PHY 231 College Physics
Biomedical Applications


Instructor: Ulrich Zurcher, u.zurcher@csuohio.edu
Science Building, Room 120, Phone: 687-2429

Lecture: TRIO-1 1:15 FT10
Lab: T8-10, T1-3, SI 117 - we'll meet in the first week

Office Hours: TBA and anytime you find the instructor in SI-120

Course Website: http://edugen.wiley.com/edugen/class/cls....
This website will be used as a primary source of interactions: Homework, announcements, lecture notes...

Text: You have 2 options:
1) Buy the package in the CSU bookstore: (printed version of text plus access code for Wiley website)
2) Buy access code online to http://edugen.wiley.com/edugen/class/cis25004 which gives you the online access from which you can print all the material for then buy a used version of 6th ed of text

Course Material: PHY231 explores a wide array of topics, ranging from mechanics, to heat and thermodynamics. The rules governing the physical world are applied to topics from biology, medicine, and chemistry (satisfying the Natural Science criteria). Mathematical expressions are used to express the physical laws, which are then used to make predictions that can be compared to empirical facts. In particular, models are used to describe the complex behavior of living systems. Context-rich examples are used to explore both the breadth and limitations of these models. The "language" of College Physics is algebraic formulas, and geometry [trigonometry] is used throughout the course. Additionally, graphs and tables are used extensively. Excel [part of the Microsoft Office suite] is used to do calculations and graphs, including linear regression analysis. Statistical methods are used throughout the labs; they address particular aspects of statistical methods: random processes can give rise to (predictable) laws described by probability distributions (satisfying the Quantitative Literacy and Critical Thinking skills).

Learning Outcomes [TAG Guidelines]: After completing this course, you should be able to understand and apply the following topics, using algebra concepts and methods where appropriate:
1. Kinematics-one- and two-dimensional
2. Vectors-vector-arithmetic
3. Force and Newton's Laws of Motion
5. Linear momentum
6. Collisions
7. Rotational kinematics and dynamics
8. Angular momentum and rotational energy
9. Simple harmonic motion
10. Waves and sound
11. Solid and fluid properties
12. Heat and thermodynamics
13. Kinetic theory of gases

**Additional Material:** Scientific calculator [with trig functions] such as TI-30, or the *Scientific Calculator from CVS.* Graphing calculator is not required for necessary.

**Labs:** Labs are required and are fully integrated into the course. Most labs are inquiry-based: i.e., you will conduct a series of (simple) experiments and then formulate a general rule. You will then test this rule by conducting additional experiments. All experiments are conducted in groups of 2-3 students, and each team submits one report at the end of each laboratory period.

The lab manuals for PHY231 offer general guidelines but are not written in "cookbook" format - it is exceedingly rare that any one student has all the answers for a particular experiments and students learn to rely on each other. For the most part, students are first exposed to physical concepts in the laboratory. Students are asked to formulate general laws and critically compare them with their own observations (satisfying the *Critical Thinking* skills).

The computers in the Physics Department are available if no class is using the lab space. Username: Physics, Password: 123456. Note that you are not allowed to download any software on the PC. Also, do not print entire chapters out of Cutnell&Johnson.

Outline: *(tentative)*

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
<th>Laboratory</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction</td>
<td>Forces/Torques</td>
</tr>
<tr>
<td>2</td>
<td>Kinematics in 1d</td>
<td>Velocity/Acceleration</td>
</tr>
<tr>
<td>3</td>
<td>Kinematics in 2d</td>
<td>Two-dimensional motion</td>
</tr>
<tr>
<td>4</td>
<td>Forces Newton's Laws</td>
<td>Newton's Laws</td>
</tr>
<tr>
<td>5</td>
<td>Dynamics of Uniform Circl Motion</td>
<td>Uniform Circular Motion</td>
</tr>
<tr>
<td>6</td>
<td>Work and Energy</td>
<td>Conservation of Mechanical Energy</td>
</tr>
<tr>
<td>7</td>
<td>Impulse and Momentum</td>
<td>Conservation of Linear Momentum</td>
</tr>
<tr>
<td>8</td>
<td>Rotational Kinematics</td>
<td>Rotational Kinematics</td>
</tr>
<tr>
<td>9</td>
<td>Rotational Dynamics</td>
<td>Moment of Inertia and Torque</td>
</tr>
<tr>
<td>10</td>
<td>Harmonic Motion</td>
<td>Harmonic Motion</td>
</tr>
<tr>
<td>11</td>
<td>Fluids</td>
<td>Archimedes Principle</td>
</tr>
<tr>
<td>12</td>
<td>Temp and Heat</td>
<td>Melting of Ice</td>
</tr>
<tr>
<td>13</td>
<td>Ideal Gas Law &amp; Kinetic Theory</td>
<td>Gas Thermometer</td>
</tr>
<tr>
<td>14</td>
<td>Thermodynamics</td>
<td>Velocity Distribution</td>
</tr>
<tr>
<td>15</td>
<td>Thermodynamics</td>
<td>Review</td>
</tr>
</tbody>
</table>

