ELECTRICAL ENGINEERING

Applied Electromagnetics For Engineers

Type of Course : New
Course Snapshot : Core / UG - B.E/B.Tech,B.Sc
Pre-requisites : Vector analysis, Differential and integral calculus, programming using Matlab
Course Duration : 30 hours / 12 weeks
Industry support : Sterlite, Analog Devices, GE, Comsol India,

COURSE OUTLINE:

Applied electromagnetics for engineers is designed to be an application oriented course while covering all the theoretical concepts of modern electromagnetics. It begins by an in-depth study of transmission lines which play an important role in high-speed digital design and signal integrity of PCBs. After a brief review of necessary mathematics (coordinate systems, vector analysis, and vector fields).

INSTRUCTOR:

Prof. Pradeep Kumar K
Department of Electrical Engineering,
IIT Kanpur

ABOUT THE INSTRUCTOR

Prof. Pradeep Kumar K obtained his PhD from the Department of Electrical Engineering, IIT Madras working on Quantum Key Distribution in 2009. He has since been at the Department of Electrical Engineering, IIT Kanpur. His research interests include Quantum key distribution, signal processing for coherent optical communications, optical signal processing using nonlinear fibers, and spin wave--optical interactions.

COURSE PLAN:

Week 1 : Introduction to Applied EM theory; Lossless Transmission line equations; Frequency-domain behavior: Characteristic impedance of T-line; Reflection and transmission coefficients.
Week 2 : More general T-lines; Attenuation and propagation coefficients; Transmission line techniques: Standing wave ratio (SWR) and line impedance; Visual aid: Smith Chart .
Week 3 : Impedance matching techniques; T-lines in time-domain: Reflection from mismatched loads; Lattice diagram calculations; Pulse propagation on T-lines.
Week 4 : Case study: High-speed digital signals on PCBs; Transients with reactive termination; Application: Time-domain reflectometry; Review of Coordinate Systems, Vector analysis.
Week 5 : Review of Vector analysis -2; Vector fields; Overview and importance of Maxwell's equations Boundary conditions between two media.
Week 6 : Solution of Laplace's and Poisson's equation -- Analytical techniques; Solution of Laplace's and Poisson's equation in two dimensions; Numerical solution of Laplace's equation.
Week 7 : Magnetostatic fields: Biot Savart and Ampere's laws; Magnetic field calculations; Inductance and inductance calculation; Quasi-statics: Fields of a wire; Quasi-static analysis of skin effect
Week 8 : Uniform plane waves - one dimensional wave equation; Uniform plane waves: propagation in arbitrary direction, phase velocity, polarization; Plane waves in conductors an dielectric .
Week 9 : Total internal reflection and Snell's laws; Application: Multilayer thin films,Fabry-Perot cavity; Waveguides-General introduction; Rectangular metallic waveguide modes.
Week 10 : Dispersion and attenuation; Dielectric planar waveguides; Case study Optical fibers; Application: Fiber-optic communications; WDM optical components
Week 11 : Wave propagation in crystals and index ellipsoid; Wave propagation in Ferrites. Wave propagation in periodic structures: Diffraction; Vector potential and wave equation
Week 12 : Fundamental Antenna parameters; Half-wave dipole; Antenna array and diffraction; Application: RFID.