Physics 201: Physics Toolbox

Instructor: Prof. Katherine Dooley
Class time: Thu. 2pm-3:50pm
Class location: Lewis Hall, Rm. 203

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Text

Davidson, Ronald C. Mathematical Methods for Introductory Physics with Calculus. Cengage Learning, ISBN-10: 0030091284, ISBN-13: 978-0030091285.

Description

This course is an introduction to problem solving in physics. The physical meaning of the mathematical concepts students encounter in introductory calculus-based physics courses is discussed, and the corresponding analytical methods applied to problems on the kinematics and dynamics of particles in three dimensions, work and energy and other physics topics.

This course is designed to be taken concurrently with Phys 211 (Intro. Physics) and Math 261 (Calculus I). Students should also be comfortable with algebra up to quadratic equations, and with the basics of trigonometry.

Pre-requisites / Co-requisites

None.

Course Objectives

On completion of this course, students should be able to do the following:

- Plot and interpret graphs of physical quantities.
- Use dimensional analysis for quick and dirty evaluation of simple physical problems.
- Use derivatives and integrals to describe and derive physical quantities and laws such as displacement, velocity, acceleration, Newton's laws of motion, work and energy.
- Perform vector operations to solve physical problems.

Grading Scale

- $90\% \leq \mathbf{A} \leq 100\%$
- $80\% \leq \mathbf{B} < 90\%$
- $70\% \leq \mathbf{C} < 80\%$
- $50\% \leq \mathbf{D} < 70$
- $\mathbf{F} < 50\%$

Evaluation

Quizzes (40%)

- 5 written quizzes, equally weighted.

Classroom exercises and homework (40%)

- In-class exercises and blackboard presentations of problem solutions individually and in groups.
- Homework exercises.

Final exam (20%)

- Written final exam.

Homework

Homework will be key to doing well in the course and will be assigned at the end of each class. The homework assignments will include reading the text book and solving quantitative problems. Homework turned in after the time it is due may not be accepted, but students may be excused from turning in an assignment on time if there is a valid reason.

Classroom exercises

A significant portion of each class will be dedicated to solving problems individually and in groups in class. You may be asked to turn in your in-class work at the end of class.

Quizzes

Each class will begin with a 15-minute quiz on the prior week's material and will contain questions consistent in style with the homework and in-class exercises. All quizzes will be closed book.

Reading Questions

For class time to be effective, you need to read before coming to class. The first couple questions of each week's quiz will be related to the reading assignment and should be easy to ace if you've completed the reading. Answering the reading questions correctly will earn you bonus points which will be applied to your final exam score (F.E.S.):

$$Recorded\ F.E.S. \equiv (Raw\ F.E.S.) + (Bonus\ points) \times \left(1 - \frac{Raw\ F.E.S.}{100}\right).$$

For example, if you earn 20 bonus points and obtain a raw score of 60 (out of 100) on the final exam, then the final exam score recorded in the gradebook is $60 + 20\times(1 - 60/100) = 60 + 8 = 68$. Note that it is impossible for your recorded final exam grade to be lower than your raw final exam score. Doing well on the reading questions will put less pressure on you at the end of the term to do well on the final.

Goals and Advice

The central goal of this class is for you to become comfortable with the mathematical tools that are needed for introductory calculus-based physics.

The main challenge you may face in Intro. Physics is developing your problem-solving skills. Physics problems often involve several steps and usually they require more than just a simple application of formulas in the book. ***It may take some time for you to develop your skills.*** This course will provide practical training in the mathematics and problem-solving approaches that are needed to succeed in Intro. Physics.

Participation in class and completion of the homework (reading and problem solving) will be key to doing well in the course. You can expect to spend many hours per week on homework. You are encouraged to work with your classmates on homework sets. For your own benefit, you should always attempt the problems by yourself first, and the final work you submit must be your own.

I want you to do well and I am available to help you. Come to my office hours, schedule an appointment with me and/or use the Physics Tutoring Room in Lewis Hall 104.

Course Design

This class meets once a week for 2 hours at a time. There are 6 class meetings.

Policies

Attendance

Class attendance is required. Two or more unexcused absences will result in a one letter grade reduction of the final grade. No make-ups of graded classroom exercises and presentations will be given except for absences due to verified university sanctioned activities. University of Mississippi policy requires that attendance be verified for every student during the first week of class. Students whose attendance is not verified will be automatically dropped from the course.

Academic Integrity

Every student of the University of Mississippi, by virtue of choosing to be part of the university community agrees to abide by the University of Mississippi Creed which covers academic integrity. Cheating on any assignment is forbidden and, in this course, will result in a zero grade on the given assignment. If a second case of cheating occurs, this will result in an F for the entire course. Please consult the M-Book, Academic Integrity document for details on university policy and the academic creed.

UM Creed

The University of Mississippi is a community of learning dedicated to nurturing excellence in intellectual inquiry and personal character in an open and diverse environment. As a voluntary member of this community:

- I believe in respect for the dignity of each person
- I believe in fairness and civility
- I believe in personal and professional integrity
- I believe in academic honesty
- I believe in academic freedom
- I believe in good stewardship of our resources
- I pledge to uphold these values and encourage others to follow my example

University of Mississippi Access and Inclusion

The University of Mississippi is committed to the creation of inclusive learning environments for all students. If there are aspects of the instruction or design of this course that result in barriers to your full inclusion and participation or to accurate assessment of your achievement, please contact the course instructor as soon as possible. Barriers may include, but are not necessarily limited to, timed exams and in-class assignments, difficulty with the acquisition of lecture content, inaccessible web content or the use of non-captioned or non-transcribed video and audio files. Students must also contact Student Disability Services at 662-915-7128 so that office can 1) provide you with an Instructor Notification form, 2) facilitate the removal of barriers and 3) ensure you have equal access to the same opportunities for success that are available to all students.

If you have provided documentation of a disability of any kind to the Student Disability Services and will need academic accommodations such as note-taking assistance or extended time on tests, please provide me with an Instructor Notification Form so appropriate arrangements can be made.

Tentative Course Schedule:

The following schedule is subject to change.

Date	Topic	Textbook Sections
Aug. 24	powers of 10; exponential notation; fundamental physical quantities; dimensional analysis; significant figures;	Ch. 1.1-1.10, Ch. 7.3
Aug. 31	linear and quadratic equations; coordinate systems in 2D and 3D; trigonometric functions; angular motion and radian measure; small angle approximation	Ch. 1.11-1.13, Ch. 2.1-2.10
Sep. 7	polar coordinates; representation of functions; graphing; motion with constant acceleration; Simple harmonic motion	Ch. 2.11-2.12, Ch. 3.1-3.5
Sep. 14	derivative relations for motion in 1D; velocity and acceleration as derivatives of displacement; derivatives of trigonometric functions; exponential functions	Ch. 4.1-4.5
Sep. 21	vector properties; vector addition; vector components; unit vectors; vector products	Ch. 5.1-5.7
Sep. 28	definite and indefinite integrals; deriving Newton's laws of motion from first principles using integration and differentiation; work done by constant and variable forces as an integral	Ch. 6.1-6.4

"Philosophy is written in this vast book which is forever open before our eyes—I mean, the Universe—but it cannot be read until you have learned the tongue and understood the character in which it is written. It is written in the language of mathematics, and its characters are triangles, circles, and other geometric pictures, without which it is not humanly possible to understand a single word; without these one is wandering in a dark labyrinth."

– Galileo Galilei on the Book of Nature, 1623