## OFFICIAL UNDERGRADUATE COURSE OUTLINE

### PHYS 312

**Science/Physics**  
**3**  
**Intermediate Electromagnetism**  
**UFV CREDITS**

### CALENDAR DESCRIPTION:

This course elaborates upon and extends many of the topics covered in PHYS 112. It begins with an introduction to vectors and vector calculus. These ideas are then applied to a study of electrostatics and magnetostatics, both in vacuum and in materials. Also, time-dependent electric and magnetic fields are considered. Faraday's law and the displacement current are introduced and serve to finalize Maxwell's equations.

Note: Students with credit for PHYS 222 cannot take this course for further credit.

### PREREQUISITES:

PHYS 112 and PHYS 381

### COREQUISITES:

PRE or COREQUISITES: MATH 312 recommended

### SYNONYMOUS COURSE(S):

(a) Replaces: PHYS 222  
(b) Cross-listed with:  
(c) Cannot take: for further credit.

### TOTAL HOURS PER TERM: 60

### STRUCTURE OF HOURS:

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<tr>
<th>Lectures: 60 Hrs</th>
<th>Seminar:</th>
<th>Laboratory:</th>
<th>Field experience:</th>
<th>Student directed learning:</th>
<th>Other (specify):</th>
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<td>60 Hrs</td>
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### TRAINING DAY-BASED INSTRUCTION:

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<th>Length of course:</th>
<th>Hours per day:</th>
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### OTHER:

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<th>Maximum enrolment: 24</th>
<th>Expected frequency of course offerings: annually</th>
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<td>(every semester, annually, every other year, etc.)</td>
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### WILL TRANSFER CREDIT BE REQUESTED? (lower-level courses only)

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<tr>
<th>Yes</th>
<th>No</th>
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### WILL TRANSFER CREDIT BE REQUESTED? (upper-level requested by department)

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<th>Yes</th>
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### TRANSFER CREDIT EXISTS IN BCCAT TRANSFER GUIDE:

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<th>Yes</th>
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Course designer(s): **George McGuire and Derek Harnett**  
Department Head: **Norm Taylor**  
Date approved: **December 6, 2011**  
Supporting area consultation (Pre-UEC):  
Date of meeting: **February 17, 2012**  
Curriculum Committee chair: **Norm Taylor**  
Date approved: **February 24, 2012**  
Dean/Associate VP: **Ora Steyn**  
Date approved: **March 9, 2012**  
Undergraduate Education Committee (UEC) approval:  
Date of meeting: **March 30, 2012**
LEARNING OUTCOMES:
Upon successful completion of this course, students will be able to:
- perform a variety of computations in vector calculus including derivatives (gradient, divergence, and curl), integrals (line, flux, volume), and applications of the divergence theorem and Stokes's theorem
- relate charge, potential, and electric field
- calculate electrostatic fields and potentials using a variety of techniques such as Coulomb's law, Gauss's law, the method of images, separation of variables, and the multipole expansion
- demonstrate their understanding, both qualitatively and quantitatively, the relationships between dielectrics and electric fields
- compute electromagnetic forces on a variety of charge and current distributions
- relate current, vector potential, and magnetic field
- calculate magnetostatic fields using the Biot-Savart law, Ampere's law, and the multipoles of superposition
- derive the relationships between materials and magnetic fields (para-, dia-, and ferromagnetism)
- use Faraday's law to calculate induced and motional EMFs
- understand that a time-dependent magnetic field generates an electric field and vice-versa

METHODS: *(Guest lecturers, presentations, online instruction, field trips, etc.)*
This course is predominantly lecture-based.

METHODS OF OBTAINING PRIOR LEARNING ASSESSMENT RECOGNITION (PLAR):
- Examination(s)
- Portfolio assessment
- Interview(s)

- Other (specify): Evidence of industrial or related experience with sufficient overlap to the course material.

PLAR cannot be awarded for this course for the following reason(s):

TEXTBOOKS, REFERENCES, MATERIALS: *[Textbook selection varies by instructor. An example for this course might be:]*
Griffiths D, Introduction to Electrodynamics (3rd Edition), Prentice Hall 1999

SUPPLIES / MATERIALS:
A computer lab at least twice per week.

STUDENT EVALUATION: *[An example of student evaluation for this course might be:]*
Assignments 20%
Term tests 35%
Final exam 45%

COURSE CONTENT: *[Course content varies by instructor. An example of course content might be:]*
1. Vector Analysis
   - curvilinear coordinates, gradient, divergence, curl, line/flux/volume integrals, Dirac delta function, divergence theorem, Stokes's theorem
2. Electrostatics
   - electric field, potential, work and energy, Coulomb's law, Gauss's law, method of images, electric dipoles, multipole expansion, electrostatic boundary conditions, separation of variables
3. Dielectrics
   - polarization, bound charge, electric displacement, linear dielectrics
4. Magnetostatics
   - Lorentz force law, current, Biot-Savart law, Ampere's law, magnetic dipoles, magnetic vector potential, multipole expansion, magnetostatic boundary conditions
5. Magnetism in Matter
   - magnetization, bound current, para-, dia-, and ferromagnetism, the H-field, linear materials
6. Electrodynamics
   - EMF, Faraday's law of induction, Ohm's law, displacement current, Maxwell's equations