University of Tehran
School of Electrical and Computer Engineering

<table>
<tr><td>Course:</td><td colspan="10">8101389 – Fields & Waves</td></tr>
<tr><td>Course type:</td><td colspan="9"><table>
<tr><td></td><td colspan="6">EE*</td><td colspan="3">CE*</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></tr>
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</table></td><td>Credit: 3</td></tr>
<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, Electromagnetics</td></tr>
<tr><td>Prerequisite by topic:</td><td colspan="10">Partial differential equations, Complex analysis, Vector derivatives, Primary knowledge of static electromagnetic fields.</td></tr>
<tr><td>Textbook(s):</td><td colspan="10">[1] S. Ramo, J. R. Whinnery, T. Van Duzer, Fields and Waves in Communication Electronics, Ch. 3-6, Ch. 8, Ch. 12, John Wiley,3rd edition, 1995.
[2] U. Inan, A. Inan, Engineering Electromagnetics, Ch. 2-3, Addison Wesley, 1999.</td></tr>
<tr><td>Coordinator:</td><td colspan="10">Reza Faraji-Dana, Professor, School of Electrical & Computer Eng.</td></tr>
<tr><td>Goals:</td><td colspan="10">-Introducing the time-varying electromagnetic (EM) fields and the phenomena related to these fields.
- Studying the effects of delay inherent in EM fields and its impact on the analysis of electromagnetic systems and high frequency circuits.
- Studying the reflection and refraction of the EM waves and their applications in guided structures.</td></tr>
<tr><td>Outcome:</td><td colspan="10">Upon successful completion of the course, students will be able to perform:
1. The Mathematical modeling and formulation of the time-varying electromagnetic systems, and solving some of the most important and practical systems like antennas, waveguides, multilayered media, etc.
2. Transient analysis of the transmission lines and its application in Time Domain Reflectometry (TDR)
3. Analysis of transmission lines in sinusoidal steady state
4. Application of the transmission line models in analyzing complex electromagnetic systems
5. Analysis of EM wave propagations in different media</td></tr>
<tr><td>Topics:</td><td colspan="10">1- Maxwell’s equations (Historical background, Maxwell’s equations in time and frequency domains, Integral form, Second order equations, Boundary conditions, Uniqueness theorem) (4 sessions)
2- Distributed circuits or transmission lines (Electromagnetic concepts of the circuit theory, Lumped circuits versus distributed circuits, Lossless transmission lines in time and frequency domains, Smith chart, Lossy transmission lines, Non-TEM lines)</td></tr>
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	(8 sessions) **3- Plane waves in free space** (Derivation of the uniform plane waves from Maxwell's equations, Plane waves in lossless free space and their solutions in time and frequency domains, Penetration of EM fields in good conductor (skin effect), Internal impedance, Surface impedance model, Propagation of plane waves in general lossy media, polarization) **(6 sessions)** **4- Plane waves in non-homogeneous media, reflection and refraction phenomena** (Normal incidence of plane waves on the interface of two homogeneous media (lossless media, general lossy media), Oblique incidence with perpendicular and parallel polarizations, extension to multilayer media by using the transmission line model) **(6 sessions)** **5- Introduction to antennas** (Retarded potentials, Far radiation field of an antenna, Radiation resistance, other applications of retarded potentials) **(5 sessions)** **6- Introduction to Waveguides** (Classical analysis of waveguides, modes, Phase and group velocity in waveguides, Introducing Rectangular waveguides as an example of the application of the classical analysis of waveguides) **(3 sessions)**
Computer usage:	Some usage of MATLAB or other programming tools in solving the course assignments
Assignments:	7 problems sets, 3-4 quizes.
Projects:	-
Grading:	Assignments: 10% Quiz: 10% Midterm exams: 30% Final exam: 50%
Further readings:	[1] C. Paul, *Elecromagnetics for Engineers with Application,* John Wiley, 2004. [1] F. Ulaby, *Fundamentals of Applied Electromagnetics*, Prentice Hall, 1997.
Prepared by:	Reza Faraji-Dana
Date:	September, ۲۰۱۷
***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		