Course Outline 2009-2010 (Offered 2010WI)

1. Course Summary

Maxwell's equations, the interactions of electromagnetic fields with matter, the relativistic formulation of electromagnetism and its applications.

Prerequisites: PHYS–COIS 3200Y (321): *Electricity and magnetism*
PHYS–MATH 3150H (305H): *Partial differential equations*

2. Instructor Information

Ralph Shiell, Department of Physics and Astronomy (lab SC214, office SC213),
ralphshiell@trentu.ca 748 1011 x7023
My office hours for this course will be flexible and as needed.
Secretary: Gina Collins, SC 327 Physics Building, gcollins@trentu.ca, 748-1011 x7715.

3. Course Format

From the timetable (may be changed to accommodate conflicts):

LCTR	SC 317	TU	13:00 – 14:50
LCTR	SC 317	TH	14:00 – 14:50
(SEM	SC 317	TH	15:00 – 15:50)

The one hour seminar is when you are expected to do some class readings, or we shall have a problem session, or computer session to tackle some of the numerical problems in your assignments (for computational work we shall use MATLAB predominately)

4. Required Text and Course Materials

Required: David J. Griffiths, *Introduction to Electrodynamics*, 3rd Edition, Prentice-Hall, 1999
Recommended: John D. Jackson, *Classical Electrodynamics*, 3rd Edition, John Wiley, 1998
Course webpage: http://www.trentu.ca/physics/rshiell/PHYS4220Hdir/PHYS4220H.html

5. Course Format

Before each class there will be assigned readings from the textbook (see the syllabus below).
Classes consist of interactive discussions based on the pre-class readings. First, I will briefly review the main points of the readings, and then we will work through them to ensure a through understanding of the concepts.
Roughly every two weeks, a set of problems that test the material from the last two weeks will be assigned.
There will be one midterm and one final exam for this course.

6. Course Evaluation

Assignments: 55%
Midterm Examination: 17.5%
Final Examination: 27.5%

Late policy: problem sets that are late without a good reason provided in advance of their respective deadline will be subject to a 10% reduction in marks for each two working day period for which they are late.

7. Syllabus

1. Summary of PHYS 3200Y (electrostatics, magnetostatics, Maxwell's equations)
2. Energy in electromagnetic systems (Ch 8)
3. Electromagnetic waves and applications (Ch 9)
4. General electromagnetic results for fields due to a moving charge, and system of charges (Ch10, 11)
5. Summary of PHYS 202H (relativity, four-vectors), and tensors
6. Relativistic formulation, electrodynamics in tensor notation (Ch 12)

Syllabus item	Topics (sections of Griffiths)	Readings
1	Summary of Electricity and Magnetism (1-7)	Relevant questions from past final exams
2	Charge and Electromagnetic Energy (8.1)	8.1.1 The Continuity Equation 8.1.2 Poynting's Theorem
3	Electromagnetic Waves in Vacuum (9.2)	9.2.1 The Wave Equation for $\vec{E}$ and $\vec{B}$ 9.2.2 Monochromatic Plane Waves 9.2.3 Energy and Momentum in Electromagnetic Waves
	Polarization of Light (9.1.4)	Notes in class, and 9.1.4 Polarization
	Electromagnetic Waves in Conductors (9.4)	9.4.1 Electromagnetic Waves in Conductors 9.4.2 Reflection at a Conducting Surface
	EM Waves in Rectangular Cavities (Prob. 9.38)	Notes in class
	Waveguides (9.5)	9.5.1 Waveguides 9.5.2 TE waves in a Rectangular Waveguide
4	Potentials and Fields (10)	10.1.1 Scalar and Vector Potentials 10.1.2 Gauge Transformations 10.1.3 Coulomb Gauge and Lorentz Gauge 10.2.1 Retarded Potentials 10.3.1 Liénard-Wiechert Potentials 10.3.2 The Fields Due to a Moving Point Charge
	Radiation (11)	11.1.1 What is Radiation? 11.2.1 Power Radiated by a Point Charge
5	Summary of Relativity (12.1)	12.1.1 Einstein's Postulates 12.1.2 The Geometry of Relativity 12.1.3 The Lorentz Transformations 12.1.4 The Structure of Spacetime
6	Relativistic Electrodynamics (12.3)	12.3.1 Magnetism as a Relativistic Phenomenon 12.3.2 How the Fields Transform 12.3.3 The Field Tensor

[Note: We shall endeavour to get through all this material, but we may spend longer on some topics if needed.]

8. Academic Integrity

Academic dishonesty, which includes plagiarism and cheating, is an extremely serious academic offence and carries penalties varying from a 0 grade on an assignment to expulsion from the University. Definitions, penalties, and procedures for dealing with plagiarism and cheating are set out in Trent University's Academic Integrity Policy. You have a responsibility to educate yourself – unfamiliarity with the policy is not an excuse. You are strongly encouraged to visit Trent's Academic Integrity website to learn more: www.trentu.ca/academicintegrity.

9. Access to Instruction

It is Trent University's intent to create an inclusive learning environment. If a student has a disability and/or health consideration and feels that he/she may need accommodations to succeed in this course, the student should contact the Disability Services Office (BL Suite 109, 748-1281, disabilityservices@trentu.ca) as soon as possible. Complete text can be found under Access to Instruction in the Academic Calendar.