University of Tehran
School of Electrical and Computer Engineering

Course: **8101604 –Dyadic Green's Functions in EM Theory**

Course type:

	EE*						CE*			Credit:
	Com	E	P	B	Con	D	SW	HW	IT	3
Required	☐	☐	☐	☐	☐	☐	☐	☐	☐	
Elective	☒	☐	☐	☐	☐	☐	☐	☐	☐	

Level: Undergraduate ☐
Graduate ■

Co-requisite(s): -

Prerequisite(s): ECE5203 Advanced Engineering Mathematics, ECE5450, Electromagnetic Theory I (ECE450) or Advanced Electromagnetics

Prerequisite by topic: Maxwell's equations, Microwaves, Antennas

Textbook(s):

1. C.T. Tai; *Dyadic Green Functions in Electromagnetic Theory,* 2nd Ed., IEEE Press, 1994
2. R.E., Collin; *Field Theory of Guided Waves,* IEEE Press, 1991
3. C.T. Tai, *Generalized Vector and Dyadic Analysis,* IEEE Press, 1992
4. Class notes, handouts and journal articles.

Coordinator: J. Rashed-Mohassel, Professor, School of ECE

Goals:

The course provides communication engineering students with advanced knowledge and tools in the analysis of various electromagnetic and antenna problems. Students will learn to formulate and analyze a given electromagnetic problem in dyadic form. Mathematical and analytical techniques for solving various EM problems including stratified media, inhomogeneous media and moving media are presented. The students will acquire advanced knowledge of current and state of the art topics in the subject.

Outcome:

Upon successful completion of the course, students will be able

1. to formulate Maxwell's equations and various electromagnetic problems in dyadic form,
2. to classify dyadic Green's functions and various vector wave functions in different coordinate systems,
3. to obtain dyadic Green's functions for various field problems
4. to formulate and handle complicated field problems including spherically stratified media, inhomogeneous spherical lenses, Rectangular and cylindrical waveguides with moving media,
5. acquire advanced knowledge and tools in the analysis of Current topics related to dyadic Green's functions (Chiral media, time dependent DGFs in waveguides, Spectral domain…)

Topics:

Review of EM theorems and formulas: vector analysis, dyadic analysis, Fourier and Hankel transforms, general EM theorems and relations,

	Scalar Green's functions in one, two and three dimensions, conventional methods and Rayleigh-Ritz method, **Dyadic Green's Functions**: Maxwell's equations in dyadic form, free space dyadic Green's functions, classification of dyadic Green's functions, reciprocity, dyadic Green's function for the half space problem. **Rectangular waveguides**: Rectangular vector wave functions, methods of G_m, G_e and G_A, waveguides with two dielectrics, parallel plate waveguide, singularity of G_e, singularity of the source region, **Cylindrical waveguides and structures**: Cylindrical vector wave functions, eigenfunction expansion of Green's functions, conducting cylinder, dielectric and coated cylinder, asymptotic expressions, conducting wedge and half-plane, radiation from an electric or magnetic dipole in presence of half plane, elliptical cylinder and vector wave functions in elliptical cylinder coordinate system **Spherical and conical structures:** Conducting sphere and cone, conducting and dielectric spheres, spherical cavity, **Planar stratified media:** Dyadic Green's functions and Sommerfeld theory, dyadic Green's functions for layered media, reciprocity in stratified media, **Inhomogeneous media and moving media:** Vector wave functions for stratified media, Vector wave functions for spherically stratified media, inhomogeneous spherical lenses, Rectangular and cylindrical waveguides with moving media, **Special topics**: Current topics related to dyadic Green's functions (Chiral media, time dependent DGFs in waveguides, Spectral domain…)
Computer usage:	MATLAB, Related Software (MININEC, AWAS)
Assignments:	8 to 10 homework assignments (20%)
Projects:	One final project (20%)
Grading:	Assignments & Project 40 % Midterm exam: 30 % Final :(Sep.,6,2017) 30 %
Further readings:	1. Dean G. Duffy, *Green's Functions with Applications, Chapman &Hall/CRC, 2001* 2. J. A. Kong, *Electromagnetic Wave Theory,* John Wiley & Sons, 1986 3. J. R. Wait, *Electromagnetic Wave Theory,* John Wiley & Sons, 1987 4. D.G. Dudley, *Mathematical Foundations for EM Theory,* IEEE Press, 1994 5. Ishimaru, *Electromagnetic Wave Propagation, Radiations, and Scattering,* Prentice Hall, 1991.
Prepared by:	Jalil Rashed-Mohassel
Date:	Sept., 17, 201۷

*EE: Electrical Engineering		CE: Computer Engineering	
Com	Communications	SW	Software
E	Electronics	HW	Hardware
P	Power	IT	Information Technology
B	Bioelectronics		
Con	Control		

D	Digital System		