

COURSE INFORMATION

PHYSICS 3041, Mathematical Methods for Physicists, 3 credits

Lectures: 3 times a week.

Course Prerequisites: Phys1301; Phys1302; Math1371 or equivalent; Math1372 or equivalent, Math2373 or equivalent.

Instructors: TBD

Office hours: TBD

Grader: TBD

REQUIRED MATERIALS

Textbook: R. Shankar "Basic Training in Mathematics: A Fitness Program for Science Students"

Course Reader for Phys3041 (Sections of Arfken, Weber, Harris "Mathematical Methods for Physicists")

COURSE GOALS

Introduce mathematical topics required for upper division physics students.

GRADING and GRADUATING

Homework (lowest two HW grades dropped): 32.5%; 2 best Quizzes: 32.5%; Final Exam: 35%

Syllabus

(Page numbers refer to the textbook)

Week 1-2:

- Estimates and Taylor series: expansion in small quantities [pages 9-10; page 15; page 22], approximations and dimensional analysis;
- Complex analysis: complex numbers, cartesian and polar coordinate, basic operations [Chapter 5, except 5.4]

Week 3-4

- Numerical methods and introduction to MatLab
- Linear algebra Brief review of linear systems of equations, Matrices and Determinants [Chapter 8]
- Linear vector (Hilbert) space [Chapter 9.1], Inner product [Chapter 9.2] and Linear Operators [Chapter 9.3]
- Eigenvalues and Hermitian operators; example spin 1/2 [Example 16.1.2 Arfken], examples of sum rules; example spin 1 [Problem 9.5.11]

Week 5-6

- Function spaces [for this and the following 3 lectures: Chapter 9.7 plus Chapters 19 and 20.1-20.2-20.3 of Arfken]
- Fourier series as an example of function series; examples on how to obtain Fourier coefficients [Chapter 9.7]; Fourier transforms
- More examples / applications of Fourier transform. Dirac delta function [Chapter 9.7]
- Tensors and basics of group representation: rotations and moment of inertia [Chapter 9.8],

Week 7-9

- Differential equations Ordinary linear differential equations with constant coefficients [Chapter 10.1-10.2]
- Examples: use of complex variables and examples with electric circuits [Chapter 5.4]; Normal modes [Chapter 9.6]
- Linear ODE with variable coefficients [10.3-10.4]; a few mathematical examples
- Examples: Hermite and Legendre polynomials [Problem 10.4.1, 10.4.4]

Week 10-12

- Partial differential equations [Chapter 10.5]; solutions through separation of variables
- Example: angular momentum [16.1 Arfken]; spherical harmonics [Chapter 15.5 Arfken]; Wave equation [Chapter 10.5.1]
- Heat equation [Chapter 10.5.2]; boundary value problems, Greens' function [Chapter 10.6]
- Variational calculus [Chapter 22 Arfken] Euler-Lagrange equations and lagrangian
- Examples: small oscillations, small oscillations and normal modes for more complicated problems

Week 13-14

- Distribution functions Minimization for constrained systems, and Lagrange multipliers [Chapter 3]
- Maxwell-Boltzmann equilibrium distributions [problem 3.1.7]
- Statistics: [This and following lecture: Chapters 23.3- 23.4-23.5 Arfken] Binomial, gaussian distribution

HOMEWORK

Each week's homework assignment will consist of two types of problems, 'weekly' and 'rolling'. The weekly HW will be assigned on Monday and will be due the following Monday. Some of these problems may be also part of the discussion section. The rolling HW will be assigned by the evening of a given lecture day, and will be due in class by the next lecture. The total HW load is the same as if the HW was all weekly.

QUIZZES + FINAL EXAM

There will be three quizzes at dates TBD.

If you have a University sanctioned reason for missing a quiz we can make some accommodations (see the university-wide policy "Makeup Work for Legitimate Absences" below). It is important that you communicate with the instructor as soon as you know about a legitimate absence.

CLASSROOM BEHAVIOR

If you attend class, you have come to learn. Please: no smartphones, no ipads, and no laptops. No open newspapers, no food, no texting.

Lectures end when the discussion of a particular topic comes to an end. Please collect your books when the instructor indicates that the lecture has ended. Doing otherwise disrupts the class.

