ORIGINAL COURSE IMPLEMENTATION DATE:	January 2013
REVISED COURSE IMPLEMENTATION DATE:	January 2021
COURSE TO BE REVIEWED (six years after UEC approval):	October 2026

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 225

Number of Credits: 3 Course credit policy (105)

Course Full Title: Waves and Introductory Optics

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 wave properties as they apply to such topics as cables, sound, light, and quantum theory. Simple optical systems will also be studied; a small number of experiments will be performed to quantify many of the concepts studied.

Prerequisites (or NONE):	PHYS 221.
Corequisites (if applicable, or NONE):	PHYS 381 recommended.
Pre/corequisites (if applicable, or NONE):	

Antirequisite Courses *(Cannot be taken for additional credit.)*

Former course code/number:

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	15
Experiential (field experience, practicum, internship, etc.)	
Supervised online activities	
Other contact hours:	
Total hours	**75**

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: Annually

Annually *(Every semester, Fall only, annually, etc.)*

Department / Program Head or Director: Norm Taylor	**Date approved:**	November 1, 2019
Faculty Council approval	**Date approved:**	January 10, 2020
Dean/Associate VP: John English	**Date approved:**	January 10, 2020
Campus-Wide Consultation (CWC)	**Date of posting:**	February 21, 2020
Undergraduate Education Committee (UEC) approval	**Date of meeting:**	October 2, 2020

Learning Outcomes:

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

- Apply the relationship between frequency, velocity, and wavelength of waves to various situations.
- Solve the wave equation for various boundary conditions in one dimension.
- Distinguish the difference between standing and traveling waves.
- Verify both plane wave and spherical wave solutions to the wave equation, and apply them to diffraction.
- Describe the difference between transverse and longitudinal waves, and identify examples of both.
- Utilize the concepts of interference and superposition of waves to perform specific calculations.
- Perform calculations involving the relationship between power and intensity of sound waves.
- Explain Huygens principle, and be able to apply it to simple situations.
- Perform basic calculations for simple optical systems involving the reflection, refraction, and diffraction of light.
- Show how a wave equation can be derived from Maxwell's equations in free space.
- Apply de Broglie and Planck's hypotheses to simple quantum systems.

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.)*

This course is primarily lecture-based, but laboratory experiments will be performed on roughly a bi-weekly basis in order to both help students better understand the lecture material, and gain a deeper insight into the physical processes involved.

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.	Smith, Walter Fox	Waves and Oscillations: A Prelude to Quantum Mechanics	☐	Oxford University Press	2010
2.	French, A.P.,	Vibrations and Waves	☐	W. W. Norton & Company	1971
3.	Fleisch & Kinnaman	A Student's Guide to Waves	☐	Cambridge University Press	2015
4.			☐		
5.			☐		

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

Typical Evaluation Methods and Weighting

Final exam:	35%	Assignments:	20%	Field experience:	%	Portfolio:	%
Midterm exam:	20%	Project:	%	Practicum:	%	Other:	%
Quizzes/tests:	10%	Lab work:	15%	Shop work:	%	Total:	100%

Details (if necessary):

Typical Course Content and Topics

1. Review and extension of harmonic motion
- Basic equation of SHM with real and complex solutions, mass on a spring, simple pendulum, physical pendulum, torsion oscillators, buoyant oscillations (cork bobbing in water), coupled oscillators

2. Continuous media
- Stress and strain, elastic deformations and Young's modulus, derivation of the wave equation for a 1-dimensional string, relationship between frequency, velocity and wavelength, energy carried by a wave

3. Solutions to the 1D wave equation
- Boundary conditions for standing waves and the quantization of frequency, boundary conditions for traveling waves between different media, reflection and transmission coefficients, superposition and interference, beats, wave packets and Fourier series, group and phase velocities

4. Sound
- Sound as a 3D longitudinal pressure wave, bulk modulus and the velocity of sound, simple musical instruments, beats, Doppler shift, power and intensity of sound waves, sonar, noise cancellation

5. More properties of waves
- Huygens principle, reflection and refraction, diffraction from: single slit, double slit and multiple slits

6. Wave optics

- 3D wave equation from Maxwell's equations, polarization, law of reflection, index of refraction, Snell's law, total internal reflection, dispersion, presentation of lens and mirror equations, real and virtual images, magnification, examples of simple optical systems, Doppler shift of light

7. Matter waves

- Planck and deBroglie's hypotheses, energy and momentum quantization, quantum theory and the simplified hydrogen atom, Balmer series, derivation of the Schrödinger equation and the introduction of the wavefunction

Laboratory experiments:

1. Periodic motion
2. Resonance in an air column
3. Standing waves on a wire
4. Interference of sound and light
5. Geometric optics and the thin lens equation
6. Diffraction of light
7. Spectral analysis