PHYS 3202 Classical Mechanics II - Syllabus

Spring 2012

Schedule

Instructor: Shina Tan, Howey W506 (office hours: W 11:00am-12:00pm or by appointment)
Office Telephone: 404-894-2821 Email: shina.tan@physics.gatech.edu
Assistant: Jeffrey Tithof, Howey W302 (office hours: M 4:30-5:30pm) Email: jtithof@gatech.edu
Lectures: Howey S104, MWF 10:05-10:55am, except 1/16 (holiday) and 3/19-3/23 (spring break).

Goals

This course mainly concerns the movements of macroscopic bodies under the influence of forces. Topics include many body mechanics, Lagrangian and Hamiltonian techniques, and concepts of relativity.

Since this is considered a continuation of PHYS 3201 Classical Mechanics I, I will usually skip material that was already covered there, unless I find it helpful to revisit certain contents.

Textbook and Other Reading Material

The majority of concepts that I will teach are in the textbook: **Thornton and Marion, Classical Dynamics of Particles and Systems, 5th edition**. For obvious reasons, only a portion of the contents in this book will be covered. I may alter the order of contents. (For example, because concepts such as many-body kinetic energy is a prerequisite for understanding Lagrangian mechanics, I will teach the first few sections of Chapter 9, Dynamics of a System of Particles first, skipping collisions and rocket motion.)

Some contents I teach can *not* be found in the above book.

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 more advanced treatments, one may read Herbert Goldstein's "Classical Mechanics". You are encouraged to read Cornelius Lanczos' beautiful book "The variational principles of mechanics". The first two parts of Malcolm Ludvigsen's "General Relativity: A Geometric Approach" contain an excellent geometrical description of special relativity.

T-square

Homework assignments will be put on t-square: https://t-square.gatech.edu/
(select PHYS-3202)

Grades will be available for you to view (login required). I may post my handouts at t-square. I may also use t-square to send group emails related to the course.

Provisional Syllabus

There will be about 44 class meetings and a final exam on Monday 4/30 at 11:30am - 2:20pm. About 42 meetings will be devoted to lectures, and 2 to quizzes. The plan is as follows (although we may not stick to it rigidly):

I. (about 5 lectures) **Dynamics of N-particle systems** (center of mass, linear momentum, angular momentum, rotational inertia, energies)

II. (about 8 lectures) **Lagrangian mechanics** (variations, Euler's equation, Hamilton's principle, generalized coordinates, Lagrange's equations, conservation theorems revisited)

III. (about 9 lectures) **Hamiltonian mechanics** (generalized momenta, Hamiltonian, Hamilton's equations, canonical transformations, Poisson brackets, cyclic coordinates, phase space, Liouville's theorem)

IV. (about 5 lectures) **Dynamics of rigid bodies** (planar motion, inertia tensor and related properties, Euler's equation of motion for a rigid body, motion of a symmetric top and precession, stabilty of rotations about principal axes)

V. (about 7 lectures) **Coupled oscillations and waves** (two coupled harmonic oscillators, general coupled oscillations, normal modes, loaded string, wave equation and general solutions, waves, phase velocity, group velocity and wave packets)

VI. (about 8 lectures) **Special relativity** [Lorentz transformation, Minkowski geometry, time dilation, twin paradox, length contraction, 4-scalors and 4-vectors (spacetime interval, rest mass, 4-velocity, 4-momentum, 4-acceleration, 4-force), relativistic Newton's second law]

Quiz #1 will be after (or several days after) the completion of Parts I and II.

Quiz #2 will be after the completion of Parts III and IV.

I will (briefly) address certain tools used in the course, such as differential equations, matrices, and calculus of variations. In the homework assignments you may be asked to solve some mathematical problems to get familiar with the tools. These problems, like the physical ones, are all counted in the final grade.

Travel

I expect to travel from the afternoon of 2/15 through 2/17, and from 2/27 through 3/2. For the dates I am absent, I will schedule

- a provisional instructor, or
- a quiz, or

- makeup lecture(s) at mutually convenient times after I return. If some people can not attend a makeup lecture, I will repeat it to them at another time, until everybody has got a chance to attend it. To keep track of exactly who have attended a makeup class, I will use a sign-up sheet, which you sign at the beginning.

Surveys

I may hand out survey sheets to you sometimes. Since these will *not* count into your grade, you do not need to put your name. If I find from the survey that people are not familiar with certain necessary concepts, I will try to explain them.

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 ($15\% + 15\%$ of final grade), and final exam (45%).

Homework

Each assignment will be announced at the end of a class, and due at the beginning of class one week later, or even later to skip a School holiday.

No past due assignments are accepted.

If an emergency or other serious cirmcumstance 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 assignment in the week preceding the finals, although a previously assigned homework may 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

For homework assignments, 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 proctor, and no other sources should be referred to. If the meanings of certain phrases in the problems are not clear to you, please ask the proctor for clarification.

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

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