SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
An Autonomous Institution

Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A++' Grade (3rd Cycle)
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

19ECT302 – TRANSMISSION LINES AND ANTENNAS

III YEAR/ V SEMESTER

UNIT 1 – TRANSMISSION LINE THEORY

TOPIC 1– 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.

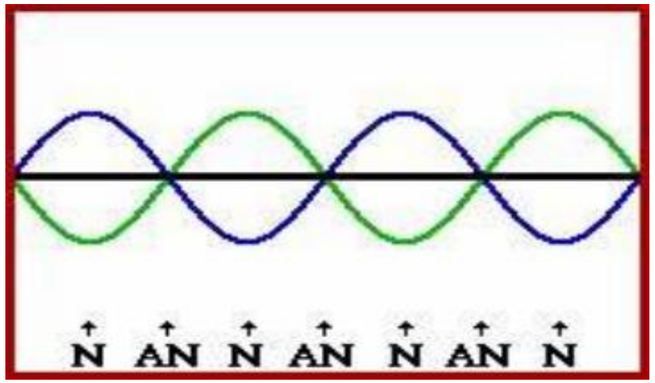
Circuit Globe

IMPEDANCE MISMATCH - EFFECTS

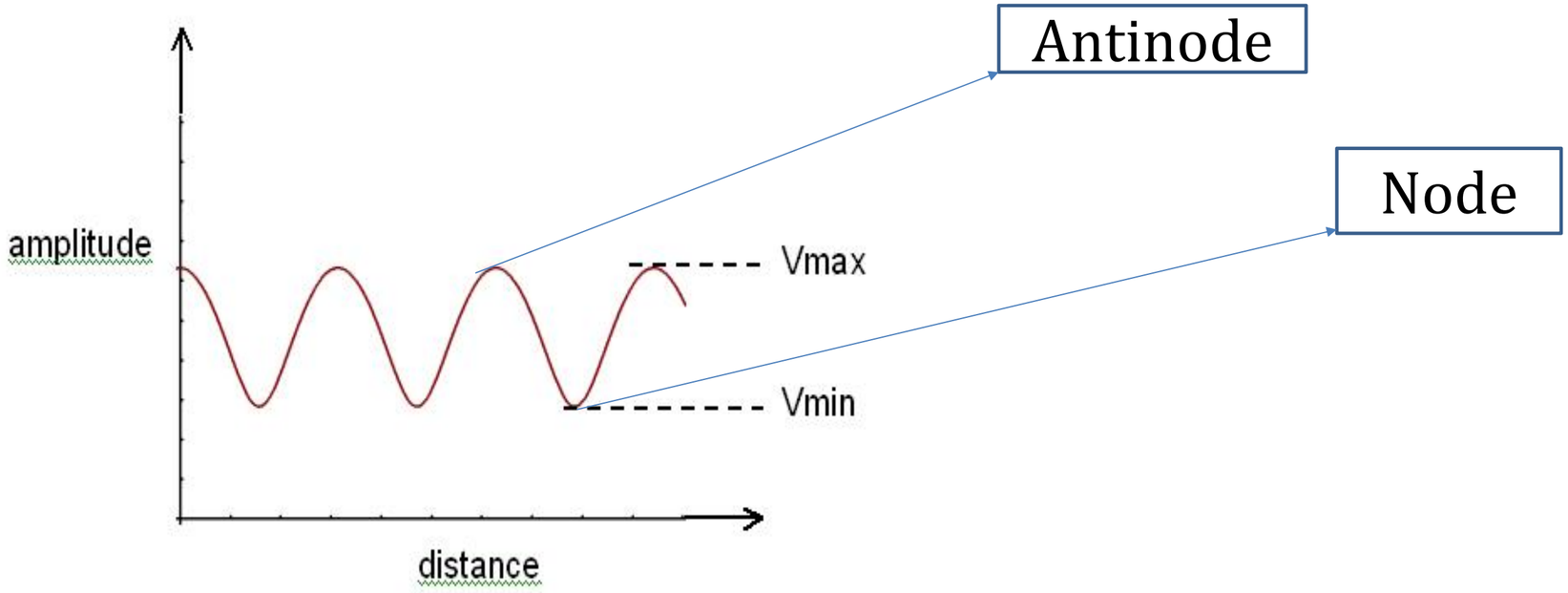
1. Signal loss during transmission
2. Noises
3. Received signal is not same as transmitted signal

