EC304	Antennas and Propagation	PCC	3-0-0	3 Credits

Pre-requisites: None

Course Outcomes: After the completion of the course the student will be able to:

CO1	Analyze the electromagnetic wave propagation in guiding structures under various matching conditions.
CO2	Provide an understanding of antenna radiating principle and discuss the fundamental characteristics and parameters of antennas.
CO3	Develop the performance characteristics of antennas arrays, its operating principles, methods and concepts to design
CO4	Measure the antenna parameters
CO5	Understand the behavior of nature on EM wave propagation

Mapping of course outcomes with program outcomes:

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**
CO2	**3**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**-**
CO3	**-**	**2**	**-**	**-**	**-**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**2**
CO4	**-**	**-**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**
CO5	**3**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**

Detailed Syllabus:

Review of electromagnetic fields

Guided waves: Waves between parallel planes, TE and TM waves, characteristics of TE and TM waves, TEM waves, Velocities of propagation, Wave Impedance.

Wave guides: Rectangular wave-guides, TE & TM modes in wave-guides, Wave Impedance in rectangular waveguides**.**

Antenna Fundamentals: Introduction to antennas & its significance, Scalar electric potential, vector magnetic potential, radiation from an alternating current element, Induction field, radiation field, power radiated by a current element, Definition of electric dipole, radiation by a half wave dipole. Power by a half wave dipole & its radiation resistance, Radiation from a quarter wave monopole Power radiation and radiation resistance of dipole & monopole (approximate analysis), Radiation resistance of aerials and loop, problems Isotropic radiator, network theorem, application of network theorem to antennas.

Antenna Parameters: Radiation pattern, power pattern, field pattern Radiation intensity, Antenna impedance, mutual impedance, gain and directivity, bandwidth, Polarization, efficiency, effective length, area or aperture, scattering loss, Collecting aperture, physical aperture---relation between large aperture and gain Effective aperture of a small elementary dipole, half wave antenna, effective length, front to back ratio, Antenna beam width and side lobes. Friss Transmission formula, Radar range equation**.**

Design of Arrays: N-element linear array- broadside array, End fire array, multiplication of patterns Effect of earth on vertical pattern mutual impedance effects, Binomial arrays, problem solving.

Practical antennas: VLF, LF, MF transmitting antennas, resonant & non resonant antennas, V antenna, travelling wave antenna, Rhombic antenna, VHF &UHF antennas, horn antenna Folded dipole & Yagi-Uda antenna, Parabolic reflector antenna,, Corner reflector, Parabolic reflector antenna, Micro strip Antennas**.**

Antenna impedance measurements: Radiation pattern measurements Measurement of antenna beam width and gain, Polarization measurements. Measurement of radiation resistance.
Wave Propagation: Types of wave propagation, space wave propagation and line of sight distance for flat and curved surfaces.

Reading:

1. E.C. Jordan & K.G. Balmain, Electromagnetic waves & Radiating Systems, PHI, 2007
2. Antenna Theory: Analysis and Design – Constantine A. Balanis, John Wiley & Sons, 3 rd Ed., 2009.
3. David K. Cheng, “Field and Wave Electromagnetics”, Pearson, 2e, 2014.
4. John D. Kraus, Antennas, 2nd Edition, McGraw Hill, 1988.
5. R.E. Collins, Antennas and Radio Propagation, Singapore: McGraw Hill, 1985.
6. David M. Pozar, “Microwave Engineering”, Wiley, 4e, 2012.