Physics 270 Mathematical Methods for Physics Spring 2024

Instructor: Daniel Robb
Office: Massengill 243
Email: robb@roanoke.edu

Class Mtgs: MWF 2:20-3:20 (TREX 272)
Office Hours: T/Th 9:30-11:00
(15 min appts via calendly.com/daniel_robb)
Phone: 540-375-5250

Course Description:
This course introduces mathematical topics needed by second year physics and/or engineering science students to be prepared for upper-level courses in their majors. Areas covered include vector analysis, coordinate systems, matrix methods, ordinary differential equations, partial differential equations, vector calculus, multivariable calculus, Taylor series, and Fourier and Laplace transforms.

Textbook:
• D. W. Jordan & P. Smith*, Mathematical Techniques: An Introduction for the Engineering, Physical, and Mathematical Sciences*, 4th ed., Oxford, 2008 ISBN: 978-0-19-928201-2

Purpose of the Course:
The purpose of the course is to prepare students for the mathematics used in upper-level physics and engineering science major classes, by reviewing key areas from previous calculus classes and by introducing key new topics that are used across the upper-level curriculum.

Specific Goals of the Course:
1) To master mathematical topics and techniques of broad significance in physics and engineering.
2) To apply these mathematical techniques to model and interpret physical phenomena and engineering problems.
3) To construct organized solutions that demonstrate logically connected steps.

Feedback and Evaluation:
I will assign numerical grades to all your work. I *may* curve your final grades (upward), but otherwise you can expect to receive an A for a 93-100 numerical semester average; A- for 90-92; B+ for 87-89; B for 83-86; B- for 80-82; C+ for 77-79; C for 73-76; C- for 70-72; D+ for 67-69; D for 60-66; F for 0-59. These are the categories and percentages that will be used:

Participation:	10%	MCSP Reflections:	5%
Homework:	25%	Three Midterm Exams:	15% each
Final Exam:	15%		

Participation: This component will consist of attendance (see below) as well as my estimation of your semester-long engagement with in-class activities.

MCSP Reflections: The MCSP department offers a series of talks each semester that appeal to a broad range of interests related to math, computer science and physics. Members of this class are invited to attend all of these talks; however, attendance for **at least two** of these talks is mandatory.

Within **one week** of attending a talk you must submit (via a link on Inquire) a full-page single-spaced paper reflecting on the discussion. (Note that for recorded talks, you may submit your reflection beyond the one-week deadline.) Your reflection should include not only a short summary of the content, but also a personal contemplation of the experience, including areas of the talk that you found particularly interesting, confusing, and/or relevant to our PHYS 270 course material.

Homework: Reading the textbook and listening to lectures are excellent first steps towards mastering new mathematical topics, but working on challenging problems involving these topics is the next step and (in this instructor's opinion) the most important step in achieving mastery. Except in weeks with a mid-term exam, homework problem sets will be assigned on Wednesdays at the end of class and will be due the following Monday at the start of class. They will be returned at the start of the next class on Wednesday.

Three Midterm Exams: Studying and synthesizing material before an exam is a further step toward mastery of new mathematical topics. Our midterm exams will be take-home exams to be completed individually. On midterm exams use of the textbook, your own notes and previous graded work, and posted Inquire materials is allowed; use of the rest of the Internet, and of Mathematica or similar programs, is not allowed. Like the homework problem sets, midterm exams will be assigned on Wednesdays, due the next Monday at the start of class, and returned at the start of the next class on Wednesday. A list of topics covered on each exam will be posted on Inquire by the Monday of exam week. No late exams will be accepted – in exceptional circumstances (an excused illness), I will accept an exam by the start of the following class.

Final exam: The final exam will be comprehensive, with half of the final covering the material from the first three course units, and half of the final covering the final unit of course material. You may bring and use your textbook and notes during the final exam. If you have electronic notes, the device must have Internet access turned off during the final exam (no use of Inquire during the final exam).

Policy on Late Work:

It benefits you to be timely and punctual with your work. As noted above, no late take-home exams will be accepted aside from exceptional circumstances. Problem set assignments will be due at the start of class on the due date. I will grade a problem set with a 10% lateness deduction if turned in by 5:00PM on the due date. Following that, problem sets will receive a further 20% lateness deduction for each successive school day late (with days considered to end at 5:00 PM). Problem sets more than three days late will receive no credit.

Attendance Policy:

You must notify me in advance if you must miss class for a valid reason (an excused absence). For each unexcused absence past the third, two points will be deducted from your final semester average.

Expected Hours of Work

In this course, you are expected to spend at least 12 hours per week inside and outside of class.

Academic Integrity:

To ensure fairness in grading across the class, the College academic integrity policies will be enforced. You must work individually on take-home exams. On problem sets you should work individually, though you may discuss the problems with me or with a Subject tutor (see below). You may discuss course material with classmates on a conceptual level in working on a problem set, but you may not discuss the specific strategy or approach to individual problems. If you are in doubt about whether a specific collaboration is allowed, please ask me.

