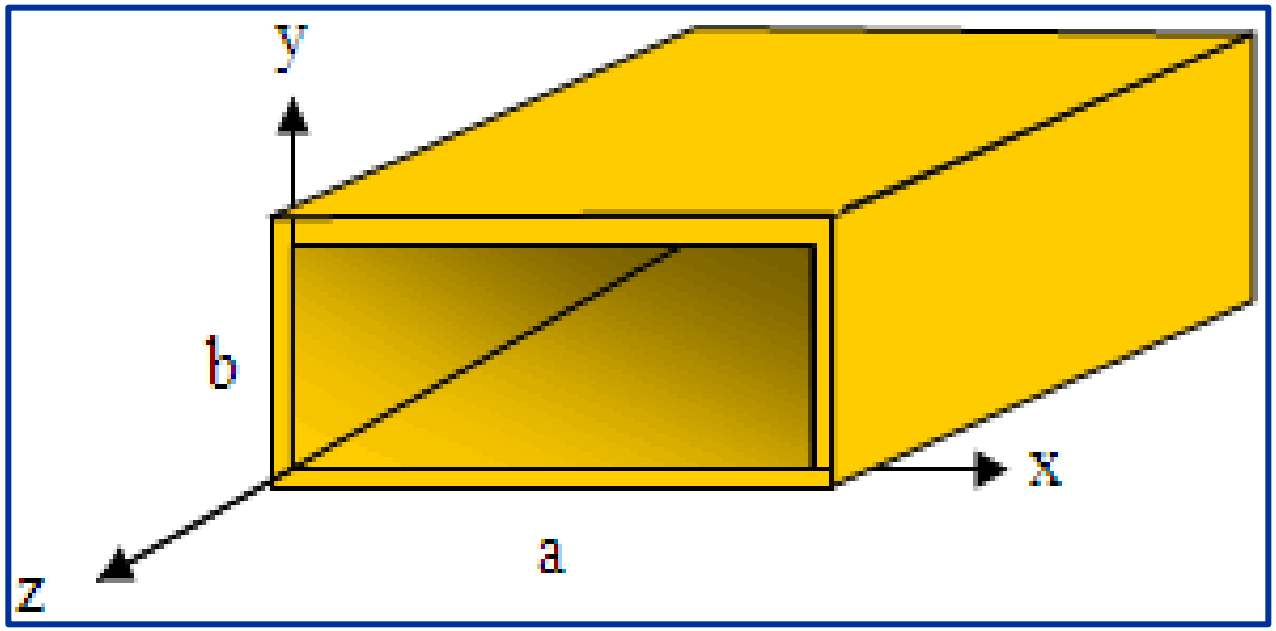
EEC 603
MICROWAVE ENGINEERING

UNIT-1

Rectangular Waveguides

- Any shape of cross section of a waveguide can support electromagnetic waves of which rectangular and circular waveguides have become more common.
- A waveguide having rectangular cross section is known as *Rectangular waveguide*

Rectangular waveguide



Dimensions of the waveguide which determines the operating frequency range

Dimensions of the waveguide which determines the operating frequency range:

1. The size of the waveguide determines its operating frequency range.
2. The frequency of operation is determined by the dimension ‘a’.
3. This dimension is usually made equal to one – half the wavelength at the lowest frequency of operation, this frequency is known as the waveguide *cutoff frequency.*
4. At the cutoff frequency and below, the waveguide will not transmit energy. At frequencies above the cutoff frequency, the waveguide will propagate energy.

Wave propagation

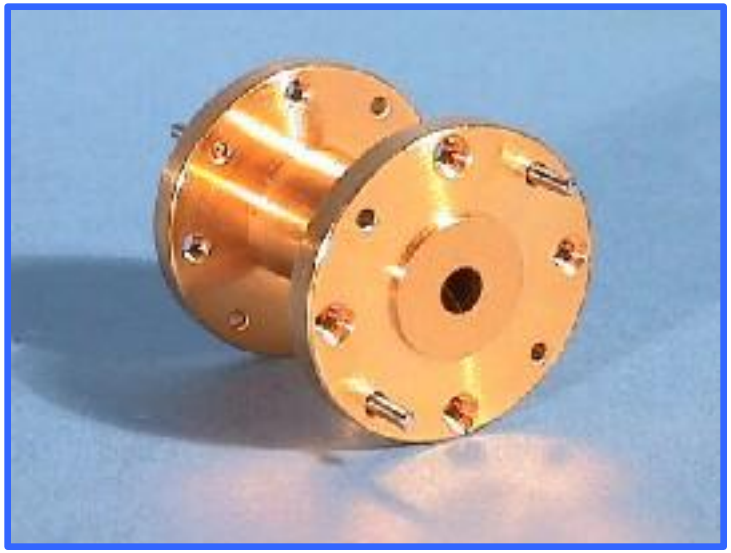
- When a probe launches energy into the waveguide, the electromagnetic fields bounce off the side walls of the waveguide as shown in the above diagram.
- The angles of incidence and reflection depend upon the operating frequency. At high frequencies, the angles are large and therefore, the path between the opposite walls is relatively long as shown in Fig.
- At lower frequency, the angles decrease and the path between the sides shortens.
- When the operating frequency is reaches the cutoff frequency of the waveguide, the signal simply bounces back and forth directly between the side walls of the waveguide and has no forward motion.
- At cut off frequency and below, no energy will propagate.

Representation of modes

- The general symbol of representation will be $TE_{m, n}$ or $TM_{m, n}$ where the subscript *m* indicates the number of half wave variations of the electric field intensity along the *b* (wide) dimension of the waveguide.
- The second subscript *n* indicates the number of half wave variations of the electric field in the *a* (narrow) dimension of the guide.
- The $TE_{1, 0}$ mode has the longest operating wavelength and is designated as the dominant mode. It is the mode for the lowest frequency that can be propagated in a waveguide.

Circular wave guide

A Hollow metallic tube of uniform circular cross section for transmitting electromagnetic waves by successive reflections from the inner walls of the tube is called ***Circular waveguide*.**



Circular wave guide

- The circular waveguide is used in many special applications in microwave techniques.
- It has the advantage of greater power – handling capacity and lower attenuation for a given cutoff wavelength. However, the disadvantage of somewhat greater size and weight.
- The polarization of the transmitted wave can be altered due to the minor irregularities of the wall surface of the circular guide, whereas the rectangular wave guide the polarization is fixed

Description

- The wave of lowest frequency or the dominant mode in the circular waveguide is the TE_{11} mode.
- The first subscript *m* indicates the number of full – wave variations of the radial component of the electric field around the circumference of the waveguide.
- The second subscript *n* indicates the number of half – wave variations across the diameter.
- The field configurations of TE_{11} mode in the circular waveguide is shown in the diagram below