

PHYS 6101 Classical Mechanics I - Syllabus

Fall 2013

Schedule

Instructor: Shina Tan, Howey W506 (office hours: Mon 12:00-1:00pm, or by appointment)

Office Telephone: 404-894-2821 Email: shina.tan@physics.gatech.edu

Assistant: Kevin Driscoll, Howey W508 (office hours: Thu 3:00-4:00pm,

or by appointment) Telephone: 864-704-5113 Email: kjd10@gatech.edu

Lectures: Howey S204, MWF 11:05-11:55am

Goals

This course mainly concerns the movements of macroscopic bodies under the influence of forces. Topics include many body mechanics, relativity, Lagrangian and Hamiltonian techniques, Hamilton-Jacobi theory, classical chaos, and continuous fields.

Textbook and Reference Material

The majority of concepts that I will teach are in the textbook: **Goldstein, Poole, and Safko, *Classical Mechanics*, 3rd edition**. Because of limited time, only a portion of the contents in this book will be covered. I may alter the order of contents.

Optional additional reading material– Kleppner and Kolenkow’s “An Introduction to Mechanics” contains excellent material on Newtonian mechanics.

For intermediate level mechanics, one could read Symon’s “Mechanics” or Patrick Hamill’s “Intermediate Mechanics”.

For a concise advanced treatment, one can study Landau and Lifshitz’s classic text “Mechanics”. Lanczos’s “The Variational Principles of Mechanics” is also highly recommended, because of its elegant description of mechanical principles.

T-square

Homework assignments will be put on t-square: <https://t-square.gatech.edu/> (select PHYS-6101). Each student will also find her/his grades there (login required). Stu-

dents are encouraged to read my solutions to homework problems at my office only (these solutions will not be posted on t-square).

Students are expected to check t-square on a daily basis except during weekends and holidays. I may put some additional tutorials or information sheets at t-square.

Provisional Syllabus

There will be about 45 class meetings and a final exam. About 43 of them will be devoted to lectures, and 2 to quizzes.

Tentative list of topics (although we may not stick to them rigidly):

I. (about 6 lectures) **Elementary principles**: mechanics of 1 particle and of n particles, constraints, D'Alembert's principle, Lagrange's equations, etc.

II. (about 6 lectures) **Lagrangian mechanics**: Hamilton's principle, variations, Lagrange's equations, conservation theorems and symmetry, etc.

III. (about 7 lectures) **Relativity**: basic postulates, Lorentz transformation, space-time interval, 4-vectors, dynamics, brief introduction to general relativity, etc.

IV. (about 9 lectures) **Hamiltonian mechanics and canonical transformations**: Legendre transformation, Hamiltonian equations, relativistic mechanics, principle of least action, definition of canonical transformation, Poisson brackets, angular momentum Poisson bracket relations, symmetry groups, Liouville's theorem, etc.

V. (about 5 lectures) **Hamilton-Jacobi theory and action-angle variables**: Hamilton-Jacobi equation, Harmonic oscillator, action-angle variables, Kepler problem, etc.

VI. (about 4 lectures) **Classical chaos**: attractors, Liapunov exponents, bifurcations, logistic equation, fractals, etc.

VII. (about 6 lectures) **From coupled oscillations to continuous fields**: n mass points connected by springs, normal modes, continuous elastic rod, Lagrangian formulation for continuous systems, stress-energy tensor and conservation theorems, Hamiltonian formulation, relativistic field theories, Noether's theorem.

Quiz #1 (15% of final grade) will be after the completion of Part III.

Quiz #2 (15% of final grade) will be after the completion of Part V.

Surveys

I may post survey sheets on t-square from time to time. Students are encouraged to answer them (not graded). Although students do not have to answer the sheets, there could be a benefit of answering them. For example, if I find that people are not experienced with a necessary mathematical tool, I will spend some time explaining it, or give some advice about where to learn it.

Questions and Comments

Questions, comments, and concerns are welcome! Whenever anything is not clear or not easily comprehensible, please interrupt me and ask. You are also welcome to chat with me

at the end of each class. If I am not available to talk right after a class, you can make an appointment with me at another time. You are also welcome to visit me in office hours or make additional appointments.

Grading Scheme

Homework (25% of final grade), 2 quizzes (15% + 15%), and final exam (45%).

Homework

Each assignment will be posted at t-square and will be due at Kevin Carter's office (Howey W111) at 3pm on a Wednesday, roughly 1 week later. If there are School holidays in between, the time is longer. *No past due assignments are accepted.*

If an emergency or other serious circumstance beyond your control prevents you from turning in solutions on time, you might, after showing adequate evidence, be assigned a new set of problems with a new due date to substitute the old ones, and I will attempt (but cannot guarantee) to maintain a similar level of difficulty in the new assignment.

There will be no new homework assignment in the week preceding the finals, although the last assignment could be due in that week.

In all assignments, quizzes, and final exam, please show intermediate steps of your calculations. Whenever appropriate, you may draw diagram(s) in the solutions. These will help us to assess how well you understand the material.

Student Honor Policy

Students are the core members of Georgia Tech. Our Institute can not thrive without its members' upholding of academic integrity.

For homework assignments in this course, students are free to interact with each other, but each must submit her or his own solutions, and *must not copy solutions from any other classmate or from other sources*. For quizzes and final exam, each student must work on her or his own. Calculators that do routine operations, but contain no other pre-recorded information, are allowed. Additional information needed in the quizzes and exam may be supplied by the instructor, and no other sources should be referred to. If the meaning of certain phrases in the problems are not clear to you, please ask the proctor for clarification.

If you spot any instance of cheating in the homework, quizzes, or exam, please report it to me. I will not reveal your identity to the accused. I am obligated to report instances of academic dishonesty to the Office of the Dean of Students.

For additional information, please consult <http://www.catalog.gatech.edu/rules/18b.php>

Shina Tan, School of Physics, Georgia Tech, Atlanta GA 30332-0430