Memorial University of Newfoundland

Faculty of Engineering and Applied Science

Engineering 9816 (Antenna Theory) **Winter 2016**

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THE COURSE

This course extends and applies the concepts encountered in undergraduate electromagnetics courses. It has been 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 electrodynamical phenomenon. Also addressed was the fact that current-carrying structures are sources of radiated electromagnetic energy. The whole of this course addresses radiation associated with a variety of such structures.

TEXT: Constantine A. Balanis, Antenna Theory – Analysis and Design 3rd Ed., Wiley, 2005; ISBN: 978-0-471-66782-7.

The following are suggested reference materials to which we shall refer from time to time.

(2) R.E. Collin, Antennas and Radio Wave Propagation, McGraw-Hill, 1985.

(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 Relevant Fundamental Electromagnetics

1.1 Introduction

1.2 Maxwell's Equations and Related Formulae

1.3 Scalar and Vector Potentials (Read Sections 3.1–3.6 of text)

Unit 2 Small Antennas and Some Antenna Parameters

2.1 The Fundamental Source of Radiated Energy (Read all of Chapter 1 of text)

2.2 The Infinitesimal Dipole (Read Sections 4.1–4.2 of text)

- 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, Radiated Power, and Power Pattern
- 2.2.5 Near and Intermediate Fields

2.3 General Antenna Parameters and Characteristics
(Read Sections 2.1–2.12 of text)

- 2.3.1 More on Radiation Patterns
- 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 More on Reciprocity (Read Sections 3.7–3.8 of text)

2.4 The Small Current Loop

Unit 3 Thin Wire Antennas and Antenna Arrays

(Selections from Chapters 5 and 6 of Text)

3.1 Thin Linear Wire Dipole Antennas

- 3.1.1 The Vector Potential and Resulting Fields
- 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 Linear Array
- 3.3.3 The Planar Array
- 3.3.4 More Linear Arrays

3.4 Long Wire Antennas (Selections from Chapter 10 of text)

3.5 Circular Loop of Constant Current (Read Section 5.3 of text)

Unit 4 A Few "Practical" Considerations

(Selections from Chapters 8 and 2 of text and other sources)

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 Dipole Pairs

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

4.4 Finite Diameter Wires (Selections from Chapter 8 of text)

Unit 5 Aperture Antennas

(Selections from Chapter 12 of text and other sources)

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

5.2 Applications of Field Equivalence

5.2.1 Rectangular Aperture on Infinite Ground Plane

5.2.2 The Parabolic Reflector (An Approximate Example)

5.3 Fourier Transforms and Aperture Antennas – A Brief Summary

5.4 Feed Waveguides for Aperture Antennas

Unit 6 Further Applications

6.1 Broadband Antennas

6.2 Log-periodic Antennas

6.3 Horn Antennas

6.4 Microstrip Antennas

6.5 Reflector Antennas

Evaluation Scheme

Evaluation Instrument	Value	Date Due
Problems on notes & Assigned Readings	15%	Every 2 or 3 weeks
Project and Presentation	20%	Week of March 28
Midterm Test	20%	March 7
Final Exam	45%	Week of Apr. 11 –