

### 3/4 B.Tech - FIFTH SEMESTER

EC5T4

Antennas and Wave Propagation

Credits: 3

Lecture: 3 Hrs. /week

Internal assessment: 30 marks

Tutorial: 1 Hrs. /week

Semester end examination: 70 marks

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**Prerequisites:** Electromagnetic Field Theory (EC 4T4)

#### Course Objectives

- To introduce the fundamental principles of antenna theory and to apply them to the analysis, design.
- To introduce to the design principles of types of antenna arrays.
- To understand the radiation mechanism of various types of antennas and also to learn about the basic parameters of antennas and their measurement.
- To understand the wave propagation over ground and through different layers of atmosphere

#### Learning Outcomes:

Student will be able

- Estimate the fundamental properties of antennas in order to construct a wireless communication link.
- Analyze the radiation characteristics of various antenna array configurations.
- Design and develop antennas required in various wireless communication systems for different frequency bands.
- Interpret the problems associated with radio wave propagation in the atmosphere

#### UNIT- I

**Antenna Fundamentals:** Introduction, radiation mechanism – single wire, 2 wire, dipoles, current distribution on a thin wire antenna, antenna parameters - radiation patterns, patterns in principal planes, main lobe and side lobes, beam widths, beam area, radiation intensity, beam efficiency, directivity, gain and resolution, antenna apertures, aperture efficiency, effective height, Friss transmission equation.

**Linear Wire Antennas:** Retarded potentials, radiation from small electric dipole, quarter wave monopole and half wave dipole – current distribution, evaluation of field components, power radiated, radiation resistance, beam widths, directivity, effective area and effective height, antenna theorems.

#### UNIT-II

**Antenna Arrays:** Introduction, 2-element arrays – different cases, principle of pattern multiplication, N-element uniform linear arrays – broadside, end fire arrays, EFA with increased directivity, concept of scanning arrays, directivity relations, Binomial arrays.

### UNIT-III

**HF, VHF and UHF Antennas:** Introduction, resonant and non-resonant antennas, long wire antennas, V- antennas, rhombic antenna, design considerations. Loop antennas: field components, comparison of far fields of small loop and short dipole.

Broadband Antennas: Introduction, folded dipole, Yagi-Uda antenna, helical antenna-monofilar, axial mode and normal mode operations, biconical antenna.

### UNIT-IV

**Microwave Antennas:** Introduction, reflector antennas- plane reflector, corner reflector, parabolic reflector- types, feed systems, F/D ratio, aperture blocking. Horn antennas – types, optimum horns, design characteristics of pyramidal horns; Lens antennas – geometry, features, dielectric lenses and zoning, applications. Antenna measurements – patterns required, set up, distance criterion, directivity and gain measurements.

### UNIT-V

**Wave Propagation :**Ground wave propagation–characteristics, parameters, wave tilt, flat and spherical earth considerations. Sky wave propagation – structural details of ionosphere, refraction and reflection, ray path, critical frequency, MUF, LUF, OF, skip distance, virtual height, Ionospheric abnormalities, Ionospheric absorption. Space wave propagation – mechanism, LOS and radio horizon. tropospheric wave propagation – radius of curvature of path, effective earth's radius, field strength calculations, M-curves and duct propagation, tropospheric scattering.

### Learning Resources

#### Text Books:

1. Antenna Theory: Analysis and Design – Constantine A. Balanis, John Wiley & Sons, 3<sup>rd</sup> Ed., 2009
2. Transmission and propagation-E.V.D.Glazier and H.R.L. Lamont, vol.5 Standard Publishers Distributors- New Delhi

#### References:

1. Electromagnetic Waves and Radiating Systems – E.C. Jordan and K.G. Balmain, PHI, 2<sup>nd</sup> Ed., 2009.
2. Antennas and Wave Propagation – John D Kraus and Ronald J Marhefka, Ahmad S khan, TMH, 4<sup>th</sup> Ed., 2010.
3. Antennas and Wave Propagation-G.S.N.Raju, Pearson, 2014

#### Web Resources:

1. <http://www.antenna-theory.com/>
2. <http://www.antenna-theory.com/basics/main.html>