

# Syllabus for PHY 404G Fall 2018

## Mechanics

Class schedule: M W F 9:00–9:50, CP 183  
Instructor: Christopher B. Crawford  
CP 295A, 257-2504, [crawford@pa.uky.edu](mailto:crawford@pa.uky.edu)  
Office hours: Thurs. 11:00-12:00; recitation Thursday at 3:00-5:00  
Grader: Si-Nong Liu, [sinong.liu@uky.edu](mailto:sinong.liu@uky.edu), Blazer 372  
Homepage: [http://www.pa.uky.edu/~crawford/phy404\\_fa18](http://www.pa.uky.edu/~crawford/phy404_fa18)  
Textbook: Grant W. Mason, “A Short Introduction to Theoretical Mechanics” (required)  
John r. Taylor, “Classical mechanics” (recommended)  
Grant R. Fowles, “Analytical Mechanics,” any edition (supplement)  
Prerequisites: PHY 232 or PHY 213 with permission of DUS; Concurrent: MA 214

**Course Description** *“A lecture and problem course covering the fundamental laws of mechanics. Topics include Newton’s Laws, Kepler’s Laws, oscillatory motion and an introduction to Lagrangian methods.”*

The course will begin with an in-depth treatment of vectors and linear operators, including the metric, and contravariant and covariant components of vectors in a generic curvilinear non-orthogonal coordinate system. Lagrange’s equations will be presented as  $\mathbf{F} = m\mathbf{a}$  in covariant coordinates, and as a least action principle. We will proceed to Hamilton’s equations through a Legendre transformation. We will develop conservation laws of energy, momentum, and angular momentum within context of the Lagrangian, and study noninertial forces associated with an accelerating reference frame.

With these tools in hand, we will analyze single particle motion under different types of forces, with a focus on techniques for solving the associated ordinary differential equations (ODE), and finish the course with three classes of multibody problems:

1. 2-particles with a central force, including the inverse square law, and both orbital and scattering.
2. The rigid body with a moment of inertia tensor and rotational degrees of freedom.
3. A multiparticle vibrational system, including the limit of waves in a continuous medium.

We will study many problems numerically using Matlab, which is available on university machines. The compatible software Octave is freely available and can be run online at <https://octave-online.net> without installing it on your own computer.

**Office Hours** I have an open door policy: come by my office and discuss physics at anytime unless my door is closed (for a phone conference or approaching deadline). Please prepare by reading the assigned chapters before coming to my office, and turn off cell phones and text messaging while in my office. There will be have an optional one hour homework recitation each week in my office.

**Attendance, Quizzes, and Reading Journal** The structure of his course will modified from previous courses I have taught, to encourage class participation. Instead of in-class lectures, there will be a reading assignment and short video lectures to learn before each class, which will allow students to learn at their own pace. At the beginning of class, I will answer questions about the material, and then give a 5-minute quiz worth 2 points. The 6 lowest scores will be dropped, but may still contribute as extra credit. As an alternative to the quiz, student may submit a reading journal entry at the time of the quiz, which will be graded on the scale 0 (partial), 1 (complete), or 2 (exemplary). It is not sufficient to simply turn in notes from the readings; the reading journal but must demonstrate substantial evidence of actively processing the material. The remainder of the class will be devoted to working the homework problems in groups.

**Homework** Weekly homework assignments must be turned in to Canvas before midnight of the day they are assigned. There is a penalty of 25% per class for late homework. Arrangements must be made with the instructor the day before the due date to receive a homework extension. The goal is to complete most of the homework together in groups during class, but each student must turn in their own work. There will be an optional recitation each week to wrap up the homework and for in-depth discussion of difficult concepts learned that week.

Students are encouraged to use the Canvas discussion board instead of email for questions of general interest. Please respond to each other's questions. The instructor will also monitor and participate in the discussion.

**Exams** There will be one midterm exam and a final exam. The exams are closed book, with an  $8\frac{1}{2} \times 11$  in<sup>2</sup> formula sheet. Exams will only be rescheduled for officially excused absences.

**Grading** Extra credit will be awarded for finding new errors in the textbook, or solving special questions posed during class. The following table shows the range for each letter grade. The instructor may upgrade the final letter grade based on effort and class participation.

Grade breakdown		Letter grade	
homework assignments	40%	A	85–100%
quizzes	15%	B	70–84%
midterm exam	20%	C	55–69%
final exam	25%	D	40–54%
		E	00–39%

**Academic integrity** Copying homework or exams from people, solution manuals, online, or any other source is plagiarism and will not be tolerated. University policies and procedures regarding cheating and other academic conduct will be strictly adhered to and can be reviewed at [www.uky.edu/StudentAffairs/Code](http://www.uky.edu/StudentAffairs/Code).

**Course evaluation** Course evaluations are an important component of our Department's instructional program. We value your feedback on both the course content and instructor. The standard university TCE eXploration Blue (<http://www.uky.edu/eval>) will be used to collect evaluations via your computer, tablet, or smart phone. You will receive an reminder email near the end of the semester with instructions. We would also appreciate immediate feedback at [http://www.pa.uky.edu/~crawford/phy520\\_fa17/feedback.html](http://www.pa.uky.edu/~crawford/phy520_fa17/feedback.html) and will address issues or incorporate suggestions into the course in a timely manner.

**Academic accommodations due to disability** If you have a documented disability that requires academic accommodations, please see me as soon as possible during scheduled office hours. In order to receive accommodations in this course, you must provide me with a Letter of Accommodation from the Disability Resource Center, <http://www.uky.edu/StudentAffairs/DisabilityResourceCenter>, for coordination of campus disability services available to students with disabilities.

See <http://uksga.org/resource-cheat-sheet> for additional student resources.

**Intellectual property** Class lectures and course materials are the intellectual property of the instructor. Students may record lectures only for their own personal use. Any other use, including sharing with other students in the class, requires written permission from the instructor. Recording for any business/commercial purpose is a violation of federal IP (copyright) law and class policy, and is strictly prohibited.