Syllabus - Fall 2020
Physics 303 – Classical Mechanics

Prof: Robert N. Oerter (roerter@gmu.edu) Class time: MWF 10:30-11:20 AM

Textbook: *Classical Mechanics,* John R. Taylor

Week of	Topics	Reading Assignment	Exams and notes
8/24	Newton's Laws, Vectors in 3-D	1.1-1.7	
8/31	Drag forces, Taylor series	2.1-2.3	
9/7	Varying Forces, Complex numbers	2.4-2.7	[No class Monday]
9/14	Conservation of Momentum, Angular momentum	3.1-3.5	
9/21	Conservation of Energy	4.1-4.5	Exam 1, Chs. 1-3 9/25
9/28	Potential Energy, Spherical Polar Coordinates	4.6-4.9	
10/5	Harmonic Oscillator, Small Oscillations	5.1-5.3	
10/12	Damped and Forced Oscillations	5.4-5.6	Monday classes meet on Tuesday
10/19	Lagrange's Equations, Part 1	6.2, 7.1-7.3	Exam 2, Chs. 4-5 10/23
10/26	Lagrange's Equations, Part 2	7.4-7.8	
11/2	Gravitation and Kepler's Laws	8.1-8.4	
11/9	Gravitation and Kepler's Laws	8.5-8.7	Exam 3, Ch. 7 11/13
11/16	Noninertial Frames and Fictitious Forces	9.1-9.7	
11/23	Noninertial Frames and Fictitious Forces	9.8-9.10	Thanksgiving break, Monday class only
11/30	Coupled oscillators and normal modes	11.1-11.5	
			Final, 12/9, Chs. 8, 9, 11 10:30-1:15 AM

Goals: Basic concepts of classical physics, solving advanced problems using Newton's Laws of motion, working with forces that vary in time and space, Lagrangian formulation

of mechanics, applications to the gravitational problem, working in non-inertial reference frames. Learn how to solve problems using cylindrical and spherical polar coordinates.

Grades:	Homework	25%
	Class Participation	10%
	3 Midterms @15%	45%
	Final Exam	20%

Course structure: This course is online only. We will use Blackboard Collaborate for all class meetings. The lectures will follow the book, however, there is not enough time to talk about everything in the book. You are responsible for material in the assigned reading, whether or not I cover it in lecture.

Practice **active reading**. Don't just skim over the textbook. As you read, challenge yourself to make sure you are understanding what's going on.

a) Think about how you would explain each part to a classmate.
b) Try to fill in the mathematical steps in each derivation. For instance, at the bottom of p. 28 the text says "you should be able to convince yourself that…" Make sure you understand how the equation follows from the diagram before reading further.
c) Make sure you understand statements that are made without explanation. For instance, in Example 4.7 statements are made ("neither of these [forces] do any work") that you should make sure you understand.
d) When you encounter something you can't figure out, make a note of it and ask about it in class or during office hours.

Monday and Wednesday will be primarily lecture using Blackboard Collaborate. Please ask lots of questions! You can put them in the chat or unmute and ask out loud. Questions help me judge whether the class is following what I am doing, whether I am going too fast or too slow. Friday's class will be primarily student-led and will be focused on problems. More details will be given in class.

Homework: Homework should be scanned into Blackboard by the due date. There will be a grade penalty for homework that is turned in after the due date.

Students are encouraged to work on the homework together; however, the work you turn in must be your own. *Simply copying someone else's solution is not acceptable and will be considered an Honor Code violation.* It is OK to check your answer using Maple or Mathematica, but your submitted homework must show all the steps worked out by hand.

Whether you are majoring in physics or some other technical, learning how to express yourself clearly is key to success. Each problem that you hand in should be laid out in clear, logical steps, with explanations for each step. A long string of equations is usually not sufficient as an answer. As you write out your "good copy", ask yourself if a classmate would be able to follow the steps. Clearly written solutions will also help you when you are studying for an exam. If you can't follow the logic yourself, no one else

will be able to, either! Often a few words is enough: "Now take the derivative with respect to time…" See the guidelines below.

It is **your responsibility** to make your method of solution clear to the grader. If I can't follow your steps, I will deduct points. When in doubt, include extra steps!

Exams: There will be three exams during the semester and a final exam. The final exam is **not** comprehensive, but it will be a bit longer and so is worth more points. The exams will all be "take-home" exams and will be open book, which means you are allowed to use your textbook only, no other books or resources. You will not be allowed to use your class notes, homework solutions, or any other resources I have posted. You are, of course, not allowed to work together, or to use any Internet resources. Your exam solutions will be scanned and uploaded to Blackboard in the same manner as homework.

Honor Code: *Use of any solution manual, internet solutions/advice, or solutions from previous years will be treated as a violation of the honor code. This applies to both homework and exams. See additional restrictions on exams above.*

If you are a student with a disability and you need academic accommodations, please see me and contact the Office of Disability Resources at 703/993-2474. All academic accommodations must be arranged through that office.

Format for Proofs/Problems

1. Define all symbols being used, using words and/or diagrams. (E.g., "Let $\vec{r}$ be the position of a point on the rim of the flywheel, taking the center of the flywheel as the origin.") A diagram can often be used to make the definition clearer.

2. State your starting point clearly. (E.g., "Starting with $\vec{r} = r\hat{e}_r$, take the derivative with respect to time....")

3. Show **all** algebra, explaining what equations are being used at each step (you may need to label your equations for easy reference). Note that page after page of equation after equation without explanatory remarks at appropriate places is **not** acceptable. Show how integrals were performed unless given in text or otherwise specified.

4. State the final result clearly.

Tips for problem-solving

1. **Break it down** - Break down a problem into smaller problems, then tackle the pieces one at a time.

2. **Work from both ends** - Ask yourself "what do I need to get the desired final result?"

3. If you can't solve, **make an approximation** and try again.

4. **Put it aside** and try again later from scratch.