Partial list of biological and medical applications:

High and Long jump [Newton's laws, energy conservation]
Running and walking [Circular motion]
Swimming [momentum conservation]
Basal metabolic rate [Energy and Work]
Biomechanics of trees and plants] forces and torques
Physics of air bubbles [surface tension]
Properties of cells [surface tension]
Blood pressure and blood circulation [fluids]
Elasticity of DNA [entropy]
**Examinations:** 3 midterm exams and one final exam. The final exam is comprehensive and covers problems from all "units." If the score of a midterm exam is lower than the score of the final exam, the midterm exam score is replaced by the corresponding score of the final exam. That is, you get a second chance *for all midterm exams!* No make-up exams for the midterm exams will be given. The midterm exams are one hour each. Practice exams will be posted on the website. The exams are closed books and notes, however a "cheat sheet" will be provided. Calculators are allowed for all exams. Tentative dates

Exam 1: TBD
Exam 2: TBD
Exam 3: TBD

**Homework:** Homework is assigned each week. We use the Internet-based Wiley-Plus system from Wiley. Detailed solutions of the homework will be posted on the Wiley-Plus course website. Wiley-Plus is setup such that each student has his/her individual numbers. Each time you log on, the system "remembers" you and returns the same set of numbers. You have three trials.

**Quizzes:** There are two quizzes for each lecture period. One quiz before the lecture that and one quiz at the end of the lecture. All quizzes are multiple-choice questions with [mostly] qualitative questions. The quiz prior to the lecture is done via Wiley-Plus. A correct answer earns 2 points, a wrong answer 1 point.

**Laboratory:** The laboratory part has 15 labs, A lab report must be written for each lab. The laboratory schedule is given in the outline of the course.

**Grades:** The grade for PHY 231 will be based on a maximum of 1000 points according to the following scheme:

- Midterm Exams 300 points (100 points each)
- Final Exam 300 points
- Homework 200 points
- Labs 100 points
- Quizzes [both online and in class] 100 points

[A: 90-100; A-: 85-90; B+: 80-85; B: 75-80; B-: 70-75; C+: 65-70; C: 55-65; D: 40-55; F: < 40]

60% of the letter grade is based on exams. The exams consist *exclusively* of problems in which students solve quantitative problems by using appropriate mathematical formulas (satisfying the Quantitative Literacy skills). 10% of the letter grade is based on the laboratory grade, which is largely based on assessment of data gathering, critical evaluation of data, and synthesizing experimental observations. 15% of the exam grades for 9% of the overall grade] is based on open-ended question where students are tested on their higher-order thinking (satisfying the Critical Thinking skills).

**MCAT:** Wiley-Plus has additional material for each chapter as a preparation for the MCAT. Students taking the MCAT are strongly encouraged to do all the problems.

Lecture notes: Material *not* covered in Cutnell & Johnson will be posted on the course website.
Criteria for General Education Courses

Natural Sciences
A course approved for the Natural Sciences requirement must meet all of the following criteria: Courses must foster general breadth of knowledge and develop foundational skills and abilities. The courses must be at the 100-200 level offered by one or more of the departments in the natural sciences. Courses must expose the student to all facets of the general scientific method used in natural sciences to build scientific principles in an effort to understand the natural world around us in a systematic and coherent fashion. Courses must also contain components emphasizing tools and approaches that are critical in science inquiry including general experimentation design, precision, observation, data-driven reasoning and analysis, logic, and deduction. Laboratory courses must translate the broad concepts of the scientific method addressed in lecture courses into practice; courses in this category should provide opportunities for students to approach scientific problems, critically analyze preliminary data, formulate hypotheses, and test them with appropriate experiments.

Skill: Critical Thinking
To qualify in the skill area of critical thinking a course must:
Designate that at least 15% of the student's grade in the course is based on an evaluation of critical thinking. Require students to attain skills beyond lower-level knowledge, thereby requiring: higher-order thinking (analysis, synthesis, evaluation); OR skills that involve the use of content knowledge (e.g. finding information to solve a problem); OR the recognition of the importance and usefulness of knowledge and skills gained in the course (e.g. recognize the ability to and importance of working with others to solve intellectual problems).

Skill: Quantitative Literacy
To qualify in the skill area of quantitative literacy a course must:
Designate that at least 15% of the student's grade is based on an evaluation of quantitative literacy.
Address at least the first three of the following objectives:
- Interpret mathematical models such as formulae, graphs, tables, and schematics and draw inferences from them.
- Represent and interpret mathematical information that is presented symbolically, visually numerically, or verbally
- Use arithmetic, algebraic, geometric, statistical models and technology or appropriate combinations of these to solve problems. Estimate and check answers to mathematical problems in order to determine their reasonableness, identify alternatives, and select optimal results.
- Recognize the limits of mathematical and statistical models and be able to explain those limitations in context.

Provide explicit instruction in quantitative methods and quantitative reasoning.
Involve quantitative work distributed over the course of the semester.