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| **Course Code** | **Course Name** | **Course Structure** | |
| **ECECC13** | **Electromagnetics** | **L-T-P** | **3-0-1** |
| COURSE OUTCOMES (COs):  CO1: To understand the concept of Electric Field Component of the RF signals. CO2: To understand the concept of Magnetic Field Component of the RF signals.  CO3: To understand the Electromagnetic wave generation, their behavior in different media. CO4: To understand the basic concept of low and high frequency circuit transmission line for various RF circuitry of communication system.  CO5: To understand the basic concept of guided waves, their mode characteristics in different  shapes of waveguides. | | | |
| COURSE CONTENT:  **UNIT-I**  **Electrostatics:**  *Introduction to the need of Electromagnetics and Electromagnetic spectrum, coordinate system transformations, general curvilinear system, physical significance of gradient, divergence, and curl in electromagnetics, Gauss divergence theorem and stoke theorem, Poisson's and Laplace's equations, Uniqueness Theorem.* Electrostatics Field, flux, flux density, Coulomb Law, Gauss Law, Electric Potential, Electric dipole, Energy density in electrostatic fields. Properties of Dielectric Materials, Convection and conduction currents, Polarization in Dielectrics, Continuity equation and relaxation time, Electric Boundary conditions, Resistance and Capacitance.  **UNIT-II**  **Magnetostatics:**  BiotSavart's Law, Ampere's Law and its applications, Magnetic Flux Density, Magnetic Scalar and Vector Potentials, Magnetic Forces and Magnetic Materials: Forces due to Magnetic Fields, Magnetic Torque and Moments, Magnetic dipole, Magnetization in Materials, Magnetic Boundary Conditions, Inductors and Inductances, Magnetic Energy, Magnetic circuits.  **UNIT-III**  **Electromagnetic wave:**  Time Varying Fields and Maxwell's Equation: Faraday's Law, Displacement Current, Maxwell's equations in Point Form and Integral Form with its physical significance, Electromagnetic Wave in Lossy Dielectrics, Free Space and in good Conductors, Poynting Theorem, Reflection of a plane wave at Normal and Oblique incidence.  **UNIT-IV**  **Transmission Lines:**  Need and Types of Transmission Lines, lumped parameter analysis of transmission line, Characteristic impedance, Propagation, attenuation constant. Discontinuities in transmission line, Voltage standing wave ratio, Input impedance of transmission line  terminated with any load, distortion less Transmission Lines, Smith chart and its | | | |

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| applications, Transient analysis of Transmission Lines for resistive, inductive, capacitive and complex loads.  **UNIT-V**  **Waveguides:**  General Wave behaviors along uniform Guiding structures, Transverse Electromagnetic waves, Transverse Magnetic waves, Transverse Electric waves, TM and TE waves between parallel plates. Modes, power and losses analysis in rectangular and cylindrical waveguides. Rectangular and Circular cavity resonators.  Introduction to Microstrip transmission Line, quasi-TEM mode analysis. |
| Text Books:  [T1] M.N.O. Sadiku, "Principles of Electromagnetics", 4th international Version, Oxford University Press.  [T2] W.H. Hayt and J. A. Buck "Engineering Electromagnetics" Seventh Edition, McGraw Hill Education.  Reference Book:  [R1] David M. Pozar, “Microwave Engineering”, 4th Edition, Wiley. |

**LIST OF EXPERIMENTS:**

* 1. In the two-dimensional electrostatic boundary-value problem, consider the configuration of conductors and potentials shown in Fig. 1. Derive an expression for the voltage at any point (x, y) inside the conductors. Write a MATLAB program that plots the contours of the voltage and the lines of the electric field.

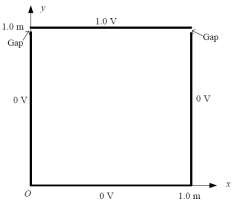


Fig.1

* 1. A current sheet **K** = 5.0 ay A/m flows in the region −0.15 m < x < −0.15 m (Fig.2). Compute **H** at P (0, 0, 0.25). Write a MATLAB program to verify your answer and plot the magnetic field in the x-y plane in the region −0.5m ≤ x ≤ 0.5m and −0.5m ≤ z ≤ 0.5m.

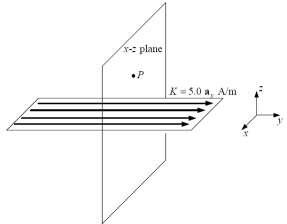


Fig.2

* 1. To investigate the electric and magnetic field components of electromagnetic signal in time and space domain for different medium conditions.
  2. Determination of primary and secondary constants of a co-axial line.
  3. To determine standing wave ratio (SWR) and Reflection coefficient of a co-axial line.
  4. To design a single stub tuner to match any given load to a 50 Ω transmission line and

measure the SWR before and after matching.

* 1. To excite a transmission line terminated by resistive, reactive and complex loads, Monitor the voltage at the input of the line over a period of time, using a vector network analyzer in the time domain; also determine the magnitude and the nature of the load.
  2. Measurement of frequency and wavelength of dominant TE mode in rectangular waveguide.
  3. To design WR-90 Waveguide to obtain the Field patterns, intrinsic Impedance, propagation constants and wavelength for the first 4 modes.
  4. To design a Circular dielectric waveguide with a high permittivity central core of radius a=1.1483m, and relative permittivity εr= 20 surrounded by air cladding. Compute the cut off frequency of the 6 modes and plot the propagation constant vs. frequency graph.
  5. To design a rectangular cavity; a = 2.286 cm, b =1.016 cm and d = 3 cm filled with free space. Compute the first cut off frequency of the 3 modes.