Syllabus for PHY 404G Fall 2020

Mechanics

Class schedule:	M W F 9:00–9:50, The 90 room 202 or online at https://uky.zoom.us/my/c.crawford
Instructor:	Christopher B. Crawford
	www.pa.uky.edu/∼crawford, CP 295A, 859-421-9612, c.crawford@uky.edu
Office hours:	Tues/Thurs 4–5 pm or by appointment at https://uky.zoom.us/my/c.crawford
Grader:	Ashish Kakkar, ashish.kakkar@uky.edu
	Tues 11–12 am or by appointment at uky.zoom.us/j/96690754813
Homepage:	http://www.pa.uky.edu/∼crawford/phy404_fa20
Canvas:	https://uk.instructure.com/courses/1987576
Textbook:	Grant W. Mason, "A Short Introduction to Theoretical Mechanics" (required)
	John r. Taylor, "Classical mechanics" (required)
	Grant R. Fowles, "Analytical Mechanics," any edition (supplement)
Prerequisites:	PHY 232 or PHY 213 with permission of DUS; Concurrent: MA 214
Appendix:	http://www.pa.uky.edu/∼crawford/phy404_fa20/syllabus_appendix.docx

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 $\boldsymbol{F} = m\boldsymbol{a}$ 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. Multiparticle vibrational systems, including coupled oscillators and waves.
2. 2-particles exerting a central force, including the inverse square law, both bound and free states.
3. Rotational degrees of freedom of a rigid body involving the moment of inertia tensor.

We will study many problems numerically using Matlab, which is available on university machines, including VirtualDen, and can be downloaded for free at download.uky.edu. The compatible open-source software GNU 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. This semester, office hours will be carried out over Zoom. Refer to my schedule at the bottom of https://uky.zoom.us/my/c.crawford and email me a request to meet at a certain time (even right then, if I'm free). In liu of weekly homework recitations, we will work on together homework during class.

Attendance, Quizes, 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. Each lecture will be accompanyied by a short online quiz, which must be complete before the beginning of class to receive credit. 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. Class will be devoted to working the homework problems in groups. There is no explicit credit for class attendance, either in person or online.

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 monitor and participate in discussions.

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^2 formula sheet. Both exams will be administered online. 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	50%	A	85–100%
quizes	15%	B	70–84%
midterm exam	15%	C	55–69%
final exam	20%	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.

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 eXplorance 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/phy404_fa20/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.