



**EENG 425/525 - Antennas**

**Spring 2017**

**Course Description:** This course provides an introduction to antennas and antenna arrays. Theoretical analysis and use of computer programs for antenna analysis and design will be presented. Experimental tests and demonstrations will also be conducted to complement the theoretical analysis.

Prerequisites: EGGN386, and/or consent of instructor.

**By the end of the course, you will understand:**

1. The source of radiation and how it is guided by an antenna structure
2. Antenna radiation parameters
3. The basic principles of analysis and computations of field patterns from simple wire antennas such as dipole and loop antennas
4. Theories for basic design of antenna arrays
5. The basic principles of analysis and computations of input impedance and near and far field patterns from different classes of antennas such as aperture, horn, reflectors, and microstrip antennas
6. The basic principles of broadband and frequency independent antennas
7. How to develop and use simple computer programs for antenna analysis
8. How to use commercial software packages for full wave analysis of antennas
9. The basic principles of antenna measurements techniques.

**By the end of the course, you will be able to:**

1. Develop a good understanding of what approximations you have to consider before designing an antenna
2. Select the proper antenna type according to the required specifications
3. Develop Matlab programs to aid in the design of antennas and antenna arrays. This also includes the development of visualization files for the radiation patterns and the input impedance.
4. Complete basic analysis and design of an antenna project.

**Topics:**

- Antenna fundamentals
- Radiation integral and potential functions
- Dipole and loop antennas
- Antenna Arrays
- Broadband and traveling wave antennas
- Frequency independent antennas
- Aperture and horn antennas

- Microstrip antennas
- Reflector antennas
- Antenna Measurements

### **Instructor and Meeting Times:**

Atef Elsherbeni, Ph.D. ([aelsherb@mines.edu](mailto:aelsherb@mines.edu))

Office location: BB 310D

**Office hours:** Available every day (except when on business travel)

### **Textbook and other required materials:**

Textbook:

- C. A. Balmain, Antenna Theory: Analysis and Design, (3rd Edition), John Wiley & Sons, 2005. Or latest edition.

References:

- W. L. Stutzman and G. A. Theile, Antenna Theory and Design, (3rd Edition), John Wiley & Sons, 2013.
- Atef Elsherbeni, Payam Nayeri, and C.J. Reddy, Antenna Analysis and Design Using FEKO Electromagnetic Simulation Software, ACES Series on Computational Electromagnetics and Engineering, SciTech Publishing Inc. an Imprint of the IET, Edison, NJ, 2014.

### **Access and familiarity with MATLAB is required**

### **Assignments and Assessment:**

- *Participation:* Active participation in class and in office and lab discussion is very important for your learning. This will include working in small groups on short problems, asking questions, brainstorming solutions as a class, and working together and with your instructor outside of class. In addition, participation in class discussions is encouraged.
- *Homework:* Weekly homework assignments will consist of solving problems and developing simple computer programs. You are encouraged to work together, but your work and answers must be your own. Due date is always one week from the date assigned, unless if it is specified otherwise. ***Additional Homework/project will be assigned for those enrolled in the ENG598.***
- *Antenna design project:* This project will focus on the design of an antenna based on a given specifications. It is expected to have theoretical analysis, computer simulation, and building and testing of the antenna prototype. The delivery will consist of a project report containing analysis and results from simulations and measurement, developed computer programs, and fabricated model.
- *Semester and final exams:* There will be three exams during the semester plus a final exam. The questions in these exams will be similar to those on homework assignments. The semester exam with the lowest grade will be dropped from the calculations of the final grade for the course.

**The point distribution for these assignments is:**

Homework	30%
Project report	15%
Semester Exams (2 out of 3)	30%
Comprehensive Final Exam	25%

**The letter grades for the course are awarded according to the following criteria:**

A	92 - 100%	Exceeds expectations in an outstanding manner.
A-/B+	89 - < 92%	Meets expectations.
B	81 - < 89%	Meets most expectations.
B-/C+	77 - < 81%	Meets most expectations, with minor reservations.
C	69 - < 77%	Meets some expectations
C-/D+	64 - < 69%	Meets some expectations with minor reservations.
D	58 - < 64%	Meets only a few expectations.
D-	55 - < 58%	Meets only a few expectations but with reservations.
F	0 - < 55%	Unacceptable performance.

**Attendance policy:** Attendance in classes is encouraged and is very important. Official absences for university sanctioned events or documentable illnesses are recorded, and students may request make-up times for missed quizzes and exams and extensions for homework and project due dates which will normally be allowed by the instructor. Similar requests for unofficial absences may be allowed at the discretion of the instructor.

**Academic Dishonesty Policy**

The consequences of academic dishonesty at the Colorado School of Mines are severe and can lead to expulsion. It is imperative that each student take responsibility for their education and adhere to the Academic Dishonesty Policy.

The policy on homework allows students to work on the homework together in groups. However, all students must turn in individual homework (unless otherwise stated) and they must understand what they turn in. Copying of solutions without understanding them is not allowed. If a student copies a solution and cannot explain it adequately it is considered academic dishonesty. For computer assignments, each student is expected to generate their own code. One cannot copy another person's computer code and modify it slightly to make it look like it is their own work. All external sources used must be referenced and cited in their entirety.

Each student should read and abide by the Academic Integrity Policy, provided on-line at: <http://inside.mines.edu/UserFiles/File/policies/STU/AcademicIntegrityPolicy.pdf>.

Each student should also read and abide by the Student Honor Code, provided online at: <http://inside.mines.edu/UserFiles/File/policies/STU/Student%20Honor%20Code.pdf>