# NETWORK ANALYSIS AND SYNTHESIS

Unit 1

# Graph Theory

# Matrices of Oriented Graphs

- Property: The determinant of any square submatrix of order q ($1 \leq q \leq v$) of $\Pi$ is either one of the following values: 1, -1, 0.
- Now, consider a graph G of p connected parts:

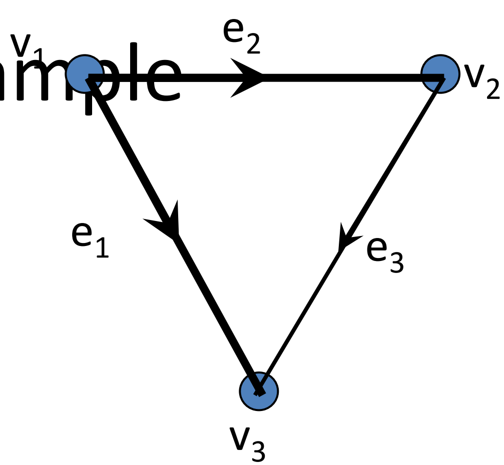
$$\Pi = \left[\begin{array}{cccc|c} E_1 & E_2 & \cdots & E_p & \\ \hline \Pi_1 & 0 & \cdots & 0 & V_1 \\ 0 & \Pi_2 & \cdots & 0 & V_2 \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ 0 & 0 & \cdots & \Pi_p & V_p \end{array}\right]$$

# Matrices of Oriented Graphs

- DEFINITION: For a connected graph G, the matrix $\Pi$, obtained by deleting any one of the rows of the incidence matrix is called the reduced incident matrix.
- Note that since any column of $\Pi$ contains exactly two nonzero entries of opposite sign, one can uniquely determine the incident matrix when the reduced incident matrix is given.

# Matrices of Oriented Graphs

- Property: Any square submatrix $\Pi_i$ of order v-1 of the reduced incidence matrix $\Pi$ of G is nonsingular if and only if the columns of $\Pi_i$ correspond to the branches of a tree T of G.
- Example




$$\Pi = \left[\begin{array}{ccc|c} e_1 & e_2 & e_3 & \\ \hline 1 & 1 & 0 & v_1 \\ 0 & -1 & 1 & v_2 \\ -1 & 0 & -1 & v_3 \end{array}\right]$$

Reduced incidence matrix

$$\Pi = \left[\begin{array}{ccc|c} e_1 & e_2 & e_3 & \\ \hline \boxed{1 \quad 1} & & 0 & v_1 \\ \boxed{0 \quad -1} & & 1 & v_2 \end{array}\right]$$

$\Pi_i$: nonsingular

# THANKS….

Queries Please…