OFFICIAL UNDERGRADUATE COURSE OUTLINE (page 1)

COURSE IMPLEMENTATION DATE:	January 1993
COURSE REVISED IMPLEMENTATION DATE:	September 2013
COURSE TO BE REVIEWED:	March 2018
(six years after UEC approval)	*(month, year)*

OFFICIAL UNDERGRADUATE COURSE OUTLINE INFORMATION

Students are advised to keep course outlines in personal files for future use.

Shaded headings are subject to change at the discretion of the department – see course syllabus available from instructor

PHYS 412	Science/Physics	3
COURSE NAME/NUMBER	FACULTY/DEPARTMENT	UFV CREDITS

Advanced Electromagnetism

COURSE DESCRIPTIVE TITLE

CALENDAR DESCRIPTION:

This course builds upon the concepts discussed in PHYS 112 and 312. Maxwell's equations are examined from several perspectives and their link with special relativity is explored. Also, the propagation, reflection, transmission, refraction, and polarization of electromagnetic waves is studied. The potential formulation of Maxwell's equations is introduced and used to analyse several time-dependent charge and current distributions. An introduction to the classical theory of radiation is also presented.

PREREQUISITES:	PHYS 312 (formerly PHYS 222)
COREQUISITES:	
PRE or COREQUISITES:	PHYS 382 or 383 (Advanced Electricity & Magnetism Group of experiments) strongly recommended

SYNONYMOUS COURSE(S):

(a) Replaces: **PHYS 322**

(b) Cross-listed with:

(c) Cannot take: **N/A** for further credit.

SERVICE COURSE TO: *(department/program)*

TOTAL HOURS PER TERM: **60**

STRUCTURE OF HOURS:

Lectures:	**60**	Hrs
Seminar:		Hrs
Laboratory:		Hrs
Field experience:		Hrs
Student directed learning:		Hrs
Other (specify):		Hrs

TRAINING DAY-BASED INSTRUCTION:

Length of course:

Hours per day:

OTHER:

Maximum enrolment: **24**

Expected frequency of course offerings: Once every 2 years

(every semester, annually, every other year, etc.)

WILL TRANSFER CREDIT BE REQUESTED? (lower-level courses only)	☐ Yes	☐ No
WILL TRANSFER CREDIT BE REQUESTED? (upper-level requested by department)	☐ Yes	☒ No
TRANSFER CREDIT EXISTS IN BCCAT TRANSFER GUIDE:	☐ Yes	☒ No

Course designer(s):	**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:

1. demonstrate their understanding of the content of Maxwell's equations in both vacuum and matter and in both differential and integral form
2. determine the electromagnetic energy-momentum density and flow, given electric and magnetic fields.
3. perform practical calculations related to propagation, transmission, and reflection of electromagnetic waves
4. write Maxwell's equations using the potential formulation and apply appropriate gauge conditions
5. compute the retarded potentials and corresponding electric and magnetic fields for a variety of charge and current distributions
6. calculate the power emitted in a variety of situations including dipole radiation, breaking radiation, and synchrotron radiation
7. re-write Maxwell's equations using special relativity and apply Lorentz transformations to electric and magnetic fields

METHODS: *(Guest lecturers, presentations, online instruction, field trips, etc.)*

Lecture, demonstration, computer simulations etc.

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. Examples for this course might be:]*

TEXT: Introduction to Electrodynamics, Griffiths, Prentice Hall

REFERENCES: 1. Foundations of Electromagnetic Theory, J. Reitz and F. Milford. Addison-Wesley.
2. Electromagnetic Fields & Waves, Lorrain, Corson & Lorrain

SUPPLIES / MATERIALS:

n/a

STUDENT EVALUATION: *[An example of student evaluation for this course might be:]*

Assignments	25%
Midterm Exam	30%
Final Exam	45%

COURSE CONTENT: *[Course content varies by instructor. An example of course content might be:]*

1. Review of vector analysis: vectors, vector derivatives and integrals, curvilinear coordinates
2. Review of electromagnetism: electrostatics, magnetostatics, electrodynamics, and Maxwell's equations with special emphasis on advanced solutions techniques such as separation of variables, method of images, and multipole expansions
3. Special relativity: Lorentz transformations, relativistic "paradoxes", four-vectors (velocity, acceleration, energy-momentum, current density), electric and magnetic field transformation laws.
4. Conservation laws: Poynting theorem, conservation of momentum and angular momentum.
5. Electromagnetic waves: wave equation, reflection, transmission, polarization, wave guides
6. Potentials and fields: scalar and vector potentials, gauge transformations, retarded potentials, Lienard-Wiechert potentials, electric and magnetic fields of a moving charge.
7. Radiation: electric and magnetic dipole radiation, radiation from a point charge.