SNS COLLEGE OF ENGINEERING

(Autonomous)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

19EC502 – TRANSMISSION LINES AND ANTENNAS

III YEAR/ V SEMESTER

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UNIT 1 – TRANSMISSION LINE THEORY

TOPIC – STANDING WAVES AND STANDING WAVE RATIO ON A LINE

IMPEDANCE MISMATCH

What happens when the input and output impedance of a transmission line is not matched?

Two-Port network.

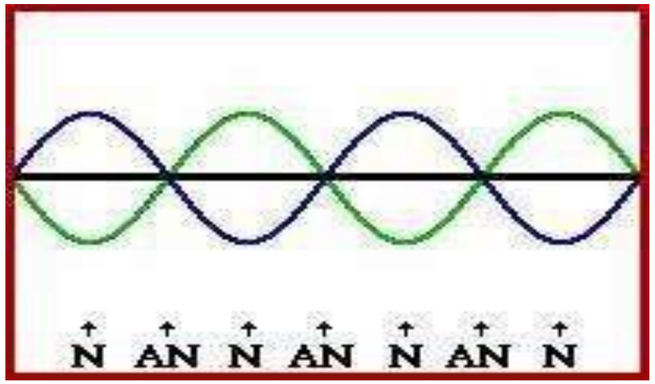
Circuit Globe

IMPEDANCE MISMATCH - EFFECTS

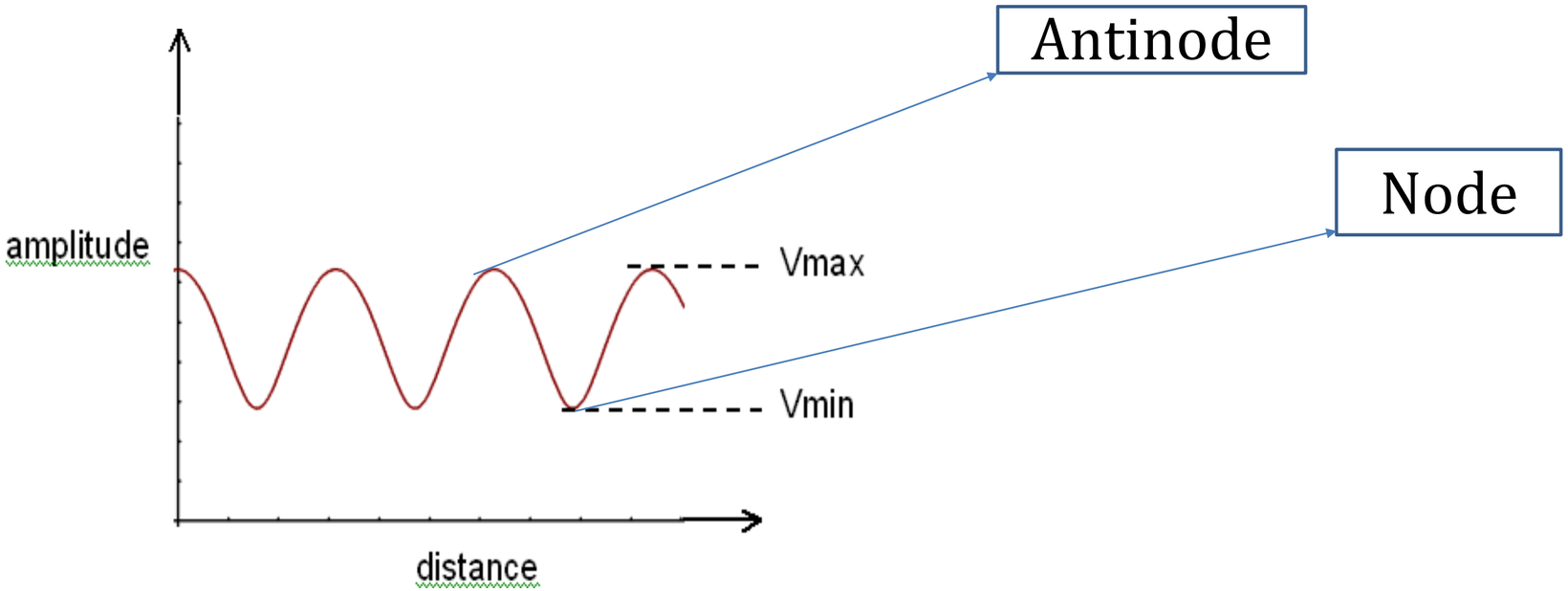
1. Signal loss during transmission
2. Noises
3. Received signal is not same as transmitted signal

IMPEDANCE MISMATCH - EFFECTS

- Due to impedance mismatch, there will be reflected wave in opposite direction to the incident wave
- The resultant total voltage appears to be stand still on the line oscillating in magnitude, but having fixed positions of maxima and minima
- Such a wave is known as standing wave



NODES AND ANTINODES



NODES AND ANTINODES - DEFINITION

➢**Nodes**

Nodes are the points along a standing wave where minimum voltage occurs.

➢**Antinodes**

Antinodes are the points along a standing wave pattern where maximum voltage occurs.

Antinodes are also called as loops.

REFLECTION FROM RESISTIVE LOADS

- When the resistive load termination is not equal to the characteristic impedance, part of the power is reflected back and the remainder is absorbed by the load.
- The amount of voltage reflected back is called voltage reflection coefficient.

$$K = V_r/V_i$$

where V_i = incident voltage

V_r = reflected voltage

- The reflection coefficient is also given by

$$K = (Z_L - Z_0)/(Z_L + Z_0)$$

STANDING WAVE RATIO (SWR)

Definition

The ratio of maximum to minimum magnitudes of voltage or current on a line having standing waves is known as standing wave ratio.

Voltage Standing Wave Ratio:

- $SWR = |V_{max}| / |V_{min}|$

Voltage standing wave ratio expressed in decibels is called the Standing Wave Ratio:

- $SWR\ (dB) = 20\log_{10} VSWR$

SWR

The maximum impedance of the line is given by:

$$Z_{max} = V_{max}/I_{min}$$

The minimum impedance of the line is given by:

$$Z_{min} = V_{min}/I_{max}$$

or alternatively

$$Z_{min} = Z_o/VSWR$$

RELATIONSHIP BETWEEN SWR & K

- Relationship between VSWR and Reflection Coefficient:

$$VSWR = (1 + |K|)/(1 - |K|)$$

OR

$$K = (VSWR - 1)/(VSWR + 1)$$

PROBLEM

Problem 2.19 A 50-Ω lossless transmission line is terminated in a load with impedance $Z_L = (30 - j50)\ \Omega$. The wavelength is 8 cm. Find:

(a) the reflection coefficient at the load,

(b) the standing-wave ratio on the line,

SOLUTION

$$\Gamma = \frac{Z_L - Z_0}{Z_L + Z_0} = \frac{(30 - j50) - 50}{(30 - j50) + 50} = 0.57e^{-j79.8^\circ}.$$

$$S = \frac{1 + |\Gamma|}{1 - |\Gamma|} = \frac{1 + 0.57}{1 - 0.57} = 3.65.$$