Sana'a University
Faculty of Engineering
Department: Electrical Engineering
Title of the Program: Communication Engineering and Networks

36. Course Specification of Waves Propagation and Antennas

I. Course Identification and General Information:

1.	Course Title:	Waves Propagation and Antennas				
2.	Course Code &Number:	CNE322				
3.	Credit hours:	C.H				Credit Hours
		Th.	Tu.	Pr.	Tr.	
		2	2	-	-	3
4.	Study level/ semester at which this course is offered:	4^{th} Level/ 1^{st} semester				
5.	Pre –requisite (if any):	Electromagnetics Field Theory II (CNE211)				
6.	Co –requisite (if any):	None.				
7.	Program (s) in which the course is offered:	Communication and Network Engineering				
8.	Language of teaching the course:	English+ Arabic				
9.	Location of teaching the course:	Faculty of Engineering, Sana'a University				
10.	Prepared By:	Assoc. Prof. Dr. Murad A. A. Almekhlafi				
11.	Date of Approval:	2020				

II. Course Description:

This course aims to provide students with an understanding and classification of radio wave propagation, with the study of the effect of coefficients (attenuation, refraction, fading, and loss) on wave propagation in the earth and atmosphere. This course gives comprehensive study of basic antenna fundamentals and parameters, Definition of construction and characteristics of antennas (like Dipole, Aperture, Horn, Reflector, Loop, and Helical) and also Types of array antennas.

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	III. Course Intended learning outcomes (CILOs) of the course	Referenced PILOs
a1	Illustrate the basic concepts of wave propagation in different mediums as Ionosphere layers.	A1
a2	Define various antenna parameters, and the general characteristics and construction of antennas.	A2
b1	Classify the waves based on frequency domain and atmosphere layers, such as the troposphere and the ionosphere.	B1
b2	Analyze the basic antenna parameters and radiation patterns of antennas using standard formulas.	B3
c1	Design of Array Antennas for given specifications, and Design antennas for specific applications.	C2
c2	Use modern computing tools to calculate path loss of radio wave propagation, and basic radiation equation.	C4
d1	Perform specific tasks individually and work in a group to achieve final course's project or to solve specific problems.	D1
d2	Present his information, his tasks' ideas clearly using presentation skills.	D4

(A) Alignment Course Intended Learning Outcomes of Knowledge and Understanding to Teaching Strategies and Assessment Strategies:

Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
a1: Illustrate the basic concepts of wave propagation in different mediums as Ionosphere layers.	▪ Lectures. ▪ Dialogue and discussion. ▪ Brainstorming. ▪ Tutorials (Problem solving).	▪ Final & Midterm Exams. ▪ Quizzes & Oral discussion. ▪ Assignments evaluation.
a2: Define various antenna parameters, and the general characteristics and construction of antennas.	▪ Lectures. ▪ Dialogue and discussion. ▪ Brainstorming.	▪ Final Exam. ▪ Quizzes & Oral discussion. ▪ Assignments evaluation.

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	▪ Tutorials (Problem solving).	

(B) Alignment Course Intended Learning Outcomes of Intellectual Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
b1: Classify the waves based on frequency domain and atmosphere layers, such as the troposphere and the ionosphere.	▪ Lectures. ▪ Dialogue and discussion. ▪ Brainstorming. ▪ Tutorials (Problem solving).	▪ Final & Midterm Exams. ▪ Quizzes & Oral discussion. ▪ Assignments evaluation.
b2: Analyze the basic antenna parameters and radiation patterns of antennas using standard formulas.	▪ Lectures. ▪ Dialogue and discussion. ▪ Brainstorming. ▪ Tutorials (Problem solving).	▪ Final Exam. ▪ Quizzes & Oral discussion. ▪ Assignments evaluation.

C Alignment Course Intended Learning Outcomes of Professional and Practical Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
c1: Design & analysis of Array Antennas for given specifications, and Design antennas for specific applications.	▪ Lectures. ▪ Dialogue and discussion. ▪ Brainstorming. ▪ Tutorials (Problem solving). ▪ Simulation tools.	▪ Final Exam. ▪ Quizzes & Oral discussion. ▪ Assignments evaluation. ▪ Simulation reports including calculation.
c2: Use modern computing tools to calculate path loss of radio	▪ Lectures. ▪ Dialogue and discussion.	▪ Final & Midterm Exams.

wave propagation, and basic radiation equation.	▪ Brainstorming. ▪ Tutorials (Problem solving). ▪ Simulation tools.	▪ Quizzes & Oral discussion. ▪ Assignments evaluation. ▪ Simulation reports including calculation.

