Lecture-1

1. Fundamental Concept

1.1 Introduction:

Antennas are an indispensable part of any wireless communication system. In today's scenario, although, *antenna* as a device is not new to common man, but understanding the background concept involved in the working of this device will certainly help in designing new versatile antennas, in order to meet the stringent requirements of wireless communication engineers.

In any wireless communication system, after a radio frequency (rf) signal has been generated in a transmitter, some means must be used to radiate this signal through space to a receiver. The device that does this job is the *antenna*. The transmitter signal energy is sent into space by a *transmitting antenna*, the rf signal is then picked up from space by a *receiving antenna*.

The rf energy is transmitted into space in the form of an electromagnetic field. As the travelling electromagnetic field arrives at the receiving antenna, a voltage is induced into the antenna (usually a conductor). The rf voltages induced into the *receiving antenna* are then passed into the receiver and converted back into the transmitted rf information.

So, antennas can be thought of as a "transducer" that converts radio waves into electrical currents and voltages and vice versa. More specifically, these are devices designed to radiate or receive electromagnetic energy efficiently in a prescribed manner.

With this introduction, in this first lecture let us see some common types of antennas that are in use:

1.2 Types of Antennas:

- Wire antennas: (Fig. 1, 2 and Fig. 9 single element)
    - dipole, monopole, loop antenna, helix
    - Usually used in personal applications, automobiles, buildings, ships, aircrafts and spacecrafts.

- Aperture antennas: (Fig. 3, 4)
    - horn antennas, waveguide opening
    - Usually used in aircrafts and space crafts, because these antennas can be flush-mounted.

- Reflector antennas: (Fig. 5)
    - parabolic reflectors, corner reflectors
    - These are high gain antennas usually used in radio astronomy, microwave communication and satellite tracking.

- Lens antennas:
    - convex-plane, convex-convex, convex-concave and concave-plane lenses
    - These antennas are usually used for very high frequency applications.

- Microstrip antennas: (Fig. 6)
    - rectangular, circular etc. shaped metallic patch above a ground plane
    - Used in aircraft, spacecraft, satellites, missiles, cars, mobile phones etc.

- Array antennas: (Fig. 7, 8, and 9)
    - Yagi-Uda antenna, microstrip patch array, aperture array, slotted waveguide array.
    - Used for very high gain applications with added advantage, such as, controllable radiation pattern.

Fig. 1

Fig. 2

Fig. 3

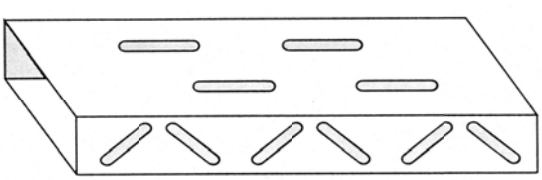

Fig. 4

Fig. 5

Fig. 6

Fig. 7

Fig. 8

Fig. 9

On completion of this course, the user will get a comprehensive knowledge of analysis and design techniques of different types of antennas and can be able to have idea of designing antennas as per the requirement of the wireless communication system. Few of the standard suggested readings for antenna theory are:

1. C. A. Balanis; **Antenna Theory: Analysis and Design**, John Wiley & Sons (Asia) Pvt. Ltd., Singapore.
2. W. L. Stutzman, G. A. Thiele; **Antenna Theory and Design**, John Wiley & Sons, Inc., USA.
3. R. E. Collin; **Antennas and Radio Wave Propagation**, McGraw Hill Int. Student Edition.
4. J. Kraus, R. Marhefka, A. Khan; **Antennas and Wave Propagation**, McGraw Hill Education (India) Pvt. Ltd.
5. R. S. Elliott; **Antenna Theory and Design**, Prentice Hall, Englewood, Cliffs, NJ.