The University of Jordan
School of Engineering
Electrical Engineering Department
2nd Semester – A.Y. 2020/2021

Course: **Electromagnetics (II) – 0903351 (3 Cr. – Required Course)**

Instructor: Dr. Yanal Al-Faouri
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Office Hours: Will be posted soon

Course website: https://elearning.ju.edu.jo/course/view.php?id=15031#section-0

Catalog description: Introduction. Maxwell's equation. 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. Consideration of some practical problems. 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 including the different parameters of an antenna. Short and half a wavelength dipoles characteristics.

Prerequisites by course: **EE** **0903251** Electromagnetics (I) (pre-requisite)

Prerequisites by topic: Students are assumed to have a background in the following topics:
- Electrostatic and magnetostatic sources and fields.
- Electrical circuit analysis techniques.
- Solving partial differential equations.

Textbook: **Elements of Electromagnetics by Matthew Sadiku, Oxford University Press, 7th edition, 2018.**

References:
1. Fundamentals of Applied Electromagnetics by Fawwaz T. Ulaby and Umberto Ravaioli, Pearson, 7th Edition, 2014.
2. Advanced Engineering Electromagnetics by Constantine A. Balanis, 2nd edition, Wiley, 2012.
3. Engineering Electromagnetics by William H. Hayt, John A. Buck, McGraw-Hill Education, 8th edition 2011.
4. Electromagnetic Fields by Roald K. Wangsness, 2nd edition, Wiley, 2007.

5. Electromagnetics by Branislav M. Notaros, Pearson, 1st Edition, 2010.
6. Schaum's Outline of Electromagnetics by Mahmood Nahvi and Joseph Edminister, McGraw-Hill Education, 5th Edition, 2018.
7. Engineering Electromagnetics and Waves by Umran S. Inan, Aziz Inan and Ryan Said, Pearson, 2nd Edition, 2014.
8. Engineering Electromagnetics by William H. Hayt, John A. Buck, McGraw-Hill Education; 8th edition 2011.

Schedule: 16 Weeks, 42 lectures (50 minutes each) plus exams.

Course goals: The overall objective is to provide the student with the knowledge and proficiency to analyze time varying electrical and magnetic fields and apply Maxwell's equations to practical situations. The student will also understand antenna operation and the propagation of electromagnetic waves and signals in unguided and guided media.

Course learning outcomes (CLO) and relation to ABET student outcomes (SO):

Upon successful completion of this course, a student will:	[SO]
1. Understand the concept of time varying fields and sources and appreciate their implication in real life problems.	[1]
2. Identify the different media characteristics.	[1]
3. Be able to apply the wave equation and understand the electromagnetic plane wave and its propagation and interaction across different media.	[1]
4. Identify the power flow and the Poynting vector in general media.	[1]
5. Identify the different forms of guided means for wave propagation (including rectangular waveguide) and to analyze the two conductor system transmission lines including both analytical and graphical means.	[1]
6. Understand different antenna parameters and be able to analyze the short dipole antenna.	[1]

Course topics:	Hrs
1. Time varying fields. Maxwell's Equations (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.	5
2. 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.	7
3. 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.	5
4. Normal incidence of UPW and its reflection from plane boundaries. Traveling and standing waves. Reflection coefficient and standing wave ratio (SWR).	5
5. UPW polarization including linear, circular and elliptical polarizations with applications.	3
6. Reflection, refraction and scattering of UPW from plane boundaries for both perpendicular and parallel polarization including Snell's law of reflection and refraction, critical and Brewester angles. Considerations for non-planar boundaries.	4

7.	Classification of wave modes based on the orientation of the electric and magnetic field components compared with that of the direction of wave propagation.	**2**
8.	Transmission line (TL) theory 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.	**2**
9.	Transmission line charts and analysis. TL matching using single stub, double stub and quarter wavelength TL. Impedance measurements using Smith chart.	**3**
10.	Waveguides 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.	**3**
11.	Introduction to antennas including simple dipole and other types.	**3**

Ground rules: Attendance is required and highly encouraged. To that end, attendance will be taken every lecture. Eating and drinking are not allowed during class, and cell phones must be set to silent mode. All exams (including the final exam) should be considered cumulative. Exams are closed book. No scratch paper is allowed. You will be held responsible for all reading material assigned, even if it is not explicitly covered in lecture notes.

Assessment & grading policy:

Assignments	0%	Quizzes	0%
First Exam	30%	Projects	0%
Midterm Exam	30%	Lab Reports	0%
Final Exam	40%	Presentation	0%
		Total	**100%**

Last Revised: March 2021