



ORIGINAL COURSE IMPLEMENTATION DATE:

September 2026

REVISED COURSE IMPLEMENTATION DATE:

COURSE TO BE REVIEWED (six years after UEC approval):

November 2031

Course outline form version: 29/08/2024

OFFICIAL UNDERGRADUATE COURSE OUTLINE FORM

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

Course Code and Number: PHYS 281		Number of Credits: 3 Course credit policy (105)													
Course Full Title: Theoretical Methods in Physics Course Short Title: Theoretical Methods in Physics															
Faculty: Faculty of Applied and Technical Studies		Department/School: Physics													
Calendar Description: Students will be introduced to a variety of topics relevant to the study of the more theoretical aspects of Physics. These topics include dimensional analysis, complex numbers, index notation, differentials and differential equations, coordinate systems and transformations, eigenvalues and eigenvectors, the calculus of variations, and line, surface, and volume integrals, as well as some basic statistics.															
Prerequisites (or NONE):		(PHYS 112 or PHYS 118) and (MATH 112 or MATH 118).													
Corequisites (if applicable, or NONE):															
Pre/corequisites (if applicable, or NONE):															
Antirequisite Courses (<i>Cannot be taken for additional credit.</i>) Former course code/number: Cross-listed with: Equivalent course(s): <i>(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.)</i>		Course Details Special Topics course: No <i>(If yes, the course will be offered under different letter designations representing different topics.)</i> Directed Study course: No <i>(See policy 207 for more information.)</i> Grading System: Letter grades Delivery Mode: Face-to-face only Expected frequency: Fall only Maximum enrolment (for information only): 24													
Typical Structure of Instructional Hours <table border="1" style="width: 100%;"> <tr> <td>Lecture/seminar</td> <td style="text-align: center;">75</td> </tr> <tr> <td> </td> <td> </td> </tr> <tr> <td style="text-align: right;">Total hours</td> <td style="text-align: center;">75</td> </tr> </table>		Lecture/seminar	75									Total hours	75	Prior Learning Assessment and Recognition (PLAR) PLAR is available for this course.	
Lecture/seminar	75														
Total hours	75														
Scheduled Laboratory Hours Labs to be scheduled independent of lecture hours: No		Transfer Credit (See bctransferguide.ca) Transfer credit already exists: No Submit outline for (re)articulation: Yes <i>(If yes, fill in transfer credit form.)</i>													
Department approval		Date of meeting:	March 19, 2025												
Faculty Council approval		Date of meeting:	May 30, 2025												
Undergraduate Education Committee (UEC) approval		Date of meeting:	November 21, 2025												

Learning Outcomes *(These should contribute to students' ability to meet program outcomes and thus Institutional Learning Outcomes.)*

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

1. Utilize techniques of dimensional analysis to check their solutions for errors.
2. Prove various trigonometric identities using Euler's formula for complex numbers.
3. Determine the eigenvalues and eigenvectors for a variety of different physical systems.
4. Use index notation to simplify calculations involving vectors, including the derivation of certain vector identities.
5. Apply the calculus of variations to solve the brachistochrone and other related problems.
6. Calculate expectations of different quantities using statistical distributions.
7. Perform a variety of calculations (including surface and volume integrals) using different coordinate systems.
8. Distinguish the difference between exact and inexact differentials in terms of their relationship to partial derivatives.

Recommended Evaluation Methods and Weighting *(Evaluation should align to learning outcomes.)*

Assignments:	20%	Final exam:	40%		%
Quizzes/tests/midterm:	40%		%		%

Details:

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

Typical Instructional Methods *(Guest lecturers, presentations, online instruction, field trips, etc.)*

Typical lecture instruction methods consist of a combination of white/chalk board calculations along with some pre-prepared lecture slides. Teaching methods are gender agnostic, making the content accessible to everyone, and students are encouraged to share their perspectives respectfully. Storytelling will be integrated as a pedagogical tool to introduce new topics, allowing students to make connections between cultural knowledge and scientific principles. Group work will also be encouraged in preparation for quizzes and exams, fostering a community-based approach to learning that mirrors Indigenous values of collective knowledge-sharing and collaboration.

Texts and Resource Materials *(Include online resources and Indigenous knowledge sources. [Open Educational Resources \(OER\)](#) should be included whenever possible. If more space is required, use the [Supplemental Texts and Resource Materials form](#).)*

Type	Author or description	Title and publication/access details	Year
1. Textbook	Riley, Hobson, and Bence	Mathematical Methods for Physics and Engineering	2006
2. Textbook	Arfken, Weber, and Harris	Mathematical Methods for Physicists	2012
3. Textbook	M. Boas	Mathematical Methods in the Physical Sciences	2005
4.			
5.			

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

Scientific calculator

Course Content and Topics

Exact course content may vary depending on the instructor, but students should expect to encounter the following topics:

1. Dimensional analysis - error checking, equation prediction
2. Complex numbers – Euler's formula, polar and Cartesian representations, trigonometric identities
3. Exact and inexact differentials – partial derivatives, Legendre transformations, applications to thermodynamics
4. Linear algebra – matrices, determinants, eigenvalues and eigenvectors
5. Index notation – Einstein summation convention, vector identities, coordinate transformations
6. Coordinate systems – Cartesian, spherical and cylindrical polar, scale factors, Jacobians
7. Line, surface, and volume integrals – applications to moments of inertia and continuous charge distributions
8. Calculus of variations – Fermat's principle, brachistochrone and tautochrone, simple geodesics, the Lagrangian
9. Basic statistics – discrete and continuous probability distributions, mean, variance, expectations
10. Solving simple ODE's – 1st and 2nd order, integration factors, applications to different branches of physics (time permitting)