

NEW YORK CITY COLLEGE OF TECHNOLOGY
The City University of New York

DEPARTMENT: Electrical and Telecommunications Engineering Technology

SUBJECT CODE AND TITLE: TCET4110/TC710 Electromagnetic and Antenna Design

COURSE DESCRIPTION: This course introduces the characteristics of the electromagnetic waves and their behavior during the propagation through a space. Maxwell's equations, RF path loss, reflection, multipath fading, noise, interference, polarization distortion and other related topics are discussed. Different types of antennas, as well as antenna in a system and antenna measurements are also discussed. Included in the course are some software packages used in antenna design along with the examples of using these packages.

PREREQUISITES: MAT1575/MA575, TCET3222/TC611&TC611L,

TEXTBOOK: Antenna theory and Design, 2nd Edition, by Warren L. Stutzman, Gary A. Thiele, Wiley, 1998.

REFERENCES :

1. Antenna theory, Theory and Design, 3rd Edition, Balanis, John Wiley & Sons, 2005.
2. Antenna, Kraus, McGraw Hill, 3rd Edition, 2001.
3. Antenna Engineering Handbook, H. Jasik, Editor, McGraw Hill, 3rd Edition, 1992.
4. Electromagnetic for Engineers, Ulaby, Fawwaz T., Prentice Hall, 2004

COURSE OBJECTIVES/ COURSE OUTCOMES: Upon completion of this course students will possess the ability to:

1. Understand electromagnetic concepts as applied to antennas.(ABET Criteria 2a, 2b, 2k)
2. Calculate and interpret the basic parameters to specify antenna characteristics.(ABET Criteria 2a, 2b, 2k)
3. Understand and implement the antenna measurement techniques. .(ABET Criteria 2a, 2b, 2c, 2k, 2l, 2m)
4. Design and analyze linear, aperture, and wire antennas. .(ABET Criteria 2a, 2b, 2c, 2f, 2k, 2l, 2m)
5. Work in a group project, to propose, build, and report on the design and realization (software) of antenna systems for telecom applications. (ABET Criteria 2a, 2b, 2c, 2d, 2e, 2f, 2g, 2h, 2k, 2l, 2m, 2n)

TOPICS:

- _ Electromagnetic radiation and propagation
- _ Antenna characteristics
- _ Antenna arrays; wire antennas, aperture antennas, broadband antennas.
- _ Antenna Measurements
- _ Antenna design using commercial software.

CLASS HOURS: 3

CREDITS: 3

Prepared by: Professors M. Kouar and M. Razani
November 2006

Course Professor M. Razani

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Project Assignment

Students will work in groups to design and analyze various types of antennas.

Grading Policy

Exams: 20% each – total of	60%
Project Assignment	30%
Regular homework assignments	<u>10%</u>
	100%

<u>Letter Grade</u>	<u>Numerical Grade Range</u>	<u>Quality Points</u>
A	93-100	4.0
A ⁻	90-92.9	3.7
B ⁺	87-89.9	3.3
B	83-86.9	3.0
B ⁻	80-82.9	2.7
C ⁺	77-79.9	2.3
C	70-76.9	2.0
D	60-69.9	1.0
F	59.9 and below	0.0

ATTENDANCE REQUIREMENT:

- A student is allowed to be absent not more than twice during the semester.
- A student is late if he/she appears after attendance is taken. Three latencies are equal to one absence.

HELPFUL SUGGESTIONS:

- **READ** the assigned sections (or chapters) before coming to class.
- **TRY** to do your homework as soon as possible after you leave the classroom (while your memory is still fresh and you do not want too much work to accumulate).
- **DO NOT** hesitate to ask questions if something is not clear to you.
- **TRUST** yourself in any work you do and learn how to be self-dependent (An important quality that hiring institutions look for).

<u>Assessment</u>	
<p>The following assessment techniques are correlated to the course objectives as follows: In addition, each assessment technique incorporates one or more of the following ABET Criterion 2 outcomes (2a, 2b, 2c, 2d, 2e, 2f, 2g, 2h, 2k, 2l, 2m, 2n).</p>	
<u>Course Objectives</u>	<u>Assessment</u>
<p>For the successful completion of this course, the student should be able to:</p>	<p>Students will exhibit skills in class homework assignments (problem solving analysis of measured data), quizzes (calculations), exams, projects and oral presentation.</p>
<p>1. Understand electromagnetic concepts as applied to antennas.</p>	<p>1. Students will demonstrate basic electromagnetic radiation and signal propagation mechanism comprehension throughout the course.</p>
<p>2. Calculate and interpret the basic parameters that are sufficient to specify an antenna and its characteristics.</p>	<p>2. Students will demonstrate their ability to analyze different types of antennas by utilization of software programs that are used to design varieties of antennas.</p>
<p>3. Understand and implement the antenna measurement techniques.</p>	<p>3. Students will show their abilities to use different antenna measurement techniques during the design of antennas.</p>
<p>4. Design and analyze various types of antennas.</p>	<p>4. Students will display analytical skills in designing and analyzing linear, aperture, and wire antennas. This is accomplished through written reports and oral presentation.</p>
<p>5. Work in a group project, to propose, build, and report on the design and realization (software) of antenna systems for telecom applications.</p>	<p>5. Students will demonstrate skills in working and communicating efficiently with team members through the realization and presentation of their project in a timely fashion.</p>

Week	Topic	Assignments
1	Electromagnetic Radiation Principles	Handouts
2	Radio wave propagation in free space & Maxwell's equations	Handouts
3	<u>Propagation Considerations</u> ; RF path loss, reflection, multipath and fading, noise and interference, polarization distortion, diversity implementation	Handouts
4	Parameters, terms, and characteristics of common antenna systems.	Chapter 1, Prob.: 1.1-1.5
5	<u>Antenna Arrays</u> ; linear arrays, array directivity and design, phased arrays, microstrip arrays, EXAM I.	Chapter 3, Prob.: 3.2,3.4,3.6
6	<u>Wire antennas</u> ; dipoles, corner reflector, Yag-Uda arrays.	Chapter 5, Prob.: 5.1-5.4
7	<u>Broadband Antennas</u> ; design principles for broadcasting, traveling wave antennas, spiral antennas, log-periodic antennas, helical antennas	Chapter 6, Prob.: 6.1-6.6
8	<u>Aperture Antennas</u> ; aperture theory, horn antenna, parabolic reflector antennas, gain calculations	Chapter 7, Prob.: 7.1,7.2, 7.4
9&10	<u>Antennas in Systems</u> ; communication systems, wireless systems, smart antennas, radar systems, radiometry and antenna noise, radiation safety, EXAM II.	Chapter 8, Prob.: 8.1,8.2,8.4,8.5
11&12	<u>Antenna Measurements</u> ; antenna ranges, radiation pattern measurement, gain measurement, polarization measurement.	Handouts
13	<u>Commercial Software Packages</u> ; familiarity with and use of EZNEC, HFSS, IE3D & XFDTD software tools for designing various antennas.	Handouts
14	<u>Demonstrate how to design an antenna</u> ; with a set of given specifications using industrial standard commercial software	Handouts
15	Final Exam	