

UNIVERSITY OF VERMONT
DEPARTMENT OF PHYSICS

PHYSICS 3990: MATHEMATICAL METHODS FOR PHYSICS

Fall 2026

Instructor:	Dr. Dennis Clougherty	Time:	MWF 1:10–2:00 PM
Email:	dennis.clougherty+PHYS3990@uvm.edu	Place:	Lafayette L406

Course Description: Introduction to basic mathematical methods of theoretical physics; vector and tensor analysis, differential equations, special functions, and complex-valued functions.

Prerequisites: PHYS 2500, MATH 3230.

Objectives: Mastery of basic mathematical techniques in theoretical physics.

Course Personnel:

Ian Christiansen, graduate teaching assistant (ichristi@uvm.edu).

Office Hours: W 2:30 PM & by appointment.

References:

1. M.L. Boas, *Mathematical Methods in the Physical Sciences*, 3rd edition, (Wiley, 2005). (This is the required text for the course.)
2. K.F. Riley, M.P. Hobson, and S.J. Bence, *Mathematical Methods for Physics and Engineering*, 3rd edition, (Cambridge University Press, 2006). (This is another high-quality text that is recommended.)
3. H. W. Wyld, *Mathematical Methods for Physics* (Addison Wesley, 1976)
(A wonderful book that is now difficult to find unfortunately.)
4. G. Arfken, H. Weber, and F. Harris, *Mathematical Methods for Physicists*, 7th edition, (Academic Press, 2012). (This standard graduate text has a comprehensive treatment of mathematical methods.)
5. C. M. Bender and S. A. Orszag, *Advanced Mathematical Methods for Scientists and Engineers*, (McGraw Hill, 1978). (This gem has an in-depth presentation of asymptotic methods for analyzing ODEs.)
6. Michael Stone and Paul Goldbart, *Mathematics for Physics*, (Cambridge University Press, 2010). (The second part goes beyond this course and emphasizes applications of differential geometry and topology to physics.)

Course Outline:

1. Vector analysis
2. Ordinary differential equations
3. Calculus of variations
4. Tensor analysis
5. Special functions
6. Series solutions of differential equations
7. Partial differential equations
8. Complex Analysis
9. Integral transforms

Online Resources:

1. Course web site: <https://brightspace.uvm.edu>
2. UVM Physics web site: <http://www.uvm.edu/physics/>
3. UVM student accessibility services (SAS): <http://www.uvm.edu/access>
4. Prof. Clougherty's web site: <http://go.uvm.edu/dpc/>

Grading Policy:

Homework (25%), Exams (25% each).

Important Dates:

Exam #1	September 30, 2026
Exam #2	October 28, 2026
Exam #3	December 2, 2026

Please mark these dates in your calendar now. Exams will take precedence over medical appointments, travel plans, athletic events, and other personal activities. If you miss an exam, you will receive a score of zero unless excused by Professor Clougherty prior to the exam. As a general rule, only a verifiable illness is reason to miss an exam.

Accommodations: In keeping with University policy, any student with a documented disability interested in utilizing accommodations should contact SAS, the office of Disability Services on campus. SAS works with students and faculty in an interactive process to explore reasonable and appropriate accommodations, which are communicated to faculty in an accommodation letter. All students are strongly encouraged to meet with their faculty to discuss the accommodations they plan to use in each course. See <http://www.uvm.edu/access> for more information.

Academic Integrity: It is expected that all students will adhere to the University code of academic integrity. Students are prohibited from publicly sharing or selling academic materials that they did not author (for example: class syllabus, outlines or class presentations authored by the professor, practice questions, text from the textbook or other copyrighted class materials, etc.); and students are prohibited from sharing assessments (for example, homework or a take-home examination). Violations will be handled under UVM's Intellectual Property policy and Code of Academic Integrity.

(<https://www.uvm.edu/sites/default/files/UVM-Policies/policies/acadintegrity.pdf>)