Course Title: Antennas and Propagation
Course Code: ETEG 402
Credit Hours: 3

Course Description:
This course intends to introduce concept of radio wave radiating technology using antennas and wave propagation mechanism used for signal transmission. This course builds on the theory introduced in Electromagnetic Fields and Waves course.

Course Contents:

Unit 1: Review of Electromagnetic Fields Parameters
Introduction of Electromagnetic wave, Review of Maxwell's wave equations, Solution of the wave equations in free space, Wave velocity, Wave impedance, Poynting's vector and polarization, Superposition and Thevenin Theorem.

Unit 2: Fundamental of Radiation Mechanisms
Retarded potential functions, EM wave generation with a conducting current, The short uniform current dipole, The small uniform current loop, The radiated electric and magnetic fields; Near and far field expressions for E and H. Huygen's principle, Radiation pattern and radiation resistance of the dipole and the loop, Maximum power transfer criteria, Fresnel and Fraunhoffer zones.

Unit 3: Antenna Terminology and Parameters
Radiation pattern, Radiation lobes, Radiation resistance, Radiation intensity, Half power beam width, Front to back ratio, Beam angle, Beam efficiency, Effective aperture, Directivity, Directive gain, Power gain, Antenna efficiency, Bandwidth, Antenna input impedance and VSWR, Self impedance, Mutual impedance, Reciprocity Theorem, Antenna feed.

Unit 4: Various Types of Antennas and Apertures
Short and long dipoles, Folded dipoles, monopoles, Ground plane considerations; Travelling wave antennas, beverage antennas, Vee antennas, rhombic antennas; Broadband antennas: Biconical antennas, Discone antennas, Helical antennas; Frequency independent antennas- spiral antennas, Horn antennas, Slot antennas, Microstrip antennas, Reflector antennas, Cassegrain antenna, Feed configuration for cassegrain antennas, Lens antennas. Radiation pattern, Radiation resistance and directivity of short, long and folded dipoles, Rectangular and Parabolic apertures, Physical and effective aperture

Unit 5: Antenna Array
Basic array theory, Arrays of isotopic sources, Principle of Pattern multiplication. Antenna Array: Broadside array, End-fire array, collinear array, Binomial array, parasitic arrays, Yagi Uda arrays, Log periodic arrays, Adaptive array and Electronic phased array.

Unit 6: Wave Propagation
Free space propagation, Friis transmission formula, Ground-wave propagation, Pseudo-Brewster angle, skywave propagation, Refraction, Virtual height, Critical frequency, Maximum usable

frequency, Skip distance, Microwave propagation, Atmospheric bending of a radio wave, Absorption of radio waves by water vapor and oxygen molecules; Diffraction and Path loss. Ionospheric and tropospheric propagation, Multi-hop and duct propagation

References:

1. J. D. Kraus, R. J. Marhefka, A. S. Khan, *Antennas and Wave Propagation*, 4th Ed McGraw Hill Education 2017.
2. E. C. Jordan and K. G. Balmain, *Electromagnetic Waves and Radiating Systems*, 3rd Edition, Prentice Hall India.
3. G. S. N. Raju, *Antennas and wave Propagation*, Pearson Education, 1st Edition, 2009.

Evaluation:

In-Semester Evaluation: 50%
End-Semester Evaluation: 50%