PHY 5200 – Classical Mechanics I – Syllabus

Semester: Fall 2017

Lecturer:

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Lecture: **Monday, Wednesday, Friday 2:30 pm – 3:20 pm**, 177 Physics Building

Required Text: John R. Taylor, *Classical Mechanics* (University Science Books, (2005); ISBN 1-891389-22-X).

Office Hours: Monday 11:30 – 12:30 pm or by appointment.

Grading: Your course grade will be determined by your performance in homework assignments, project work, two Midterm Exams and a Final Exam on the basis of the following distribution.

Short Homework Projects (typically every class)	30%
Topical take-home Projects (typically every topic; total 6)	20%
First Midterm Exam	10%
Second Midterm Exam	10%
Final Exam	30%

The completed one-page short homework assignments are due *at the beginning of each class* (date will also be specified). **Late submissions will not be accepted.** Homework must include *explanatory text* and be *neatly written* or it will be given zero credit. Five lowest homework scores will be dropped. Topical take-home projects will be given at the end of each chapter with due dates specified.

The final exam will cover all the material of this course; however, there will be slight emphasis on material not covered by the first and the second midterm exams.

Course description and objectives: This course provides an introduction to fundamental ideas of classical mechanics: Newton's laws, notions of momentum, angular momentum, kinetic and potential energy, mechanical energy, conservation laws, motion in 1- and 3- dimensions, friction and retardation forces, oscillations, resonances, and gravitation.

Website: http://www.physics.wayne.edu/~apetrov/PHY5200/

Topics to be covered (approximate):

1. **Newtons's Laws of Motion**. Notions of space and time, reference frames, mass and force, the three laws of Newton expressed in vector calculus, conservation of momentum, 2nd law in Cartesian and polar coordinates.
2. **Motion of Projectiles and Charged Particles.** Air resistance, linear and quadratic retardation forces, trajectory, range of projectiles, motion of charges in a uniform magnetic field
3. **Momentum and Angular Momentum.** 3rd law applied to a system of N particles, momentum and angular momentum conservation, motion of rockets, notion of center-of-mass, Kepler's second law, angular momentum of single and several particles, moment of inertia.
4. **Energy.** Kinetic energy, work as a line integral, potential energy, and conservative forces, non-conservative forces, graphs of potential energy, condition of stability.
5. **Oscillations.** Hooke's law, simple harmonic motion, two-dimensional oscillator, damped and driven oscillators, resonance.
6. **Gravitation and Central Forces.** Force of gravity due to an extended object, planetary orbits, perturbations.
7. **Scattering.** (time permitting)

PHY 5100 or equivalent is a co-requisite for this course.

Final Grade: The overall course grade will be determined on the basis of the following grading curve (any score below 40 is considered as F):

Grade	Cumulated Score	Grade	Cumulated Score
A	90-100	C+	65-69
A-	85-89	C	60-64
B+	80-84	C-	55-59
B	75-79	D+	50-54
B-	70-74	D	40-49

Learning outcomes: Understanding of the principles and concepts of Classical Mechanics. Ability to solve problems and apply corresponding techniques for the material outlined above. Ability to critically read and understand scientific texts related to Classical Mechanics.

Students with disabilities If you have a documented disability that requires accommodations, you will need to register with Student Disability Services for coordination of your academic accommodations. The Student Disability Services (SDS) office is located at 1600 David Adamany Undergraduate Library in the Student Academic Success Services department. SDS telephone number is 313-577-1851 or 313-577-3365 (TDD only). Once you have your accommodations in place, I will be glad to meet with you privately during my office hours to discuss your special needs. Student Disability Services mission is to assist the university in creating an accessible community where students with disabilities have an equal opportunity to fully participate in their educational experience at Wayne State University.

PHY 5200 – Classical Mechanics I – Useful info

Problem Solving Guidelines
First of all, there is no single way to solve problems; if you have already developed some methods that work for you, then stick with them! Yet, here are some points to keep in mind when you solve problems in classical mechanics.

1. Carefully read the statement of the problem.
2. Make a diagram(s) for the problem. Include any objects, forces, and motions mentioned in the statement of the problem. Artistic quality is not an issue, as long as you can visualize what is occurring through the drawing.
3. Set up a coordinate system for the problem, especially important for more complex 2 and 3 dimensional problems. Choose a coordinate system that is most convenient for the problem (consider symmetries of the system)
   i. fixed, inertial (x,y,z) coordinate system (Cartesian)
   ii. fixed, inertial (r,θ,z) coordinate system (cylindrical)
   iii. other possible inertial coordinate system, for instance spherical
   iv. non-inertial coordinate system
4. Evaluate the forces in your chosen coordinate system, and write down the equations of motion, $\boldsymbol{F} = m\boldsymbol{a}$. Remember to include fictitious forces if you use a non-inertial coordinate system, and write down the correct form for $\boldsymbol{a} = d^2\mathbf{r}/dt^2$ if you are using a non-Cartesian coordinate system.
5. Solve the equation of motion. If the task looks extremely difficult or impossible, consider if it might be easier in a different coordinate system. Try re-reading the statement of the problem, paying particular attention to your diagram of the problem. If, after 20 minutes or so, you have made no progress on this problem, leave it and go on. Come back to it later, perhaps after talking about it with a classmate or the professor.
6. Re-check your work for missing minus signs and "factors of 2, 3, 5, etc".
7. Make sure that that your answer "makes sense", i.e. it is of the right order of magnitude and has correct units.

Of course, many problems are different, and don't require you to solve the equation of motion, but instead to apply some other derived results to a specific case. In these situations, there are often new terms that are used, and you should have a good understanding of what they mean. It may be helpful to write down a "vocabulary list" in these situations.

General points on problem solving
It is important to work problems constantly through the course, providing solutions with an explanation of how it is obtained. A sequence of equations without explanation is not appropriate. It is important to take and keep lecture notes and read the textbook (you paid a lot of money for it). Please remember that

1. An equation as a solution expresses much more information than a number.
2. It is important to check units of your answer.
3. It is important to understand and check the limiting behavior of a solution.

Finally, it is important to work your own homework problems so that you understand how to get the solution, not just copy one.