SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
An Autonomous Institution

Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A++' Grade
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

OPTICAL AND MICROWAVE ENGINEERING

III YEAR/ VI SEMESTER

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UNIT 1 – MICROWAVE PASSIVE DEVICES

TOPIC – Properties of S Matrix

Properties of S Matrix

Properties of S matrix

For m-port network, it is always square matrix with order m × m

$$
\begin{bmatrix} b_1 \\ b_2 \\ \cdot \\ \cdot \\ b_{m-1} \\ b_m \end{bmatrix} = \begin{bmatrix} S_{11} & S_{12} & \cdots & \cdots & S_{1(m-1)} & S_{1m} \\ S_{21} & S_{22} & \cdots & \cdots & S_{2(m-1)} & S_{2m} \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ S_{(m-1)1} & S_{(m-1)2} & \cdot & \cdot & S_{(m-1)(m-1)} & S_{(m-1)m} \\ S_{m1} & S_{m2} & \cdot & \cdot & S_{m(m-1)} & S_{mm} \end{bmatrix} \begin{bmatrix} a_1 \\ a_2 \\ \cdot \\ \cdot \\ a_{m-1} \\ a_m \end{bmatrix}
$$

Properties of S Matrix

Properties of S matrix

For lossless network, [S] matrix is unitary

$$[S][S]^* = I$$

$$\Rightarrow \begin{bmatrix} S_{ii} & S_{ij} \\ S_{ji} & S_{jj} \end{bmatrix} \begin{bmatrix} S_{ii} & S_{ij} \\ S_{ji} & S_{jj} \end{bmatrix}^* = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

Properties of S matrix

[S] is symmetric for all reciprocal networks

$$[S] = [S]^T$$

$$\Rightarrow \begin{bmatrix} S_{ii} & S_{ij} \\ S_{ji} & S_{jj} \end{bmatrix} = \begin{bmatrix} S_{ii} & S_{ji} \\ S_{ij} & S_{jj} \end{bmatrix}$$

$$\Rightarrow S_{ij} = S_{ji}$$

Properties of S Matrix

Properties of S matrix

Under this condition

$$\sum_{i=1}^{N} S_{ij} S_{ij}^{*} = 1 \qquad \sum_{i=1}^{N} S_{ij} S_{ik}^{*} = 0$$

THANK YOU