PHYS 301 Intermediate Mechanics (Fall 2019)

Instructors:

- Matthew Foster, BRK 303, matthew.foster@rice.edu, ext. 3922
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Lectures: 9:25-10:40 AM Tues. & Thurs., (TBA)
Problem session: 2:30-3:50 PM Tues., (TBA)
Office hours:

- Foster: (TBA), 303 Brockman Hall
- Huang: (TBA), 252 Brockman Hall

Textbook: *Classical Dynamics of Particles and Systems*, 5th Edition, Thorton and Marion.
Possibly useful references include

- *Classical Mechanics*, John Taylor
- *Classical Mechanics*, Herbert Goldstein
- *Nonlinear Dynamics and Chaos*, Steven H. Strogatz

(Approximate) Syllabus

1. Mathematical review: Coordinates, vectors
2. Newton's laws, motion with drag, rocket motion
3. Driven and damped oscillators
4. Mathematical review: Spherical, cylindrical coordinates and unit vectors
5. Gravitational potentials
6. Calculus of variations
7. Lagrangian mechanics
8. Hamiltonian mechanics
9. Central force problems, orbits and scattering
10. Centrifugal and Coriolis forces
11. Many-particle systems and rigid body motion
12. Coupled oscillators and waves

Additional/alternative topics, interest and time-permitting

1. Solitons and integrable dynamics

2. Chaotic dynamics

Learning outcomes

1. Good knowledge and comprehension of classical mechanics in its Newtonian, Lagrangian, and Hamiltonian formulations.
2. Familiarity with ballistics, rocket motion, oscillators, central-force motion, scattering, rotating-frame problems, coupled oscillations and waves.
3. Practical ability to apply classical mechanics to solve, exactly or approximately, to a large variety of simple mechanical systems.
4. Proficiency in predicting qualitative properties of mechanical motion from general principles: symmetry and conservation laws, orbits and turning points, small oscillations, unstable equilibria, etc.
5. Ability to evaluate the appropriateness of various approximation strategies in mechanical problems.
6. Practical problem-solving and solution-checking skills by dimensional analysis, consideration of special cases.

Homeworks and problem session: Problem-solving is a key aspect of this class. Homework will be assigned (almost) each Tuesday, and due the following Tuesday *promptly* at the beginning of the afternoon problem session (2:30 pm). Solutions will be discussed during the problem session, so late work will not be accepted.

Unless otherwise noted, you are allowed to discuss homework problems with other students to understand the ideas involved, or to compare final answers. You should always try to do the problems yourself, since you will need to internalize the ideas and develop computational dexterity in order to perform well on the exams. You should not simply read over another student's solution to see how to work a problem, nor should you consult solutions from previous years or from online resources.

Exams: There will be a midterm and a final exam. Both will be take-home exams with a fixed allowed time for working. Exams are open notes and open book. You must work the exam on your own, without conferring with anyone else (except with the instructors, for clarification on a problem). The Rice Honor-Code pledge will be required on exam scripts. You are expected to be familiar with the Rice Honor Code and to know the proper wording of the pledge (see below).

Grading: Homework will count for 45% of the grade. The midterm and final exam will respectively count for 25% and 30% of your grade.

Disability and accommodations: Any student with a documented disability needing academic adjustments or accommodations is requested to speak with us during the first week of class. Additionally, students will need to contact Disability Support Services in the Allen Center.

Rice Honor Code: In this course, all students will be held to the standards of the Rice Honor Code, a code that you pledged to honor when you matriculated at this institution. If you are unfamiliar with the details of this code and how it is administered, you should consult the Honor System Handbook at http://honor.rice.edu/honor-system-handbook/. This handbook outlines the University's expectations for the integrity of your academic work, the procedures for resolving alleged violations of those expectations, and the rights and responsibilities of students and faculty members throughout the process.