

Ministry of Higher Education and Scientific research



Physics department

College of Education

Salahaddin University-Erbil

Subject: Antennas and Wave propagation

Course Book – (PhD. Student)

Lecturer's name: Assist Prof. Dr. Rashad H. Mahmud

Academic Year: 2023/2024

Course Book

1. Course name	Antennas and Wave Propagation
2. Lecturer in charge	Assist Prof Dr. Rashad H. Mahmud
3. Department/ College	Physics, Education
4. Contact	e-mails: Rashad.mahmud@su.edu.krd
5. Time (in hours) per week	Theory: 3 Hours
6. Office hours	Wednesday: From 11:30 AM To 01:00 PM Thursday: From 11:30 AM To 2:30 PM
7. Course code	
8. Teacher's academic profile:	I was born in Erbil, Kurdistan Region-Iraq, in 1986. I received the B.Sc. degree (First Class) in Physics from Salahaddin University-Erbil, in 2007, the MSc. degree (first class) in Electromagnetics from Salahaddin University-Erbil, in 2010, and the Ph.D. degree in Communications and Electronic engineering from the University of Birmingham, Edgbaston, Birmingham, U.K., in 2016. My doctoral research concerned Micromachined terahertz waveguide circuits Such as antennas and filters. Also, part of my research interest is about microwave components integration. In 2007, I became an assistant physicist with the physics department, where I worked in the Electronic, advanced electricity and magnetism, and Mechanics Labs. Shortly after I joined the physics department, I Started my master and then became the decider of the department. Now, I am a lecturer in both physics department and Faculty of Engineering in Ishik University and have been teaching Nuclear lab., Mechanics and Properties of Matter, and Mathematics.
9. Keywords	
10. Course overview:	In this fast-developing society, a wireless communication system has come to stay as the most important branch of engineering and Science. Components of

wireless communication systems have been investigated more recently due to the continuous demand increase of the system users. Also, in almost all the industries and automation, wireless systems are involved in processing and assembling in the factories. Great strides taken in the industrial applications of wireless systems during the recent years have demonstrated that this versatile system can be of the great importance in increasing production, efficiency and control.

Antennas are the key components of wireless communication systems. Basic concepts of antennas will be covered in this course. The performance, design, and analysis of some fundamental types of antennas will be studied.

11. Course objective:

The main objectives of this course are:

- Understanding the principles of Wave propagations.
- Understanding the antenna components
- Design and analysis of some essential types of antennas.

12. Student's obligation:

- Students must be on time for class and should refrain from leaving and re-entering the classroom during lecture. If a student has a legitimate reason for being excused early from class, then he or she should discuss this with me before class.
- Cell phones may not be used during class (no texting) and should be silent. Laptops may not be used for anything other than taking notes. It is important that you refrain from excessive talking during lecture as a courtesy to your fellow students.

13. Forms of teaching:

Different forms of teaching will be used to come across with objectives of the course. Power point presentations for the head titles, definitions, graphs and many useful illustrations with summary at the end of each chapter will be presented and discussed.

There will be also classroom discussions and the lecture will cover enough

information about the description of the subjects, solution of many examples, analysis and derivation for all necessary equations and proving theorems and many problems are presented as a home work for improving student abilities.

Question Bank (Homework): problems will be solved and discussed weekly to improve the student's ability for understanding materials to let the chance for practicing on several aspects of the course in the classroom.

14. Assessment scheme:

Attaining the requirements set to succeed in this study subject requires developing a mathematical sense, related to this topic, based on emergent analytical and problem solving skills and memorizing topics cannot secure success.

In this system the maximum mark is (100%). The grading system is based on the summation of two categories of evaluations:

- **First**, (50%) of the mark is based on the article review related to the antennas and wave propagation
- **Second**, (50%) of the mark is based on final examination that is comprehensive for the whole of the study material reviewed during the academic year and it usually occurs during the month of January.

At the end of the evaluation process, if the students could not secure a minimum of (60%), they are given a chance to repeat the final exam in September and they should be able by then to equal or exceed the (60%) limit otherwise they will have to repeat this subject during the next academic year if it did not contradict with the administrative regulations.

15. Student learning outcome: The learning objects and the main goals of studying Antenna Theory are summarized in the following important points:

- Wave Propagations
- Systems Components
- Antennas
- Antenna Parameters
- Antenna Types
- Design of Antennas Using Microwave Studio (CST)

16. Course Reading List and References:

1. Balanis, Constantine A. *Antenna theory: analysis and design*. John wiley & sons, 2016.

2. Stutzman, Warren L., and Gary A. Thiele. *Antenna theory and design*. John Wiley & Sons, 2012.
3. Kraus, John D., Ronald J. Marhefka, and Ahmad S. Khan. *Antennas and wave propagation*. Tata McGraw-Hill Education, 2006.

17. The Topics:	Dr. Rashad H. Mahmud
<p>Chapter One: Antenna Basics</p> <p>3 Weeks</p>	<ul style="list-style-type: none"> • Introduction to Antennas • Antenna Patterns Definition and its Parameters • Antenna Field Types and Field Regions • Average Power Radiated by an Antenna • Antenna Radiation Intensity • Antenna Directivity • Antenna Efficiency • Antenna Gain • Antenna Impedance • Antenna Radiation Efficiency • Antenna Loss Resistance • Antenna Polarization • Antenna Equivalent Area • Maximum Directivity and Effective Aperture
<p>Chapter Two: Antenna Radiation Mechanisms</p> <p>4 Weeks</p>	<ul style="list-style-type: none"> • Antenna radiation Sources • Maxwell's equations (symmetric, time-harmonic form) • Maxwell's Equations (electric sources only $F = 0$) • Maxwell's Equations (magnetic sources only $A = 0$) • Determination of Radiation Fields Using Potentials - Summary • Antenna Far Fields in Terms of Potentials • Rectangular coordinate source

	<ul style="list-style-type: none"> • Cylindrical coordinate source • Spherical coordinate source • Duality • Duality equations • Dual Quantities
<p>Chapter Three: Wire Antennas</p> <p>4 Weeks</p>	<ul style="list-style-type: none"> • Wire Antenna Definition • Infinitesimal Dipole • Field Regions of the Infinitesimal Dipole • Reactive Near Field of Infinitesimal Dipole • Radiating Near Field of Infinitesimal Dipole • Radiating Far-Field of Infinitesimal Dipole • Total Power and Radiation Resistance of Infinitesimal Dipole • Infinitesimal Dipole Radiation Intensity and Directivity
<p>Chapter Four: Antenna Array</p> <p>3 Weeks</p>	<ul style="list-style-type: none"> • Antenna array Definition. • Linear array • Circular array • Planar array • Conformal array
18. Practical Topics (If there is any)	Not Exist
<p>19. Examinations: Different types of questions will be provided to the student as an exercise and also in examinations such as given them in the question banks which contain</p>	

each of the following ones:

1. Physical representations and explanation questions for different subjects in antenna theory are provided.
2. Mathematical calculation questions for different areas of antenna designs and transistor subjects are also given to them.
3. Multiple choices questions for every subject that are given in antenna types are also provided to them.
4. Finally the true and false questions are also given to them for several subjects.

Each of these mentioned question types will be seen clearly in the question banks that are given to the quality assurance committee of our physics department.

20. Extra notes:

Due to a number of unforeseen reasons that may lead to the shifting of the academic year program, it may be subjected to modifications. Also extra curriculum hours may be needed to cover all the topics mentioned above. The students shall be notified of the changes if and when they may occur.

21. Peer review