COMMUNICATIONS and WEBSITE

The primary means for information transfer is the class meeting. Although the class has a web-site: <http://www.physics.umn.edu/classes/2017/spring/Phys%204002.001/> you are responsible for any information relayed in class, but not posted on the web.

You are more than welcome to provide feedback and voice your concerns. The class website has features that enable you to provide anonymous feedback, or post a question. There is also a wiki area in which you can exchange notes with your peers and TAs.

You are welcome to e-mail the instructors about subjects that cannot wait for the next class meeting to be discussed, but note that grades and problems solutions will not be discussed by email. The best way to interact with the professors is face-to-face right before or after class, or during the weekly office hour.

DEPARTMENTAL POLICIES

ATHLETES must provide their official University of Minnesota athletic letter containing the approved competition schedule to their instructor and the staff in office 148. Away exams will be arranged with the athletic adviser traveling with the team. Accommodations will be made for official university sports only (i.e. no accommodations will be made for intramurals, club sports, etc.)

DISABILITY SERVICES: If you have accommodations for this course, please provide the staff in office 148 with a copy of your accommodation letter for the current semester. Exams will be arranged according to accommodations and sent to the testing center for administration.

MANDATORY POLICY INFORMATION [REFERENCES/LINKS VERSION FOLLOWS]

- Student conduct code
http://regents.umn.edu/sites/default/files/policies/Code_of_Conduct.pdf
- Scholastic Dishonesty
See student conduct code

- Disability Accommodations
<http://ds.umn.edu/student-services.html>
- Use of Personal Electronic Devices in the Classroom
<http://www.policy.umn.edu/Policies/Education/Education/STUDENTRESP.html>
- Appropriate Student Use of Class Notes and Course Materials
<http://www.policy.umn.edu/Policies/Education/Education/STUDENTRESP.html>
- Makeup Work for Legitimate Absences
<http://policy.umn.edu/Policies/Education/Education/MAKEUPWORK.html>
- Grading and Transcripts
<http://policy.umn.edu/Policies/Education/Education/GRADINGTRANSCRIPTS.html>
- Sexual Harassment
<http://regents.umn.edu/sites/default/files/policies/SexHarassment.pdf>
- Equity, Diversity, Equal Opportunity, and Affirmative Action
http://regents.umn.edu/sites/default/files/policies/Equity_Diversity_EO_AA.pdf
- Mental Health and Stress Management
<http://www.mentalhealth.umn.edu>

MANDATORY POLICY INFORMATION [FULL TEXT VERSION FOLLOWS]

Student Conduct Code

The University seeks an environment that promotes academic achievement and integrity, that is protective of free inquiry, and that serves the educational mission of the University. Similarly, the University seeks a community that is free from violence, threats, and intimidation; that is respectful of the rights, opportunities, and welfare of students, faculty, staff, and guests of the University; and that does not threaten the physical or mental health or safety of members of the University community.

As a student at the University you are expected adhere to Board of Regents Policy: *Student Conduct Code*. To review the Student Conduct Code, please see: http://regents.umn.edu/sites/default/files/policies/Student_Conduct_Code.pdf.

Note that the conduct code specifically addresses disruptive classroom conduct, which means "engaging in behavior that substantially or repeatedly interrupts either the instructor's ability to teach or student learning. The classroom extends to any

setting where a student is engaged in work toward academic credit or satisfaction of program-based requirements or related activities."

Scholastic Dishonesty

You are expected to do your own academic work and cite sources as necessary. Failing to do so is scholastic dishonesty. Scholastic dishonesty means plagiarizing; cheating on assignments or examinations; engaging in unauthorized collaboration on academic work; taking, acquiring, or using test materials without faculty permission; submitting false or incomplete records of academic achievement; acting alone or in cooperation with another to falsify records or to obtain dishonestly grades, honors, awards, or professional endorsement; altering, forging, or misusing a University academic record; or fabricating or falsifying data, research procedures, or data analysis. (Student Conduct Code: http://regents.umn.edu/sites/default/files/policies/Student_Conduct_Code.pdf) If it is determined that a student has cheated, he or she may be given an "F" or an "N" for the course, and may face additional sanctions from the University. For additional information, please see: <http://policy.umn.edu/Policies/Education/Education/INSTRUCTORRESP.html>.

