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

Course: **Antennas and Wave Propagation – 0933551 (3 Cr. – Elective Course)**

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

Course website: http://elearning.ju.edu.jo/

Catalog description: Introduction and Overview. Antenna Types. Antenna Parameters. Free Space Path loss. Mathematical formulation. Wire antennas: Short dipole, long and half-wavelength dipoles, standing and traveling wave antennas, wire antennas above the surface of the earth. Loop antennas. Antenna arrays analysis. Aperture antennas. Wave equation. Plane, cylindrical, and spherical waves. Wave components and wave polarization. Reflection, refraction and transmission of wave. Huygens principal. Physics of the atmosphere. Wave propagation in the troposphere. Space wave. Surface wave. Physics of the ionosphere. Wave propagation in the ionosphere. Sky wave. Effect of the earth magnetic field. Case studies.

Prerequisites by course: **EE** **0903351** Electromagnetics (II) (pre-requisite)

Prerequisites by topic: Students are assumed to have a background in the following topics:
• Fundamentals of electromagnetics.
• Analog and digital modulation techniques.

Textbook: **Antennas and Wave Propagation by A. R. Harish and M. Sachidananda , Oxford University Press, 1st edition, 2008.**

References:

1. Practical Antenna Handbook by Joseph J. Carr and George W. Hippisley, McGraw-Hill Education, 5th edition, 2012.
2. Antennas and Radiowave Propagation by Robert E. Collin, McGraw-Hill College, 1st edition, 1985.
3. Antenna Theory: Analysis and Design by Constantine A. Balanis, Wiley, 4th edition, 2016.
4. Slotted Waveguide Array Antennas: Theory, analysis and design by Lars Josefsson and Sembiam R. Rengarajan, Scitech Publishing, 1st Edition, 2018.
5. The ARRL Antenna Book for Radio Communications by ARRL Inc, Amer Radio Relay League, 23rd edition, 2016.

6. Antenna Theory and Design by Warren L. Stutzman and Gary A. Thiele, Wiley, 3rd edition, 2012.
7. Space Antenna Handbook by William A. Imbriale, Steven Shichang Gao and Luigi Boccia, Wiley, 1st edition, 2012.
8. ARRL's Small Antennas for Small Spaces by ARRL Inc, National association for Amateur Radio, 2nd edition, 2016.

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

Course goals: The overall objective is to introduce the student to the basics of antenna types and designs, wave propagation and wireless medium characteristics.

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

Upon successful completion of this course, a student will: **[SO]**

1. Be able to analyze and identify different antenna types, parameters and designs, including: wire antennas, loop antennas, aperture antennas, and antenna arrays. **[1]**
2. Perform analysis using the wave equation, and know the properties of electromagnetic wave reflection, refraction, etc. **[1]**
3. Understand the physics of wave propagation in different layers of the atmosphere including the troposphere and ionosphere . **[1]**

Course topics:

		Hrs
1.	Introduction and Overview.	**1**
2.	Antenna Types. Antenna Parameters and Free Space Path loss.	**4**
3.	Mathematical formulation including the magnetic vector potential and electric vector potential.	**3**
4.	Wire antennas: Short dipole, long and half-wavelength dipoles, standing and traveling wave antennas, wire antennas above the surface of the earth.	**5**
5.	Loop antennas and its relation to the short electric dipole antenna.	**2**
6.	Antenna arrays analysis: Array factor, gain, grating loop, super directive array, adaptive array and smart antenna.	**6**
7.	Aperture antennas and the concept of effective area.	**3**
8.	Wave equation, plane, cylindrical, and spherical waves. Wave components and wave polarization.	**3**
9.	Reflection, refraction and transmission of electromagnetic waves including the Brewester and Critical Angels.	**2**
10.	Huygens principal and Fresnel Zones.	**3**
11.	Physics of the atmosphere and wave propagation in the troposphere.	**3**
12.	Classification of electromagnetic wave: Space wave and Surface wave.	**3**
13.	Physics of the ionosphere: Wave propagation in the ionosphere and the Sky wave. Effect of the earth magnetic field.	**3**
14.	Practical Case studies.	**1**

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	20%	Projects	10%
Midterm Exam	30%	Lab Reports	0%
Final Exam	40%	Presentation	0%
		Total	**100%**

Last Revised: March 2021