**OFFICIAL UNDERGRADUATE COURSE OUTLINE FORM**

Note: The University reserves the right to amend course outlines as needed without notice.

<table>
<thead>
<tr>
<th>Course Code and Number: PHYS 312</th>
<th>Number of Credits: 3</th>
<th><a href="http://example.com">Course credit policy (105)</a></th>
</tr>
</thead>
</table>

**Course Full Title:** Intermediate Electromagnetism  
**Course Short Title:**  
*(Transcripts only display 30 characters. Departments may recommend a short title if one is needed. If left blank, one will be assigned.)*

**Faculty:** Faculty of Applied and Technical Studies  
**Department (or program if no department):** Physics  

**Calendar Description:**  
An introduction to vector calculus; electrostatics and magnetostatics, both in vacuum and in materials; and time-dependent electric and magnetic fields including Faraday's law, displacement current, and Maxwell's equations.

**Prerequisites (or NONE):** PHYS 112 and PHYS 381.  
**Corequisites (if applicable, or NONE):** NONE  
**Pre/corequisites (if applicable, or NONE):** MATH 312 is recommended.

**Antirequisite Courses** *(Cannot be taken for additional credit.)*  
**Former course code/number:** PHYS 222  
**Cross-listed with:**  
**Dual-listed with:**  
**Equivalent course(s):** *(If offered in the previous five years, antirequisite course(s) will be included in the calendar description as a note that students with credit for the antirequisite course(s) cannot take this course for further credit.)*  

**Special Topics** *(Double-click on boxes to select.)*  
This course is offered with different topics:  
☑ No ☐ Yes *(If yes, topic will be recorded when offered.)*

**Independent Study**  
If offered as an Independent Study course, this course may be repeated for further credit: *(If yes, topic will be recorded.)*  
☑ No ☐ Yes, repeat(s) ☐ Yes, no limit

**Transfer Credit**  
Transfer credit already exists: *(See [bctransferguide.ca](http://bctransferguide.ca).)*  
☐ No ☑ Yes  
Submit outline for (re)articulation:  
☐ No ☑ Yes *(If yes, fill in transfer credit form.)*

**Grading System**  
☑ Letter Grades ☐ Credit/No Credit

**Typical Structure of Instructional Hours**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture/seminar</td>
<td>60</td>
</tr>
<tr>
<td>Tutorials/workshops</td>
<td></td>
</tr>
<tr>
<td>Supervised laboratory hours</td>
<td></td>
</tr>
<tr>
<td>Experiential (field experience, practicum, internship, etc.)</td>
<td></td>
</tr>
<tr>
<td>Supervised online activities</td>
<td></td>
</tr>
<tr>
<td>Other contact hours</td>
<td></td>
</tr>
<tr>
<td><strong>Total hours</strong></td>
<td><strong>60</strong></td>
</tr>
</tbody>
</table>

Labs to be scheduled independent of lecture hours: ☑ No ☐ Yes

**Maximum enrolment (for information only):** 24  
**Expected Frequency of Course Offerings:**  
Annually *(Every semester, Fall only, annually, etc.)*

<table>
<thead>
<tr>
<th>Department / Program Head or Director: Norm Taylor</th>
<th>Date approved: January 2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faculty Council approval</td>
<td>Date approved: February 8, 2019</td>
</tr>
<tr>
<td>Dean/Associate VP: John English</td>
<td>Date approved: February 8, 2019</td>
</tr>
<tr>
<td>Campus-Wide Consultation (CWC)</td>
<td>Date of posting: n/a</td>
</tr>
<tr>
<td>Undergraduate Education Committee (UEC) approval</td>
<td>Date of meeting: March 29, 2019</td>
</tr>
</tbody>
</table>
Learning Outcomes:
Upon successful completion of this course, students will be able to:

- Calculate vector derivatives (gradient, divergence, and curl) and integrals (line, flux, volume)
- Apply the divergence and Stokes's theorem
- Calculate electrostatic fields and potentials using Coulomb's law, Gauss's law, the method of images, separation of variables, and the multipole expansion
- Compute D-fields using Gauss's law for dielectrics
- Compute electromagnetic forces on charge and current distributions using the Lorentz force law
- Derive magnetostatic fields using the Biot-Savart law, Ampere's law, and the multipole expansion
- Compute H-fields using Ampere's law for magnetic materials
- Define paramagnetism, diamagnetism, and ferromagnetism
- Calculate induced and motional EMFs using Faraday's law
- Determine displacement current from a time-dependent electric field
- State Maxwell's equations
- Present solutions to questions in these topic areas in a clear, logical and consistent framework

Prior Learning Assessment and Recognition (PLAR)
☒ Yes ☐ No, PLAR cannot be awarded for this course because

Typical Instructional Methods (Guest lecturers, presentations, online instruction, field trips, etc.; may vary at department's discretion.)
lectures, assignments, exams, projects

NOTE: The following sections may vary by instructor. Please see course syllabus available from the instructor.

Typical Text(s) and Resource Materials (If more space is required, download Supplemental Texts and Resource Materials form.)

<table>
<thead>
<tr>
<th>Author (surname, initials)</th>
<th>Title (article, book, journal, etc.)</th>
<th>Current ed.</th>
<th>Publisher</th>
<th>Year</th>
</tr>
</thead>
</table>

Required Additional Supplies and Materials (Software, hardware, tools, specialized clothing, etc.)

Typical Evaluation Methods and Weighting

<table>
<thead>
<tr>
<th>Final exam:</th>
<th>45%</th>
<th>Assignments:</th>
<th>20%</th>
<th>Field experience:</th>
<th>%</th>
<th>Portfolio:</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midterm exam:</td>
<td>%</td>
<td>Project:</td>
<td>%</td>
<td>Practicum:</td>
<td>%</td>
<td>Other:</td>
<td>%</td>
</tr>
<tr>
<td>Quizzes/tests:</td>
<td>35%</td>
<td>Lab work:</td>
<td>%</td>
<td>Shop work:</td>
<td>%</td>
<td>Total:</td>
<td>100%</td>
</tr>
</tbody>
</table>

Details (if necessary):

Typical Course Content and Topics

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