

EE 680 Engineering Electromagnetics, 3-0 (3 credit hours)

Text: *Advanced Engineering Electromagnetics* (Second Edition), Balanis, Wiley, 2012, ISBN-10: 0470589485, ISBN-13: 978-0470589489.

Chapter 1 Time-Varying and Time-Harmonic Electromagnetic Fields

- Maxwell's equations in differential form
- Maxwell's equations in integral form
- Maxwell's equations for time-harmonic fields
- Continuity equation
- Constitutive equations and parameters
- Boundary conditions
- Power and energy, e.g., Poynting vector and theorem

Chapter 2 Electrical Properties of Matter

- Dielectrics, polarization, & permittivity
- Magnetics, magnetization, & permeability
- Currents, conductors, & conductivity
- AC variations- complex permittivity & permeability, equivalent conductivities, loss tangents

Chapter 3 Wave equation and its Solution

- Wave equations for time-varying and time-harmonic fields- lossy and lossless cases
- Solutions to wave equations- rectangular coordinates (traveling & standing waves)
- Solutions to wave equations- cylindrical coordinates (traveling & standing waves)
- Constraint/dispersion equations and wave constants/numbers

Chapter 4 Wave Propagation and Polarization

- TEM modes and uniform plane waves (UPWs)
- UPWs in unbounded lossless media- principal axis
- UPWs in unbounded lossless media- oblique angle (TE and TM modes)
- UPWs in unbounded lossy media- principal axis
- UPWs in unbounded lossy media- oblique angle (TE and TM modes)
- Polarization

Chapter 5 Reflection and Transmission

- Reflection and transmission coefficients
- UPW at normal incidence- lossless media, planar interface
- UPW at oblique incidence perpendicular polarization with lossless media & planar interface
- UPW at oblique incidence parallel polarization with lossless media & planar interface
- Total transmission/Brewster angle with lossless media & planar interface
- Total reflection/critical angle with lossless media & planar interface
- UPW at normal incidence- lossy-lossy media, planar interface
- UPW at oblique incidence- lossless-lossy media, planar interface
- UPW at normal incidence- multiple interfaces, lossless media, planar interfaces

Chapter 6 Auxiliary Vector Potentials, ... (not officially covered, but used)

- (6-59), (6-61), & (6-64) to get fields for rectangular TM^z , TM^x , & TM^y modes from A_z , A_x , & A_y
- (6-70) to get fields for cylindrical TM^z modes from A_z
- (6-72), (6-74), & (6-67) to get fields for rectangular TE^z , TE^x , & TE^y modes from F_z , F_x , & F_y
- (6-80) to get fields for cylindrical TE^z modes from F_z

Chapter 8 Rectangular Cross-Section Waveguides and Cavities

- Rectangular waveguides- TE modes
- Rectangular waveguides- TM modes
- Power Density, power, attenuation for rectangular waveguides
- Rectangular cavities- TE modes
- Rectangular cavities- TM modes

Chapter 9 Cylindrical Cross-Section Waveguides and Cavities

- Cylindrical waveguides- TE modes
- Cylindrical waveguides- TM modes
- Attenuation for cylindrical waveguides
- Cylindrical cavities- TE modes
- Cylindrical cavities - TM modes
- Cylindrical cavities – TM_{010} mode quality factor
- Cylindrical dielectric waveguides
- Cylindrical dielectric resonators- PMC assumption TE & TM modes