

Memorial University of Newfoundland
Faculty of Engineering and Applied Science

Engineering 7811 (Antennas)

Course Particulars

Term 8, Winter 2009

Class of 2009

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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 electro-dynamical 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.

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.

Evaluation Scheme

Evaluation Instrument	Value	Date
Assignments (5 or 6)	10%	Biweekly
Term Tests (2)	40%	Feb. 13 March 20
Final Exam	50%	Wk. of Apr. 13

Office Hours

Official: Monday 12:00–1:00 PM and Tuesday 3:30–4:30 PM.

Actual: Open door most of the time.

Calculator Policy: Calculators and other devices with text storage capabilities are NOT permitted in Tests and Exams.