UNIVERSITY OF THE FRASER VALLEY

ORIGINAL COURSE IMPLEMENTATION DATE: January 1993
REVISED COURSE IMPLEMENTATION DATE: September 2019
COURSE TO BE REVIEWED (six years after UEC approval)**:** March 2025
Course outline form version: 05/18/2018

OFFICIAL UNDERGRADUATE COURSE OUTLINE FORM

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

Course Code and Number: PHYS 412	**Number of Credits:** 3 Course credit policy (105)

Course Full Title: Advanced 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:

Electromagnetic stress-energy-momentum tensor; propagation, polarization, reflection, and transmission of electromagnetic waves; the potential formulation of Maxwell's equations; retarded potentials (including the Liénard-Wiechert potentials) for time-dependent charge and current distributions; classical electromagnetic radiation; and Lorentz transformations of electromagnetic fields.

Prerequisites (or NONE):	PHYS 312.
Corequisites (if applicable, or NONE):	NONE
Pre/corequisites (if applicable, or NONE):	

Antirequisite Courses *(Cannot be taken for additional credit.)*
Former course code/number: **PHYS 322**
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.)

Typical Structure of Instructional Hours

Lecture/seminar hours	60
Tutorials/workshops	
Supervised laboratory hours	
Experiential (field experience, practicum, internship, etc.)	
Supervised online activities	
Other contact hours:	
Total hours	**60**

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

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**.)*
☒ No ☐ Yes
Submit outline for (re)articulation:
☐ No ☐ Yes *(If yes, fill in transfer credit form.)*

Grading System
☒ Letter Grades ☐ Credit/No Credit

Maximum enrolment (for information only): 24

Expected Frequency of Course Offerings:
Once every two years *(Every semester, Fall only, annually, etc.)*

Department / Program Head or Director: Norm Taylor	**Date approved:**	January 2019
Faculty Council approval	**Date approved:**	February 8, 2019
Dean/Associate VP: John English	**Date approved:**	February 8, 2019
Campus-Wide Consultation (CWC)	**Date of posting:**	n/a
Undergraduate Education Committee (UEC) approval	**Date of meeting:**	March 29, 2019

Learning Outcomes:

Upon successful completion of this course, students will be able to:

- Compute the electromagnetic stress-energy tensor given electric and magnetic fields.
- Calculate reflected and transmitted electromagnetic wave amplitudes using the Fresnel equations.
- Express Maxwell's equations in terms of electromagnetic potentials.
- Define a gauge transformation.
- Compute retarded potentials and corresponding electromagnetic fields for time-dependent charge and current distributions.
- Calculate the power spectrum for dipole radiation, breaking radiation, and synchrotron radiation.
- Apply Lorentz transformations to electromagnetic fields.
- Summarize their computations and calculations in a logical manner and present these solutions clearly and effectively.

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.)*

Lecture, assignments, exams, project

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.)*

	Author (surname, initials)	Title (article, book, journal, etc.)	Current ed.	Publisher	Year
1.	Griffiths, D.	Introduction to Electrodynamics	☒	Pearson	2012
2.	Zangwill, A.	Modern Electrodynamics	☒	Cambridge University Press	2012
3.	Slater, J.C. and Frank, N.H.	Electromagnetism	☒	Dover Publications	2011
4.	Jackson, J.D.	Classical Electrodynamics	☒	Wiley	1998
5.			☐		

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

Typical Evaluation Methods and Weighting

Final exam:	45%	Assignments:	25%	Field experience:	%	Portfolio:	%
Midterm exam:	30%	Project:	%	Practicum:	%	Other:	%
Quizzes/tests:	%	Lab work:	%	Shop work:	%	Total:	100%

Details (if necessary):

Typical Course Content and Topics

- Stress-energy-momentum tensor, Poynting's theorem, conservation of momentum and angular momentum
- Electromagnetic waves, the wave equation, polarization, the Fresnel equations, wave guides
- Potentials and fields, scalar and vector potentials, gauge transformations, retarded potentials, Liénard-Wiechert potentials, electric and magnetic fields of a moving charge
- Electric and magnetic dipole radiation, breaking radiation, and synchrotron radiation
- Lorentz transformations of electromagnetic fields