

**Course Title: Electromagnetic Fields and Waves**

**Course Code: EEG 309**

**Credit Hours: 3**

**Course Description:**

This course extends the introductory first year course in electricity and magnetism and to provide an in depth understanding of the concepts and engineering application of electromagnetic fields and waves.

**Course Contents:**

**Unit 1: Electromagnetic Spectrum and Real World Applications**

Review of electromagnetism, Electromagnetic spectrum. Overview, Application and Special characteristic: Radio Wave, Microwave, Millimeter wave, Sub-millimeter wave, Infrared, Visible Light, Ultraviolet, X-Rays, Gamma Rays.

**Unit 2: Uniform Plane Waves**

Overview of Scalar and Vector, Physical interpretation of Gradient, Divergence and Curl, Conductor and dielectric, Laplace's and Poisson's equations, Time varying field: Maxwell's equations, Phasor notation, Boundary condition, Basic characteristic of uniform plane wave, Solution of uniform plane waves in free space, Wave polarization, Wave equation and solutions for conducting media, Wave impedances and intrinsic impedance, Waves in dielectrics and conductors, wave propagation in lossless medium, Poynting vector and pointing theorem, Refraction and reflection of plane wave, Standing waves, Skin depth.

**Unit 3: Transmission Lines**

Transmission line configurations, transmission line equations, Primary and secondary parameters, Characteristic impedance, Propagation constant, Discontinuities and reflection, Shorted and open line, Reflection coefficient, Transmission coefficient, VSWR, arbitrary terminations, Impedance matching, Smith Chart, Matching methods, Dissipative transmission line.

**Unit 4: Waveguides**

Introduction to waveguides, TEM, TE and TM modes, Dispersion, Phase and group velocities,  $TE_{mn}$  and  $TM_{mn}$  wave in rectangular waveguides, Cutoff frequency, Degenerate and dominant modes. Power transmission in rectangular waveguide, Power loss in rectangular waveguide, Excitation modes of rectangular waveguide, Fundamental of cylindrical waveguides, Cavity resonators, Rectangular cavity resonator and modes, Dielectric waveguides, Optical waveguides

**Unit 5: Effect of Electromagnetic Field Exposure and Safety**

Exposure sources, Effect of exposure, Protection and safety management from radiation exposure.

**References:**

1. W. Hayat, J. A. Buck, *Engineering Electromagnetics*, McGraw Hill, 9<sup>th</sup> edition, 2018.
2. N. Narayan Rao, *Elements of Engineering Electromagnetics*, PHI, 1992.

3. J. Kraus and K. Carver, *Electromagnetics*, McGraw Hill, 2<sup>nd</sup> edition, 1973.
4. J. Reitz, F. Milford and R. Christy, *Foundations of Electromagnetic Theory*, Addison Wesley, 4<sup>th</sup> edition, 2008.
5. R. Kitchen, *RF and Microwave Radiation Safety*, Newnes, 2<sup>nd</sup> edition, 2001.

**Evaluation:**

In-Semester Evaluation: 50%

End-Semester Evaluation: 50%