EC-211	ELECTROMAGNETIC FIELDS & TRANSMISSION LINES	L T P C 4 1 - 3

COURSE OBJECTIVES:

1. To calculate the electric field and electric potential due to various charge distributions using coulomb's law and guass's law.
2. To derive the boundary conditions for electrostatic case and to calculate capacitances of widely used configurations.
3. To know the basic laws describing the relationship between steady magnetic field and current.
4. To derive the maxwell's equations and apply these equations in free space to describe the electromagnetic waves.
5. To analyze and study the phenomenon of two wire transmission lines at low frequencies and high frequencies.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. demonstrate knowledge in electrostatic fields, steady magnetic fields, electromagnetic wave propagation and transmission lines.
2. analyze applications of Gaussâ€™s law, Ampereâ€™s law, electric and magnetic boundary conditions in different mediums and reflection of electromagnetic waves in free space and in transmission lines.
3. develop the solutions for complex engineering problems of propagation parameters of electromagnetic waves in free space and transmission lines.
4. evaluate potential in electric and magnetic fields.
5. Design and analyze appropriate techniques in transmission lines to deliver maximum energy at load.

UNIT I *Text Book - 1* **(12)**

Electrostatics - I : The experimental law of coulomb, Electric field intensity, Field due to a continuous volume charge distribution, Field of a line charge, sheet of charge. Electric Flux Density, Guass's law, Applications of Gauss law, Divergence, Maxwell's First equation (Electrostatics), Energy expended in moving a point charge in an electric field, The line integral, Definition of potential and potential difference. The potential field of a point charge, system of charges, potential gradient, the dipole and Energy density in electrostatic field.

UNIT II *Text Book - 1* **(10)**

Electrostatics - II : Current and current density, continuity of current, conductor properties and boundary conditions. The nature of dielectric materials, boundary conditions for perfect dielectric materials. Capacitance. Several capacitance examples. Capacitance of a two wire line. Derivations of Poisson's and Laplace's equations, Examples of the solution of Laplace's equation.

UNIT III *Text Book - 1* **(13)**

The Steady Magnetic Field : Biot-Savart Law, Ampere's Circuital Law, Magnetic Flux and Magnetic Flux Density, The scalar and vector magnetic potentials.

Magnetic Forces and Materials : Force on a moving charge, Force on a differential current element, Force between differential current elements, Force and torque on a closed circuit, The nature of magnetic materials, Magnetization and Permeability. Magnetic boundary conditions. Potential energy and forces on magnetic materials.

UNIT IV *Text Book - 1,2* **(13)**

Time Varying Fields and Maxwell's Equations : Faraday's law, Displacement current, Maxwell's equations in point form, integral form.

Electromagnetic waves : Solution for free space conditions, Uniform plane wave propagation, Uniform

Plane waves, Wave Equations for conducting medium, Sinusoidal Time variations. Conductors and dielectrics, Polarization, Direction Cosines, Reflection by Perfect conductor- normal incidence, Oblique Incidence, Reflection by Perfect Dielectric - Normal Incidence, Oblique Incidence, Poynting's theorem.

UNIT V *Text Book - 3* **(15)**

Transmission Lines : Line Parameters, The transmission line-general solution, Physical significance of the equations,The infiniteline,Wave length, Velocity of propagation, Waveform ditortion, The distortion less line, Reflection on a line not terminated in Zo, Constants for the line of zero dissipation, Standing waves, nodes, standing wave ratio, Input impedence of the dissipationless line, The input impedance of OC and SC lines, The eighth-wave line, The quarter wave line, Impedance matching, The halfwave line, Smith chart, Applications of smith chart: reflection coefficient, VSWR, input impedence.

LEARNING RESOURCES:

TEXT BOOK(s):

1. W H Hayt, J A Buck - Engineering Electromagnetics, 7th Edition TMH, 2006.
2. EC Jordan and KG Balmain - Electromagnetic Waves and Radiating Systems,PHI, 2003.
3. John D. Ryder - Networks, Lines and Fields, 2nd Edition, PHI, 1999.

REFERENCE BOOK(s):

1. G S N Raju, Electromagnetic Field Theory and transmission lines, 1st Edition, Pearson Education India, 2005.
2. Joseph A Edminister - Theory and Problems of Electromagnetics, 2nd Edition, Schaum's Outline Series, Mc-Graw Hill International, 1993
3. Mathew N O Sadiku - Elements of Electromagnetics, Oxford University Press, 2003.

WEB RESOURCES:

1. http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-%20Guwahati/em/index.htm
2. http://www.mike-willis.com/Tutorial/PF2.htm