(D) Alignment Course Intended Learning Outcomes of Transferable Skills to Teaching Strategies and Assessment Strategies:

Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
d1: Perform specific tasks individually and work in a group to achieve final course's project or to solve specific problems.	▪ Brainstorming	▪ Coursework report including calculation
d2: Present his information, his tasks' ideas clearly using presentation skills.	▪ Dialogue and discussion ▪ Brainstorming	▪ Coursework report including calculation

IV. Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	Contact hours
1.	Introductions to Wave Propagation.	a1, b1	▪ General introduction of course description. ▪ Definitions, Categorizations and General Classifications. ▪ Electromagnetic spectrum, its applications. ▪ Different Modes of Wave Propagation.	1	2

2.	Ground wave propagation	a1, b1	▪ Plane Earth Reflections. ▪ Wave Tilt, Curved Earth Reflections. ▪ Surface waves propagation in ▪ conducting medium (dry soil and sea water). ▪ Attenuation Function for radio links. ▪ Signal distortion in propagation.	2	4
3.	Wave propagation in the troposphere	a1, c2, d1	▪ Field Strength Variation with Distance and Height. ▪ Effect of Earth's Curvature. ▪ Refraction of waves in the troposphere. ▪ Multiple reflections in the troposphere. ▪ Attenuation and fading of radio waves in the troposphere.	2	4
4.	Sky Wave Propagation	a1, b1	▪ Structure of Ionosphere layers ▪ Refraction and Reflection conditions of sky waves by Ionosphere as critical frequency, MUF, LUF. ▪ Electric field strength for LF and VLF waves. ▪ Properties of LF and VLF waves in the Earth's atmosphere.	2	4
5.	Basic Antenna concepts	a2, b2, c2	▪ Patterns (HPBW & FNBW) ▪ Beam Area, Radiation Intensity. ▪ Beam Efficiency. ▪ Directivity-Gain-Resolution.	2	4

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			▪ Effective Height. ▪ Polarization.		
6.	Wire,VHF, UHF and Microwave Antennas	a2, b2, d2	▪ Defining the general characteristics ▪ Construction of antennas (linear wire, Loops. helical, horns, reflector, patches and apertures).	3	6
7.	Antenna Arrays	a2, b2, c1, d1	▪ Broadside Arrays, End-fire Arrays (EFA). ▪ EFA with Increased Directivity. ▪ Principle of Pattern Multiplication. ▪ Yagi-Uda.	2	4
Number of Weeks /and Units Per Semester				**14**	**28**

B- Tutorials Aspect:

Order	Tutorial Skills List	Nº of Weeks	C.H.	CILOs
1.	Introductions to Wave Propagation • General introduction of course description • Definitions, Categorizations and General Classifications • Electromagnetic spectrum, its applications • Different Modes of Wave Propagation	2	4	a1, b1
2.	Ground wave propagation • Plane Earth Reflections • Wave Tilt, Curved Earth Reflections • Surface waves propagation in conducting medium (dry soil and sea water) • Attenuation Function for radio links • Signal distortion in propagation	2	4	a1, b1

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3.	Wave propagation in the troposphere • Field Strength Variation with Distance and Height • Effect of Earth's Curvature • Refraction of waves in the troposphere • Multiple reflections in the troposphere • Attenuation and fading of radio waves in the troposphere	2	4	a1, c2, d1
4.	Sky Wave Propagation • Structure of Ionosphere layers • Refraction and Reflection conditions of sky waves by Ionosphere as critical frequency, MUF, LUF. • Electric field strength for LF and VLF waves. • Properties of LF and VLF waves in the Earth's atmosphere.	2	4	a1, b1
5.	Basic Antenna concepts • Patterns (HPBW & FNBW) • Beam Area, Radiation Intensity. • Beam Efficiency. • Directivity-Gain-Resolution. • Effective Height. • Polarization.	2	4	a2, b2, c2
6.	Wire,VHF, UHF and Microwave Antennas • Defining the general characteristics • Construction of antennas (linear wire, Loops. helical, horns, reflector, patches and apertures).	2	4	a2, b2, d2
7.	Antenna Arrays • Broadside Arrays, End-fire Arrays (EFA) • EFA with Increased Directivity. • Principle of Pattern Multiplication. • Yagi-Uda.	2	4	a2, b2, c1, d1
Number of Weeks /and Units Per Semester		**14**	**28**	

