INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

ANTENNA AND WAVE PROPAGATION								
V Semester: ECE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AECD21	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Electromagnetic Waves and Transmission Lines								

I. COURSE OVERVIEW:

This course will cover the fundamentals of antenna, radiation phenomenon, antenna theory, different types of antennas, antenna arrays, design and measurements, concepts of antenna wave propagation (influence of earth's atmosphere on radio waves). Antennas had wide range of application in government and commercial fields and able to design the antennas like Yagi-Uda and Microstrip. The course presents fundamental theory together with techniques for the practical design, measurement and application of antennas over the RF (radio-frequency) to millimeter wave frequency range.

II. COURSES OBJECTIVES:

The students will try to learn

I. Principles of radiation, antenna parameters and working principle of VHF, UHF and Microwave antennas used in communications, broad casting, radar, navigation and similar systems.
II. Familiarize with basic antenna types and common structures, measurement of antenna characteristics and application of antennas over the radio frequency (RF) to micro wave (MW) frequency range.
III. The applications of smart, wideband and ultra wideband (UWB) antennas for wireless communications, satellite communication, and radar systems

III. COURSE OUTCOMES:

At the end of the course, students should be able to:

CO1 Illustrate the radiation mechanism in wire antennas and retarded potentials using Maxwell's equations.
CO2 Interpret the radiation characteristics of yagi-uda, horn and helical antennas using radiation pattern in far field region.
CO3 Analyze the radiation characteristics of micro strip and micro wave antennas using electric and magnetic field distribution.
CO4 Identify the radiation patterns of arrays using principle of pattern multiplication.
CO5 Examine the performance of antennas using the radiation pattern, directivity and gain.
CO6 Select the modes of wave propagation in the atmosphere at micro wave frequencies using refraction and reflection concepts.

IV. COURSE CONTENT:

MODULE –I: ANTENNA BASICS

Antenna fundamentals: Introduction, basic antenna parameters-patterns, beam area, radiation intensity, beam efficiency, directivity-gain-resolution, antenna apertures, effective height, illustrative problems, fields from oscillating dipole, field zones, front-to-back ratio, antenna theorems, radiation, retarded potentials, radiation from small electric dipole, quarter wave monopole and half wave dipole, current distributions, field components, radiated power, radiation resistance, loop antennas- introduction, small circular loop, comparison of far fields of small loop and short dipole.

MODULE –II: VHF, UHF AND MICROWAVE ANTENNAS-I

Arrays with parasitic elements, Yagi-uda array, folded dipoles and their characteristics, helical antennas-helical geometry, helix modes, practical design considerations for monofilar helical antenna in axial and normal modes, horn antennas- types, Fermat's principle, optimum horns, design considerations of pyramidal horns, illustrative problems.

MODULE –III: VHF, UHF AND MICROWAVE ANTENNAS-II

Micro strip Antennas-Introduction, basic characteristics of micro strip antennas, feeding methods, method of analysis, rectangular and circular micro strip antennas, basic concepts of Smart antennas, concepts and benefits of smart antennas, fixed weight beam forming, adaptive beam forming.

Reflector Antennas- Introduction, paraboloidal reflectors- geometry, pattern characteristics, feed methods lens antennas: introduction, geometry of non-metallic dielectric lenses, zoning, tolerances, applications, slot antenna, Babinet's principle, applications.

MODULE –IV: ANTENNA ARRAYS AND MEASUREMENTS

Antenna Arrays: Point sources- definition, patterns, arrays of 2 isotropic sources – different cases, principle of pattern multiplication, uniform linear arrays- broadside arrays, end-fire arrays, EFA with increased directivity, derivation of their characteristics and comparison, BSAs with non-uniform amplitude distributions, general considerations and binomial arrays, illustrative problems

Antenna Measurements: Introduction, concepts – Reciprocity, near and far fields, coordinate system, sources of errors patterns to be measured, pattern measurement arrangement directivity measurement, gain measurements (by Comparison, Absolute and 3-Antenna methods)

MODULE –V: RADIO WAVE PROPAGATION

Radio wave propagation, Modes, structure of atmosphere, sky wave propagation, effect of earth's magnetic field, Ionospheric abnormalities and absorption, space wave propagation, LOS distance, Field strength of space wave, duct propagation, VHF and UHF Mobile radio propagation, tropospheric scatter propagation, fading and diversity techniques.

V. TEXTBOOKS:

1. John D. Kraus, Ronald J. Marhefka, Ahmad S. Khan, "Antennas and Wave Propagation", TMH, 4th Edition, 2010.
2. C.A. Balanis, "Antenna Theory", John Wiley and Sons, 2nd Edition, 2001.

VI. REFERENCE BOOKS:

1. E.C. Jordan, K.G. Balmain, "Electromagnetic Waves and Radiating Systems", PHI, 2nd Edition, 2000.
2. E.V.D. Glazier, H.R.L. Lamont, "Transmission and Propagation", Her Majesty's Stationery Office, 1958.
3. F.E. Terman, "Electronic and Radio Engineering", McGraw-Hill, 4th Edition, 1955.
4. K.D. Prasad, SatyaPrakashan, "Antennas and Wave Propagation", Tech India Publications, 1st Edition, 2001.

VII. ELECTRONICS RESOURCES:

1. https://nptel.ac.in/courses/117/107/117107035/

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Tech talk topics
4. Open end experiments
5. Definitions and terminology

6. Assignments
7. Model question paper – I
8. Model question paper - II
9. Lecture notes
10. E-learning readiness videos (ELRV)
11. Power point presentation