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.

$$K = V_r/V_i$$

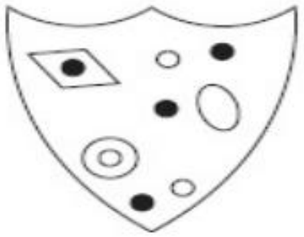
where V_i = incident voltage

V_r = reflected voltage

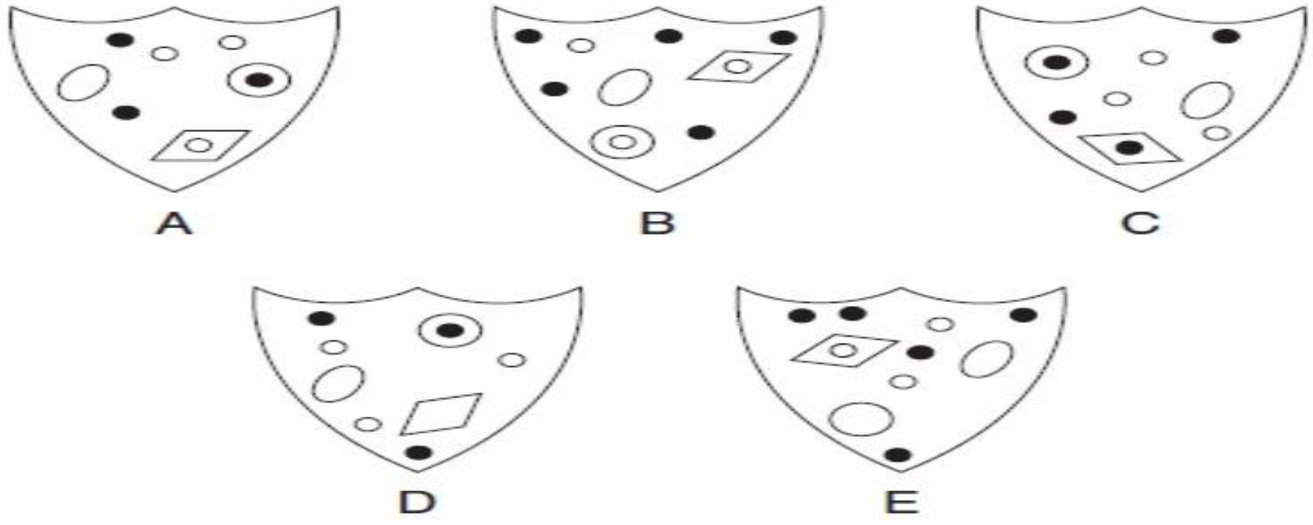
- The reflection coefficient is also given by

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

ACTIVITY



Which below has most in common shield with the shield above?



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

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

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

ASSESSMENT

1. Standing waves occurs due to

a) Impedance match b) Inductance

c) Reflection d) Transmission

2. **Standing wave ratio is defined as the**

a) Ratio of voltage maxima to voltage minima

b) Ratio of current maxima to current minima

c) Product of voltage maxima and voltage minima

d) Product of current maxima and current minima

ASSESSMENT

3. Given that the reflection coefficient is 0.6. Find the SWR.

a) 2 b) 4

c) 6 d) 8

4. The maxima and minima voltage of the standing wave are 6 and 2 respectively. The standing wave ratio is

a) 2 b) 3

c) 1/2 d) 4

REFERENCES

- J.D.Ryder “Networks, Lines and Fields”, PHI, New Delhi, 2003
- Raju, “Electromagnetic Field Theory and Transmission Lines”, Pearson Education, 2005

THANK YOU