Course Syllabi: UEE302 Electro Magnetic Field Theory (L : T : P :: 3 : 1 : 0)

1. **Course number and name:**UEE302; Electromagnetic Field Theory

2. **Credits and contact hours:**Credits: 3.5; Hours: 4

3. **Text book, title, author, and year**

   - *Hayt, W.H., Engineering Electromagnetics, Tata McGraw Hill (2008) 7th ed.*
   - *Kraus, J.D., Electromagnetics, McGraw Hill (2006) 5thed.*
   - *Sadiku, M.N.O, Elements of Electromagnetics, Oxford University Press (2009) 4th ed.*
   - *Jordan, E.C. and Balmain K.G., Electromagnetic Waves and Radiating Systems, Prentice Hall of India (2008) 2nd ed.*
   - *Paramanik, A, Electromagnetism: Theory and Applications, Prentice Hall of India (2006) 2nd ed.*

   a. Other supplemental materials
      - Nil

4. **Specific course information**

   a. Brief description of the content of the course (catalog description)

   Vector Analysis: Review of vector algebra, Review of cartesian, Cylindrical and spherical coordinate systems, Introduction to del Δ (operator, Use of del operator as gradient, divergence, curl).

   Electrostatic fields: Introduction to coulomb's law, Gaussian law and its applications in determination of field of spherical and cylindrical geometries, Laplace's and poisson's equation in various coordinate systems. Effect of dielectric on capacitance, Boundary conditions at electric interfaces, Method of images and its applications.

   Magnetostatics: Introduction to ampere's law, Magnetic vector potential, Magnetic forces, Boundary conditions at magnetic interfaces.

   Time Varying Fields and Maxwell's Equations: Continuity of charge, Concept of displacement current, Maxwell's equation in integral and differential form: for static fields, for time varying fields, for free space, for good conductors, for harmonically varying fields, Poynting theorem: Energy stored and radiated power, Complex poynting vector, Properties of conductor and dielectrics, Wave equations for free space, Wave equations for conductors.

   Uniform Plane Waves: Introduction, Uniform plane wave propagation: Wave equations, Transverse nature of uniform plane waves, Perpendicular relation between $\vec{E}$ and $\vec{H}$, EM waves in charge free, Current free dielectric, Reflection by ideal conductor: Normal incidence, reflection and transmission with normal incidence at another dielectric, Plane wave in lossy dielectric, Wave impedance and propagation constant, Depth of penetration, Surface impedance and surface resistance.

   Transmission Lines and Matching Networks: Introduction, Circuit representation of parallel plane transmission lines, Transmission lines with losses, Characteristic impedance, Characteristic impedance at radio frequencies, Propagation constant, Attenuation constant and phase constant, An infinite line equivalent to a finite line terminated in its characteristic impedance, Reflection, Reflection coefficient, Expression for input impedance in terms of reflection coefficient, Standing wave ratio (SWR), Relation between SWR and reflection coefficient, Location of voltage maxima and minima, Impedance matching devices, Principle of impedance matching devices, Smith Chart.

Wave Guides: Introduction, Simple waveguides between two infinite and parallel conducting plates, Transverse Electric (TE) Waves or HWaves, Transverse magnetic (TM) Waves or EWaves, Characteristic of TE and TM waves, Transverse Electromagnetic (TEM) waves, TEM mode in a hollow wave guide, TM and TE mode solutions of rectangular waveguides, Difference between TE and TM modes.

5. **Specific goals for the course**

After the completion of the course, the students will be able to:

- Calculate electric and magnetic fields in different coordinates for various charge and current configurations.
- Demonstrate different aspects of plane wave in dielectric and conducting media.
- Realize the analogy of wave with transmission line and calculate the transmission line performance.
- Select the appropriate guide for electromagnetic waves.

6. **Brief list of topics to be covered**

- Vector analysis
- Electrostatic fields
- Magnetostatics
- Time Varying Fields and Maxwell's Equations
- Uniform plane waves
- Waveguides