

Electromagnetics of Planar Layered Media and Periodic Structures

25120-1

Fall 2015

INSTRUCTOR: Amir Borji, Room 211 (Ext. 4381, aborji@sharif.ir)

SCHEDULE AND LOCATION: **Sat and Mon 9:00-10:30**

CLASS WEBSITE: <http://sharif.ir/~aborji/25120/>

TEXT: Part of lectures is covered by the following books but most of the material is taken **from journal papers**:

- 1- *Radiation and Scattering of Waves*, L. B. Felsen and N. Marcuvitz, IEEE Press, 1994
- 2- *Field Theory of Guided Waves*, 2nd ed., R. E. Collin, IEEE Press/OUP, 1991
- 3- *Electromagnetic Wave Propagation, Radiation, and Scattering*, A. Ishimaru, Prentice-Hall, 1991
- 4- *Waves and Fields in Inhomogeneous Media*, W. C. Chew, IEEE Press, 1995
- 5- *Antenna Theory*, part 2, R. E. Collin and F. J. Zucker (Eds), McGraw-Hill Inc., 1969
- 6- *Theory and Phenomena of Metamaterials*, F. Capolino (Ed), 2009, CRC Press
- 7- *Dyadic Green's Functions in Electromagnetics*, 2nd Ed., C.-T. Tai, IEEE Press, 1994

“TENTATIVE” COURSE OUTLINE:

Green's Functions in Planar Layered Media

- ◇ Dyadic analysis and dyadic Green's functions
- ◇ Plane-wave and cylindrical wave expansion of a point source
- ◇ General formulation of the Green's functions in planar multilayer media: Spectral domain Green's functions, transmission line equivalent network, vector and scalar potentials
- ◇ Spectral domain method (impedance approach) for planar circuits and antennas
- ◇ Numerical evaluation of Sommerfeld integrals, discrete complex image method

Asymptotic Evaluation of Integrals

- ◇ Basic concepts, Watson's lemma, Laplace method
- ◇ Method of steepest descent (saddle point technique), uniform asymptotic approximation
- ◇ Method of stationary phase in 1D and 2D

Radiation Physics in Planar Layered Media

- ◇ Guided complex waves in uniform planar structures, classification of complex waves
- ◇ Modal representation of fields in open regions: discrete and continuous modal spectrum, leaky waves
- ◇ Mathematics of steepest descent plane
- ◇ Sommerfeld half space problem
- ◇ Line source excitation of a dielectric slab
- ◇ General properties and design of leaky wave antennas

Periodic Structures

- ◇ Bloch-Floquet theorem, dispersion diagram and Brillouin zones
- ◇ One dimensional periodic structures: transfer matrix method, Bloch impedance, periodically loaded waveguide, electromagnetic band gap
- ◇ Periodic Green's function, convergence acceleration techniques, Poisson sum formula, Kummer's method, Ewald's method
- ◇ Analysis and applications of periodic strip gratings and corrugated metallic surfaces, hard and soft boundaries
- ◇ Theory and applications of 2D planar periodic structures: Electromagnetic bandgap structures (EBG), frequency selective surfaces (FSS), artificial magnetic conductors (AMC), high impedance surfaces (HIS), reactive impedance surfaces (RIS), Metasurface concept
- ◇ Electromagnetic analysis of 2D planar periodic structures: spectral domain technique, integral equation method, equivalent circuit analysis
- ◇ (*) Radiation of a finite source in proximity of a periodic structure: Array Scanning Method

(*) If time permits (*)