester



INTRODUCTION

Singular Transformation

Singular Transformation Method

The bus admittance matrix Y_{BUS} can be obtained by determining the relation between the variables and parameters of the primitive network described *in section (2.1)* to bus quantities of the network using bus incidence matrix. Consider eqn. (1.5).

$$\bar{i} + \bar{j} = [y]\bar{\upsilon}$$

Pre multiplying by $[A^t]$, the transpose of the bus incidence matrix

$$[A^t]\,\bar{i} + [A^t]\,\bar{j} = A^t\,[y]\bar{\upsilon} \qquad \text{.....(3.13)}$$

Matrix A shows the connections of elements to buses. $[A^t]$ i thus is a vector, wherein, each element is the algebraic sum of the currents that terminate at any of the buses. Following Kirchoff's current law, the algebraic sum of currents at any node or bus must be zero. Hence

$$[A^t]\,\bar{i} = 0 \qquad \text{.....(3.14)}$$

Again $[A^t]\,\bar{j}$ term indicates the algebraic sum of source currents at each of the buses and must equal the vector of impressed bus currents. Hence,

$$\bar{I}_{BUS} = [A^t]\,\bar{j} \qquad \text{.....(3.15)}$$

Substituting eqs. (3.14) and (3.15) into (3.13)

$$\bar{I}_{BUS} = [A^t][y]\bar{\upsilon} \qquad \text{.....(3.16)}$$

In the bus frame, power in the network is given by

$$[\bar{I}_{BUS}^{*}]^t\,\bar{V}_{BUS} = P_{BUS} \qquad \text{.....(3.17)}$$

Power in the primitive network is given by

$$\left(\bar{j}^{*}\right)^t\bar{\upsilon} = P \qquad \text{.....(3.18)}$$

ST Method

Power must be invariant, for transformation of variables to be invariant. That is to say, that the bus frame of referee corresponds to the given primitive network in performance. Power consumed in both the circuits is the same.

Therefore $\quad [\bar{I}_{BUS}^{*}]^{t}\bar{V}_{BUS} = [\bar{j}^{*}]^{t}\bar{\upsilon}$ .....(3.19)

Conjugate transpose of eqn. (3.15) gives

$$[\bar{I}_{BUS}^{*}]^{t} = [j^{*}]^{t} A^{*} \quad .....(3.20)$$

However, as A is real matrix $A = A^{*}$

$$[\bar{I}_{BUS}^{*}]^{t} = (j^{*})^{t}[A] \quad .....(3.21)$$

Substituting (3.21) into (3.19)

$$(j^{*})^{t}[A] \cdot \bar{V}_{BUS} = (j^{*})^{t}\bar{\upsilon} \quad .....(3.22)$$

i.e., $\quad [A]\,\bar{V}_{BUS} = \bar{\upsilon}$ .....(3.23)

Substituting eqn. (3.22) into (3.16)

$$\bar{I}_{BUS} = [A^{t}]\,[y]\,[A]\,\bar{V}_{BUS} \quad .....(3.24)$$

From eqn. 3.7

$$\bar{I}_{BUS} = [\bar{Y}_{BUS}]\,\bar{V}_{BUS} \quad .....(3.25)$$

Hence

$$[Y_{BUS}] = [A^{t}]\,[y]\,[A] \quad .....(3.26)$$

Once $[Y_{BUS}]$ is evaluated from the above transformation, (Z_{BUS}) can be determined from the relation.

$$Z_{BUS} = Y_{BUS}^{-1} = \{[A^{t}][y][A]\}^{-1} \quad .....(3.27)$$

Node Incidence

3.1 Element Node Incidence Matrix

Element node incidence matrix $\bar{A}$ shows the incidence of elements to nodes in the connected graph. The incidence or connectivity is indicated by the operator as follows :

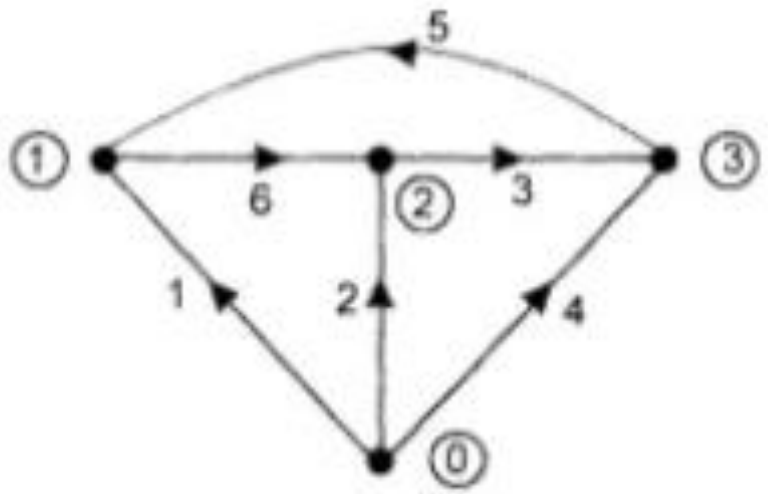
$\alpha_{pq} = 1$ if the p^{th} element is incident to and directed away from the q the node.

$\alpha_{pq} = -1$ if the p^{th} element is incident to and directed towards the q the node.

$\alpha_{pq} = 0$ if the p^{th} element is not incident to the q^{th} node.

The element-node incidence matrix will have the dimension exn where 'e' is the number of elements and n is the number of nodes in the graph. It is denoted by $\bar{A}$.

The element node incidence matrix for the graph of Fig. 2.3 is shown in Fig. 3.1.



$\bar{A} =$

e \ n	(0)	(1)	(2)	(3)
1	1	−1		
2	1		−1	
3			1	−1
4	1			−1
5		−1		1
6		1	−1	

Fig. 3.1 Element-node incidence-matrix for the graph of Fig. (2.3).

Problem 1

Summary

Activity

KEEP LEARNING..

Thank u

SEE YOU IN NEXT CLASS