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V. Teaching strategies of the course:

- Lectures
- Tutorials (Problem solving)
- Dialogue and discussion
- Brainstorming

VI. Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1.	Problems on Propagation Parameters for Ground Wave, Space Wave	a1, b1, c2, d1	3rd	1.5
2.	Problems on calculate basic radiation equation	a1, b1, c2, d1	5th	1.5
3.	Problems on calculate path loss of radio wave propagation	a1, b1, c2, d1	8th	1.5
4.	Problem of Plot of Far-Field Pattern and Calculate parameters of linear wire, Loops, helical, horns, reflector, patches and apertures	a2, b2, c1, d1	12th	1.5
5.	Problem of Design array antenna	a2, b2, c1, d1, d2	14th	1.5
	Total			**7.5**

VII. Schedule of Assessment Tasks for Students During the Semester:

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes
1.	Assignments	3rd, 5th, 8th, 12th, 14th	7.5	5%	a1, a2, b1, b2, c1, c1, d1
2.	Quiz 1&2	4th ,10th	15	10%	a1, a2, b1, b2. d1
3.	Attendance & Participation	Weekly	7.5	5%	a1, a2 b1, b2, c1, c2
4.	Midterm Exam	8th	30	20%	a1, b1, c2
5.	Final Exam	16th	90	60%	a1, a2, b1, b2, c1, c2

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	Sum	**150**	**100%**	

VIII. Learning Resources:

1- Required Textbook(s) (maximum two).

1. Antennas for All Applications – John D. Kraus and R. J. Marhefka, and Ahmad S. Khan TMH, New Delhi, 4th ed. 2010.
2. Electromagnetic Waves and Radiating Systems – E.C. Jordan and K.G. Balmain, PHI, 2nd 2000

2- Essential References.

1. Antenna Theory - C.A. Balanis, John Wiley & Sons, 3rd ed., 2005.
2. Antennas and Wave Propagation – K.D. Prasad, 2001.
3. Transmission and Propagation – E.V.D. Glazier and H.R.L. Lamont, the Services Text Book of Radio, vol. 5.
4. Antennas – John D. Kraus, McGraw-Hill (International Edition), 2nd Ed. 1988.

3- Electronic Materials and Web Sites etc.

1. http://www.wiley.com/go/permissions.
2. http://www.cst.com
3. http://he-cda.wiley.com/wileycda/
4. www.mm-microwave.com

IX. Course Policies:

1.	**Class Attendance:** - The students should have more than 75% of attendance according to rules and regulations of the faculty.
2.	**Tardy:** - The students should respect the timing of attending the lectures. They should attend within 15 minutes from starting of the lecture.
3.	**Exam Attendance/Punctuality:** - The student should attend the exam on time. The punctuality should be implemented according to rules and regulations of the faculty for mid-term exam and final exam.
4.	**Assignments & Projects:** - The assignment is given to the students after each chapter; the student has to submit all the assignments for checking on time.

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5.	**Cheating:** - If any cheating occurred during the examination, the student is not allowed to continue and he has to face the examination committee for enquires.
6.	**Plagiarism:** - If one student attends the exam on another behalf; he will be dismissed from the faculty according to the policy, rules and regulations of the university.
7.	**Other policies:** - All the teaching materials should be kept out the examination hall and mobile phones are not allowed. - Mutual respect should be maintained between the student and his teacher and also among students. Failing in keeping this respect is subject to the policy, rules and regulations of the university.

Reviewed By	**Vice Dean for Academic Affairs and Post Graduate Studies: Asst. Prof. Dr. Tarek A. Barakat** **President of Quality Assurance Unit: Assoc. Prof. Dr. Mohammed Algorafi** **Name of Reviewer from the Department: Asst. Prof. Dr. Mohammed Al-Suraby**
	Deputy Rector for Academic Affairs Asst. Prof. Dr. Ibrahim AlMutaa **Assoc. Prof. Dr. Ahmed Mujahed** **Asst. Prof. Dr. Munasar Alsubri**

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