

Memorial University of Newfoundland  
Faculty of Engineering and Applied Science

Engineering 7811 (Antennas)

Course Particulars

Term 8, Winter 2012

Class of 2012

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**THE COURSE**

This course extends and applies the concepts encountered in Engineering 6813 (Electromagnetic Fields). In ENGI6813, it was seen that Maxwell's Equations, along with a pair of constitutive relations, Ohm's law, the definition of convection current and the Lorentz force equation, were the means of describing any classical electrodynamic phenomenon. Also intimated, but not discussed, was the fact that current-carrying structures could be responsible for radiated electromagnetic energy. The whole of this course addresses this phenomenon. The *antenna*, as we shall see, is the means of radiating or receiving "radio" waves. As time permits, a further discussion of electromagnetic wave propagation will be included.

**TEXT:** There is no specific text for this course. The following are suggested reference materials to which we shall refer from time to time.

- (1) Constantine A. Balanis, Antenna Theory – Analysis and Design, Wiley, 1997.
  - (2) Hayt and Buck, Engineering Electromagnetics, 7th ed., McGraw-Hill, 2006.
  - (3) J.D. Kraus, Antennas, McGraw-Hill, 1988.
  - (4) W.L. Stutzman and G.A. Thiele, Antenna Theory and Design, 2nd ed., Wiley, 1998.
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# COURSE OUTLINE

## Unit 1 Electromagnetics Review (Mostly)

- 1.1 Introduction
- 1.2 Maxwell's Equations and Related Formulae
- 1.3 Scalar and Vector Potentials

## Unit 2 Small Antennas and Some Antenna Parameters

- 2.1 The Fundamental Source of Radiated Energy
- 2.2 The Infinitesimal Dipole
  - 2.2.1 Reality and Useful “Fiction”
  - 2.2.2 The Vector Potential for a Uniform-Current Element
  - 2.2.3 The Electric and Magnetic Far-Fields for the Infinitesimal Dipole
  - 2.2.4 Radiation Power Density and Radiated Power
- 2.3 General Antenna Parameters and Characteristics
  - 2.3.1 Radiation Pattern and Related Concepts
  - 2.3.2 Radiation Power Density, Radiated Power and Radiation Resistance
  - 2.3.3 Radiation Intensity, Directivity, and Gain
  - 2.3.4 Half-Power Beamwidth
  - 2.3.5 Reciprocity
- 2.4 The Small Current Loop

## Unit 3 Linear Wire Antennas and Antenna Arrays

- 3.1 Thin Linear Wire Dipole Antennas
  - 3.1.1 The Vector Potential and Resulting Fields of the Thin Linear Dipole
  - 3.1.2 Power Density and Other Parameters
  - 3.1.3 Special Cases of the Thin Dipole
- 3.2 Images and Monopoles
- 3.3 Antenna Arrays
  - 3.3.1 Two-Element (Dipole) Array – Free Space Analysis
  - 3.3.2 The Linear Array
  - 3.3.3 The Planar Array
- 3.4 Long Wire Antennas

## Unit 4 A Few “Practical” Considerations

- 4.1 Antenna Impedance
  - 4.1.1 Self Impedance of a Thin Linear Antenna
  - 4.1.2 Mutual Impedance (Two Elements Only)

- 4.1.3 Driving Point Impedance of a Side-by-Side Dipole Pair
- 4.2 Ground Effects
- 4.3 Effective Aperture and the Friis Transmission Formula
  - 4.3.1 Effective Aperture
  - 4.3.2 The Friis Transmission Formula

**Unit 5 Aperture Antennas**

- 5.1 Field Equivalence and Related Concepts
  - 5.1.1 Magnetic Current Density, Electric Vector Potential and Duality
  - 5.1.2 More on Images
  - 5.1.3 Field Equivalence
  - 5.1.4 Application – Rectangular Aperture on an Infinite Ground Plane

**Topics on Propagation as Time Permits.**

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**Evaluation Scheme**

Evaluation Instrument	Value	Date (Approx.)
Assignments (5 or 6)	10%	Jan. 18, 25, Feb. 8, 29 Mar. 14, 28
Term Tests (2)	40%	Feb. 15 March 21
Final Exam	50%	Wk. of Apr. 11 –

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**Office Hours**

Official: Tuesday 11:00–11:50 AM and Wednesday 11:00–11:50 AM.

Actual: Open-door for the duration of the term.

**Calculator Policy**

Simple scientific calculators, preferably with complex number capability, are allowed for tests and exams. No graphing or programmable calculator or other text-memory device, including electronic communications devices, is permitted for tests and exams.

## **The Memorial University of Newfoundland Code** (<http://www.mun.ca/regoff/calendar/sectionNo=GENINFO-1502>)

All members of the Memorial University of Newfoundland Community, which includes students, faculty, and staff, shall treat others with respect and fairness, be responsible and honest, and uphold the highest standards of academic integrity.

### **Expectations of Student Conduct** (<http://www.engr.mun.ca/policies/codeofconduct.php>)

Like Professional Engineers, engineering students are expected to behave in a professional manner at all times. Students are encouraged to conduct themselves in a manner consistent with the PEG-NL code of ethics. See

(<http://www.pegnl.ca/publications/>)

MUN has two sets of rules which deal with inappropriate behaviour by students. The first set deals with academic offences such as cheating

(<http://www.mun.ca/regoff/calendar/sectionNo=REGS-0748>)

while the other set deals with non-academic offences such as disruptive behaviour in class

(<http://www.mun.ca/regoff/calendar/sectionNo=REGS-0897>).

Both sets of rules can be found in the University Calendar under Regulations. It is strongly recommended that students read and follow these rules because the penalties can be severe, the severest being expulsion from the University.