Zarqa University

Faculty of Engineering
Department: Electrical Engineering
Course title: Electromagnetics 2 (0904345)

Prerequisite: Electromagnetics 1 (0904245)
Instructor: Eng. Rasha Al-Bzoor
Lecture's time: 12:30 - 2:00
Semester: 2nd, 2017
Office Hours: M, W, 11 – 12:30 morning

Course description:

Maxwell's equation in time varying fields. Wave equation: plane wave (PW) in general medium, wavelength, wave number, direction of wave propagation, phase velocity, group velocity, phase and attenuation constants and wave impedance, PW propagation in lossless, lossy and good conducting media, skin effect and the surface impedance in lossy and good conducting media, generalized form of the PW, poynting vector, normal and oblique incidence of the UPW, wave polarization. **Transmission lines (TL):** transient analysis of lossless TL, analysis of TL for harmonic source using vector and crank diagram. Short TL (stubs), TL charts, matching using single stub, double stubs and quarter wavelength TL, impedance measurement. **Waveguides:** rectangular and circular waveguides, slots in waveguide, the concept of resonant cavity. **Introduction to antennas.**

Aims of the course:

1. Student will learn some fundamental laws of electrodynamics (based on Maxwell's equations).
2. Students will learn electrical properties of materials, solutions of the wave equation.
3. Student will learn reflection/transmission of plane waves, polarization.
4. Students will learn the concept of guided wave propagation using transmission lines and waveguides.

Intended Learning Outcomes (ILOs):

Upon successful completion of this course, a student should be able to:

1. 1 Provide the knowledge and proficiency to analyse time varying fields and apply Maxwell's equations to practical situations.
2. Understand the implications of time varying electrical and magnetic fields and their manifestations in practical situations.
3. Understand the propagation of electromagnetic waves and signals in unguided and guided media and interfaces.
4. Calculate how signals propagate through transmission lines and use the concept of impedances.
5. Understand generation and reception of electromagnetic radiation antenna.

Course structures:

Week	C. Hrs	IL Os	Topics	Teaching Procedure	Assessment methods
1-2		1+2	**Time varying fields and Maxwell's equations :** Review and overview of the course. Maxwell's Equation (ME) in integral and differential forms, Derivation of the continuity equation and relaxation relationship. ME for harmonic sources. Concept of both dielectric and magnetic hysteresis. Boundary conditions.	Whiteboard + Lecture notes	
3-5		2+3	**Wave equation and plane wave in lossless medium :** Derivation of the wave equation and its solution for uniform plane wave (UPW) in general medium. Characterization of the UPW and identifying its different components such as its wavelength, wave number, direction of wave propagation, phase velocity, phase constant, attenuation constant, wave impedance, group velocity. Medium classifications: Lossless, lossy, and good conducting media.	Whiteboard + Lecture notes	Quizzes
6		2+3	**Plane wave in good conduction medium and the Poynting vector:** UPW propagation in lossy, lossless and good conducting media and the concept of skin depth in lossy and good conducting media. Generalized form of UPW. Poynting vector and the concept of power flow in high frequency circuits.	Whiteboard + Lecture notes	Quizzes 1st Exam
7-8		3	**Normal incidence of plane wave:** Normal incidence of UPW and its reflection from plane boundaries for both lossless and lossy media. Traveling and standing waves. Reflection coefficient and the standing wave ratio (SWR).	Whiteboard + Lecture notes	Quizzes
9		3	**Wave polarization:** UPW polarization including linear, circular and elliptical polarizations with applications.	Whiteboard + Lecture notes	Quizzes
10-11		3+4	**Transmission line theory:** Transmission lines (TL) including the conversion from field components to voltage and current expressions. Derivation of the general TL equations in general form. TL propagation constant and its characteristic impedance. Transient analysis of lossless TL. TL for harmonic sources including its analysis using vector and crank diagrams. Short TL (Stubs) and the concept of distributed circuit parameters.	Whiteboard + PPT notes + Lecture notes	Quizzes
12-13		4	**Transmission line charts:** TL charts and its analysis including the concept of matching using single stub, double stub and quarter wavelength TL. Impedance measurements for high frequency circuits using Smith chart.	Whiteboard + PPT notes + Lecture notes	Quizzes 2nd Exam

14		4	**Waveguides:** Waveguide including the concept of wave propagation in one conductor system. Rectangular waveguide analysis including waveguide wavelength, phase velocity, dominant mode, and waveguide impedance. Slots in waveguide. The concept of resonant cavity.	Whiteboard + Lecture notes	Final Exam TBD
15		5	**Radiating systems and antennas :** Introduction to antennas including simple dipole and other antenna types.	Whiteboard + Lecture notes	Final Exam TBD

References:

M. N., O. Sadiku, Elements of Electromagnetics, 3rd Ed., Oxford University Press, 2001.

Assessment Methods:

Methods	Grade	Date
Quizzes	10	Bi-weekly
1st Exam	20	17/4/2017
2nd Exam	20	10/5/2017
Final Exam	50	TBD