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

Course Description:
This course extends the treatment of wave propagation and radiating systems introduced in the Electromagnetic Fields and Waves course.

Course Contents:

Unit 1: Antenna Fundamentals
Review of Maxwell's equations and the wave equations. Solution of the wave equations in free space, Wave velocity, Wave impedance, Poynting's vector and polarization

Unit 2: Review 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. Radiation pattern and radiation resistance of the dipole and the loop

Unit 3: Antenna Terminology and Parameters
Radiation pattern, Radiation lobes, Half power beamwidth, Front to back ratio, Beam angle, Beam efficiency, Directivity, Directive gain, Power gain, Antenna efficiency, Frequency bandwidth, Antenna input impedance, Self impedance, Mutual impedance

Unit 4: Antenna Theorems
Superposition, Reciprocity, Thevenin, Maximum power transfer; Basic array theory, Arrays of isotopic sources, Pattern multiplication, Broadside, Endfire and binomial arrays, Array patterns, Parasitic arrays, Huygen's principle, Fresnel and Fraunhoffer zones, Rectangular and circular apertures, Horns

Unit 5: Various Types of Antennas
Short and long dipoles: Radiation pattern, Radiation resistance and directivity; 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, Log-periodic antennas; Array antennas: Yagi Uda arrays, Log periodic arrays; Reflector antennas, Feed configuration for parabolic antennas, Lens antennas

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, VHF and UHF propagation, Diffraction, Fresnel zones, Path loss due to smooth earth and knife edge obstacles, Microwave propagation, Atmospheric bending of a radio wave, Absorption of radio waves by water vapor and oxygen molecules; Statistical

considerations: Ionospheric propagation and path predictions, Scatter propagation, Ducting; Propagation in optical fibers, Dispersion and losses in the fibers

References:

1. R. E. Collin, *Antennas and Radiowave Propagation*, McGraw Hill
2. J. D. Kraus, *Antennas*, 2nd Ed McGraw Hill 1988
3. E. C. Jordan and K. G. Balmain, *Electromagnetic Waves and Radiating Systems*, 3rd Ed, Prentice Hall India