University of Tehran
School of Electrical and Computer Engineering

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<tr><td>Course:</td><td colspan="10">8101… – Asymptotic techniques in Electromagnetics</td></tr>
<tr><td>Course type:</td><td colspan="10"><table>
<tr><td></td><td colspan="6">EE*</td><td colspan="3">CE*</td><td rowspan="2">Credit: 3</td></tr>
<tr><td></td><td>Com</td><td>E</td><td>P</td><td>B</td><td>Con</td><td>D</td><td>SW</td><td>HW</td><td>IT</td></tr>
<tr><td>Required</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td></td></tr>
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<tr><td>Level:</td><td colspan="10">Undergraduate ☐
Graduate ■</td></tr>
<tr><td>Co-requisite(s):</td><td colspan="10">-</td></tr>
<tr><td>Prerequisite(s):</td><td colspan="10">Engineering Mathematics (8101206)</td></tr>
<tr><td>Prerequisite by topic:</td><td colspan="10">Basics of electromagnetic wave theory, analysis of functions of a complex variable</td></tr>
<tr><td>Textbook(s):</td><td colspan="10">[1] W. C. Chew, Waves and Fields in Inhomogeneous Media, Wiley-IEEE press, 1999.
[2] D. A. McNamara, C. W. I. Pistotius, and J. A. G. Malherbe, Introduction to the Uniform Geometrical Theory of Diffraction, Artech House, 1990.
[3] P. Y. Ufimtsev, Fundamentals of the Physical Theory of Diffraction, Wiley-IEEE press, 2007.</td></tr>
<tr><td>Coordinator:</td><td colspan="10">Mojtaba Dehmollaian, Associate Professor, School of ECE</td></tr>
<tr><td>Goals:</td><td colspan="10">In this course the asymptotic techniques used in electromagnetic wave theory, are studied. Main topics are, 1) dipole radiation in presence of multilayer/stratified media, 2) stationary phase approximation, 3) steepest descent algorithm, 4) WKB method, 5) Geometrical Optics (GO) approximation, 6) Physical Optics (PO) approximation, 7) GTD (Geometrical Theory of Diffraction) and UTD (Uniform Theory of Diffraction), and 8) PTD (Physical Theory of Diffraction).</td></tr>
<tr><td>Outcome:</td><td colspan="10">Upon successful completion of the course, students will be able
1. to increase their insight to the problem of radiation in presence of stratified media.
2. to understand asymptotic methods for evaluation of some integrals,
3. to understand the physics behind some high-frequency techniques, GO, PO, GTD, UTD, and PTD.</td></tr>
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Topics:	1) **Waves in layered media** (derivation of the scalar wave equation for 1-D planar inhomogeneity, spectral representations of sources, source on top of a layered medium, source embedded in a layered medium) 2) **Asymptotic expansion of integrals** (method of stationary phase, method of steepest descent, semi-infinite integrals, asymptotic expansion of fields of a dipole on top of a half space and over a slab) 3) **WKB method** (derivation of the WKB solution, asymptotic matching) 4) **Geometrical and uniform theories of diffraction** (2D wedge diffraction, Keller's original GTD, UTD). 5) **Physical Theory of Diffraction (PTD)**
Computer usage:	MATLAB or another programming language of student choice
Assignments:	8 HW assignments
Projects:	One term project
Grading:	Assignments: 25% Project: 25% Midterm exams: 25% Final exam: 25%
Further readings:	[1] G. L. James, Geometrical Theory of Diffraction, 3rd Edition, IEE Electromagnetic Waves series, 1985. [2] J. A. Kong, *Electromagnetic wave Theory*, EMW, 2000. [3] J.J. Bowman, T.B.A Senior, P.L.E Uslenghi, *Electromagnetic and acoustic scattering by simple shapes*, Hemisphere Publishing Corp., 1987. [4] L. B. Felsen, Radiation and Scattering of Waves, Wiley-IEEE press, 1994.
Prepared by:	Mojtaba Dehmollaian
Date:	August 26, 2017

*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		