

<b>COURSE CODE</b>	<b>COURSE NAME</b>	<b>L-T-P-C</b>	<b>YEAR OF INTRODUCTION</b>
<b>EC306</b>	<b>Antenna &amp; Wave Propagation</b>	<b>3-0-0-3</b>	<b>2016</b>
<b>Prerequisite:</b> EC303 Applied Electromagnetic Theory			
<b>Course objectives:</b> <ul style="list-style-type: none"> <li>• To learn the basic working of antennas.</li> <li>• To study various antennas, arrays and radiation patterns of antennas.</li> <li>• To understand various techniques involved in various antenna parameter measurements.</li> <li>• To understand the propagation of radio waves in the atmosphere.</li> </ul>			
<b>Syllabus:</b> Antenna and antenna parameters, Duality of antennas, Derivation of electromagnetic fields and directivity of short dipole and half wave dipole, Measurement of antenna parameters. Antenna arrays and design of Endfire, broadside, binomial and Dolphchebyshev arrays, Principles of practical antennas. Traveling wave antennas, principle and applications of V and rhombic antennas Principles of Horn, Parabolic dish antenna and Cassegrain antenna, Log periodic antenna array and Helical antenna. Design of rectangular Patch antennas. Principle of smart antenna, Radio wave propagation, Different modes, effect of earth's magnetic field. Fading and diversity techniques.			
<b>Expected outcome:</b> The student will be able to know: <ol style="list-style-type: none"> <li>The basic working of antennas.</li> <li>Various antennas, arrays and radiation patterns of antennas</li> <li>Various techniques involved in various antenna parameter measurements.</li> <li>The propagation of radio waves in the atmosphere.</li> </ol>			
<b>Text Books:</b> <ol style="list-style-type: none"> <li>Balanis, Antenna Theory and Design, 3/e, Wiley Publications.</li> <li>John D. Krauss, Antennas for all Applications, 3/e, TMH.</li> </ol>			
<b>References:</b> <ol style="list-style-type: none"> <li>Collin R.E, Antennas &amp; Radio Wave Propagation, McGraw Hill. 1985.</li> <li>Jordan E.C. &amp; K. G. Balmain, Electromagnetic Waves &amp; Radiating Systems, 2/e, PHI.</li> <li>Raju G.S.N., Antenna and Wave Propagation, Pearson, 2013.</li> <li>Sisir K.Das &amp; Annapurna Das, Antenna and Wave Propagation, McGraw Hill, 2012</li> <li>Terman, Electronics &amp; Radio Engineering, 4/e, McGraw Hill.</li> <li>Thomas A. Milligan, Modern Antenna Design, IEEE PRESS, 2/e, Wiley Inter science.</li> </ol>			

Course Plan			
Module	Course content	Hours	End Sem. Exam Marks
I	Basic antenna parameters - gain, directivity, beam solid angle, beam width and effective aperture calculations. Effective height - wave polarization - antenna temperature - radiation resistance - radiation efficiency - antenna field zones - principles of reciprocity. Duality of antennas.	7	15
II	Concept of retarded potential. Field, directivity and radiation resistance of a short dipole and half wave dipole. Measurement of radiation pattern, gain, directivity and impedance of antenna	7	15
FIRST INTERNAL EXAM			
III	Arrays of point sources - field of two isotropic point sources - principle of pattern multiplication - linear arrays of ‘n’ isotropic point sources. Grating lobes.	4	15
	Design of Broadside, Endfire & Binomial arrays. Design of DolphChebyshev arrays.	4	
IV	Basic principle of beam steering. Travelling wave antennas. Principle and applications of V and rhombic antennas. Principles of Horn, Parabolic dish antenna, Cassegrain antenna (expression for E, H and Gain without derivation).	6	15
SECOND INTERNAL EXAM			
V	Principle of Log periodic antenna array and Helical antenna. Antennas for mobile base station and handsets.	3	20
	Design of rectangular Patch antennas. Principle of smart antenna.	3	
VI	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	4	20
	Field strength of space wave, duct propagation, VHF and UHF Mobile radio propagation, tropospheric scatter propagation, fading and diversity techniques.	4	
END SEMESTER EXAM			

### Question Paper Pattern ( End semester exam)

**Max. Marks : 100**

**Time : 3 hours**

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 50% for theory and 50% for logical/numerical problems, derivation and proof.