Engineering 5812 — Basic Electromagnetics Winter, 2012

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COURSE RATIONALE

This is the first of two elementary courses, the second being Engineering 6813, designed to prepare students for further applications in engineering electromagnetics. The concepts and governing equations associated with steady electric and magnetic fields will be treated. The ideas addressed will be essential to an understanding of applications involving time-varying fields to be encountered in future courses. For example, the underlying processes touching the physical layer of such topics as electromagnetic communications will be discussed.

TEXT: *Engineering Electromagnetics*, 8th Ed., by W.H. Hayt, Jr. and J.A. Buck, McGraw Hill.
OTHER MATERIALS: See http://www.engr.mun.ca/~egill for regular postings of notes and other course materials during the semester.

Course Prerequisite: ENGI 3821 (Circuit Analysis)
Co-requisite: ENGI 4430 (Advanced Calculus for Engineering)

Course Format: Lecture: 3hrs/wk ; Tutorial: 1hr/wk (very important)

COURSE OUTLINE

Unit 1 Coordinate Systems and Vectors (Chapter 1)

1.1 Scalars, Vectors, Cartesian Coordinates, and Vector and Scalar Products

1.1.1 Scalars and Vectors – Relevant Definitions
1.1.2 Vectors and Vector Space
1.1.3 Miscellaneous Vector Characteristics and Elementary Operations

1.2 Coordinate Systems and Coordinate Transformation

1.2.1 Cartesian (or Rectangular) Coordinates
1.2.2 (Circular) Cylindrical Coordinates
1.2.3 Spherical Polar Coordinates

Unit 2 Coulomb's Law and Electric Field Intensity (Chapter 2)

2.1 Coulomb's Law
2.2 Electric Field Intensity Due to Point Sources

2.2.1 Electric Field Due to a Single Point Charge
2.2.2 Electric Field Due to Multiple Point Charges

2.3 Electric Field Intensity Due to Continuous Charge Distributions

2.3.1 Continuous Charge Distributions
2.3.2 Electric Field Intensity of Continuous Line Sources
2.3.3 Electric Field Intensity of a Sheet of Charge
2.3.4 Electric Field Intensity of a Volume Charge

2.4 Streamlines – Visualizing the Electric Field

Unit 3 Electric Flux Density, Gauss' Law and Divergence (Chapter 3)

3.1 Electric Flux density

3.1.1 Gauss's Law

3.2 Gauss' Law and the Divergence Theorem

3.2.1 Divergence
3.2.2 Divergence and Maxwell's First Equation in Point Form
3.2.3 The Divergence Theorem

Unit 4 Energy and Potential (Chapter 4)

4.1 Force and Energy

4.1.1 Line Integrals

4.2 Potential and Potential Difference

4.2.1 Potential Difference
4.2.2 Potential (or Absolute Potential)
4.2.3 The Divergence Theorem

4.3 Potential Due to Point and Continuous Charge Distributions
4.4 Potential Gradient and Equipotential Surfaces
4.5 The Dipole
4.6 Electrostatic Field Energy Density

Unit 5 Current, Conductors and Dielectrics (Chapters 5 and 6)

5.1 Current and Current Density
5.2 Continuity of Current
5.3 Conductors, Boundary Conditions and Semiconductors

5.3.1 Conductors and the Point Form of Ohm's Law
5.3.2 Conductors and Electrostatic Boundary Conditions

5.3.3 The Method of Images
5.3.4 Semiconductors

5.4 Dielectrics and Boundary Conditions

5.4.1 Polarization, Susceptibility and Permittivity of Dielectrics
5.4.2 Boundary Conditions for Dielectrics

5.5 Capacitance

Unit 6 Poisson's and Laplace's Equations (Chapter 7)

6.1 Derivation of Poisson's and Laplace's Equations
6.2 Some Sample Solutions to Laplace's and Poisson's Equations

Unit 7 The Magnetostatic Field (Chapters 8 and 9)

7.1 Biot-Savart Law
7.2 Ampère's Circuital Law
7.3 Stokes' Theorem Flux Density
7.4 Magnetic Flux Density
7.5 Magnetic Potentials
7.6 Magnetic Forces
7.7 Magnetic Materials and Boundary Conditions

Evaluation Scheme:

Evaluation Instrument	Value	Approximate Date
Test 1	20%	Wednesday, February 15, 2012
Test 2	20%	Monday, March 19, 2011
Assignments (5 or 6)	10%	Jan. 16,23;Feb. 6,27;Mar.12,26
Final Exam	50%	Week of April 11—

Office Hours: Official office hours will be 11-11:50 AM on Tuesdays and Wednesdays, unless otherwise posted for specific weeks. Unofficially, there will be an open-door office hour policy 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
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

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. MUN has two sets of rules which deal with inappropriate behaviour by students. The first set deals with academic offences such as cheating while the other set deals with non-academic offences such as disruptive behaviour in class. 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.