The Office for Student Conduct and Academic Integrity has compiled a useful list of Frequently Asked Questions pertaining to scholastic dishonesty: <http://www1.umn.edu/oscai/integrity/student/index.html>. If you have additional questions, please clarify with your instructor for the course. Your instructor can respond to your specific questions regarding what would constitute scholastic dishonesty in the context of a particular class-e.g., whether collaboration on assignments is permitted, requirements and methods for citing sources, if electronic aids are permitted or prohibited during an exam.

Disability Accommodations

The University of Minnesota is committed to providing equitable access to learning opportunities for all students. Disability Services (DS) is the campus office that collaborates with students who have disabilities to provide and/or arrange reasonable accommodations.

If you have, or think you may have, a disability (e.g., mental health, attentional, learning, chronic health, sensory, or physical), please contact DS at 612-626-1333 to arrange a confidential discussion regarding equitable access and reasonable accommodations.

If you are registered with DS and have a current letter requesting reasonable accommodations, please contact your instructor as early in the semester as possible to discuss how the accommodations will be applied in the course.

For more information, please see the DS website, <https://diversity.umn.edu/disability/>.

Use of Personal Electronic Devices in the Classroom

Using personal electronic devices in the classroom setting can hinder instruction and learning, not only for the student using the device but also for other students in the class. To this end, the University establishes the right of each faculty member to determine if and how personal electronic devices are allowed to be used in the classroom. For complete information, please reference: <http://policy.umn.edu/Policies/Education/Education/STUDENTRESP.html>.

Makeup Work for Legitimate Absences

Students will not be penalized for absence during the semester due to unavoidable or legitimate circumstances. Such circumstances include verified illness, participation in intercollegiate athletic events, subpoenas, jury duty, military service, bereavement, and religious observances. Such circumstances do not include voting in local, state, or national elections. For complete information, please see: <http://policy.umn.edu/Policies/Education/Education/MAKEUPWORK.html>.

Appropriate Student Use of Class Notes and Course Materials

Taking notes is a means of recording information but more importantly of personally absorbing and integrating the educational experience. However, broadly disseminating class notes beyond the classroom community or accepting compensation for taking and distributing classroom notes undermines instructor interests in their intellectual work product while not substantially furthering instructor and student interests in effective learning. Such actions violate shared norms and standards of the academic community. For additional information, please see: <http://policy.umn.edu/Policies/Education/Education/STUDENTRESP.html>.

Grading and Transcripts

The University utilizes plus and minus grading on a 4.000 cumulative grade point scale in accordance with the following:

A

4.000 - Represents achievement that is outstanding relative to the level necessary to meet course requirements

A-

3.667

B+

3.333

B

3.000 - Represents achievement that is significantly above the level necessary to meet course requirements

B-

2.667

C+

2.333

C

2.000 - Represents achievement that meets the course requirements in every respect

C-

1.667

D+

1.333

D

1.000 - Represents achievement that is worthy of credit even though it fails to meet fully the course requirements

S

Represents achievement that is satisfactory, which is equivalent to a C- or better.

For additional information, please refer to: <http://policy.umn.edu/Policies/Education/Education/GRADINGTRANSCRIPTS.html>.

Sexual Harassment

"Sexual harassment" means unwelcome sexual advances, requests for sexual favors, and/or other verbal or physical conduct of a sexual nature. Such conduct has the purpose or effect of unreasonably interfering with an individual's work or academic performance or creating an intimidating, hostile, or offensive working or academic environment in any University activity or program. Such behavior is not acceptable in the University setting. For additional information, please consult Board of Regents Policy: <http://regents.umn.edu/sites/default/files/policies/SexHarassment.pdf>

Equity, Diversity, Equal Opportunity, and Affirmative Action

The University provides equal access to and opportunity in its programs and facilities, without regard to race, color, creed, religion, national origin, gender, age, marital status, disability, public assistance status, veteran status, sexual orientation, gender identity, or gender expression. For more information, please consult Board of Regents Policy: http://regents.umn.edu/sites/default/files/policies/Equity_Diversity_EO_AA.pdf.

Mental Health and Stress Management

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance and may reduce your ability to participate in daily activities. University of Minnesota services are available to assist you. You can learn more about the broad range of confidential mental health services available on campus via the Student Mental Health Website: <http://www.mentalhealth.umn.edu>