Regarding the use of generative AI tools such as ChatGPT, you may use generative AI tools as a last resort to generate ideas on a problem on a problem set, but be aware that at this point these tools' solutions are not always fully correct. You must write up problem set solutions on your own in any case. You may not use generative AI tools on take-home exams.

Accessible Education Services:

Accessible Education Services (AES) is in the Goode-Pasfield Center for Learning and Teaching in **Fintel Library**. AES provides reasonable accommodation to students with documented disabilities. To register for services, students must self-identify to AES, complete the registration process, and provide current documentation of a disability along with recommendations from the qualified specialist. Please contact Dustin Persinger, Assistant Director of Academic Services for Accessible Education, at 540-375-2247 or by e-mail at aes@roanoke.edu to schedule an appointment. If you have registered with AES in the past and would like to receive academic accommodations for this semester, please contact Dustin Persinger at your earliest convenience to schedule an appointment and/or obtain your accommodation letter for the current semester.

Subject Tutoring:

Subject tutoring is located on the lower level of Fintel Library and is open 4-9 PM Sunday-Thursday. Subject Tutors are highly trained, current students who offer free, one-on-one (and small group) tutorials in over 80 courses taught at Roanoke College, including: Business, Economics, Mathematics, INQ 240, Modern Languages, Lab Sciences, and Social Sciences. Check out all available subjects and schedule 30- or 60-minute appointments at www.roanoke.edu/tutoring. If you have a question, feel free to stop by, or contact us at subject_tutoring@roanoke.edu or 540-375-2590.

Wk	Date	Rdg	Topic	Due
1	15-Jan		**MLK Day: No class**	
1	17-Jan	Ch 9: 1-4, 6-8	Introductions, Review of Vectors	
1	19-Jan		Review of Vectors	
2	22-Jan	Ch 10: 1-3, 9	Scalar Product	Homework 1
2	24-Jan	Ch 11: 1-2, 5	Vector Product	
2	26-Jan		Vector Product	
3	29-Jan	Ch 1: 2-4, 9-13	Functions/Coordinate Systems	Homework 2
3	31-Jan		Functions/Coordinate Systems	
3	2-Feb	Ch 2: 1-9	Differentiation	
4	5-Feb	Ch 3: 1-9	Differentiation Rules	Homework 3
4	7-Feb		Differentiation Rules	
4	9-Feb	Ch 18: 1-3	Differential Equations	
5	12-Feb		Differential Equations	Midterm 1 (take-home)
5	14-Feb	Ch 6: 1-5	Complex Numbers (worksheet)	
5	16-Feb		No class	
6	19-Feb	Ch 18: 4-5	Boundary Conditions	
6	21-Feb	Ch 14: 1-3	Integration	Homework 4
6	23-Feb	Ch 22: 3	Separation of Variables	
7	26-Feb		Separation of Variables	Homework 5
7	28-Feb	Ch 28: 1-3 Ch 17: 1-7	Partial Differential Equations	
7	1-Mar		Partial Differential Equations	
8	4-Mar		**Spring Break: No class**	
8	6-Mar		**Spring Break: No class**	
8	8-Mar		**Spring Break: No class**	
9	11-Mar	Ch 7: 1-4	Matrix Algebra	
9	13-Mar	Ch 8: 1-3	Determinants	Homework 6
9	15-Mar	Ch 12: 1-5 Ch 13: 1-4	Row Operations Eigenvalues/Eigenvectors	
10	18-Mar		Eigenvalues/Eigenvectors	Homework 7
10	20-Mar		Eigenvalues/Eigenvectors	
10	22-Mar	Ch 29: 6 Ch 31: 4	Gradient Vector	
11	25-Mar	Ch 34: 1-2, 5	Divergence, Curl, Laplacian	Homework 8
11	27-Mar		Divergence, Curl, Laplacian	
11	29-Mar		**Good Friday: No Class**	
12	1-Apr	Ch 33: 1-2, 4-5, 7-9	Line Integrals	Midterm 2 (take-home)
12	3-Apr	Ch 32: 1-2, 5-7 Ch 34: 3-4, 6	Double Integrals Surface and Volume Integrals	
12	5-Apr		Double/Surface/Volume Integrals	
13	8-Apr	Ch 33: 6, Ch 34: 8	Green's and Stokes' Theorems	Homework 9
13	10-Apr	Ch 5: 1-8	Taylor Series	
13	12-Apr	Ch 26: 1-9	Fourier Series	
14	15-Apr		Fourier Series	Homework 10
14	17-Apr	Ch 27: 1-6	Fourier Transform	
14	19-Apr		Fourier Transform	
15	22-Apr	Ch 24: 1-3	Laplace Transform	Midterm 3 (take-home)
15	23-Apr		Final Exam review	
15	25-Apr		Final Exam 2:00-5:00 PM	