ASEN 2003 INTRODUCTION TO DYNAMICS AND SYSTEMS
Syllabus, Spring 2012

Lecture: Tuesday and Thursday 8-9:15 AM ECCR 265
Lab: Monday & Wednesday ITLL 2B10 / Section 011 1:00-2:50 PM / Section 012 3:00-4:50 PM

Class web site: http://learn.colorado.edu

Instructors

Prof. Daniel J. Scheeres
Office: ECOT 6038 / Phone: (303) 492-7420 / Email: scheeres@colorado.edu
Office Hours: Tuesday and Thursday 9:15-10 AM in ECOT 611

Prof. Hanspeter Schaub
Office: ECNT 321 / Phone: (303) 492-2767 / Email: hanspeter.schaub@colorado.edu
Office Hours: Tuesday and Thursday, 9:15-10:00am in ECNT 321

Guest Instructor:
Christine Hartzell / Christine.Hartzell@colorado.edu

Lab Coordinator:
Trudy Schwartz
Office: ECAE 1B44 / Phone (303)735-2986 / Email: trudy.schwartz@colorado.edu

Teaching/Learning Assistants:
Elliot Barlow / elliot.barlow@colorado.edu
Office Hours: Thursday 2-4pm (ECAE 124)

Corrina Gibson / Corrina.Gibson@colorado.edu
Office Hours: Monday 9-11am (ECAE 124)

Course Assistants:
Boris Papazov / Boris.Papazov@Colorado.EDU
Karla Rosario / Karla.Rosario@Colorado.EDU

Textbook

Required: *Engineering Mechanics: Dynamics,* by Bedford and Fowler, Fifth Edition, 2008.
ISBN VP ISBN-10: 0132971135

Overview

The study of dynamics is a key component of every undergraduate engineering major, but is especially relevant to Aerospace Engineering. In the upper division you will begin taking courses dealing with the dynamics of air and space vehicles building upon the fundamentals presented in this class. Structures, fluids, controls, and orbital mechanics all have roots in this material, so it is critical that you build this technical base carefully. ASEN 2003 differs from a classical first course in dynamics in two ways. The first is that the fundamentals of two-dimensional motion of particles and rigid bodies are presented from both a theoretical and practical point of view. In addition to deriving and using first principles of dynamics, we will do experiments, designs, and hands-on homework that are intended to help students develop an intuition or feel for dynamics. Furthermore, we take the study of simple motions one step further by introducing the fundamental concepts of vibrations and control in this introductory course. Vibration analysis is critical to aerospace vehicle design, and as engineers we are not content to understand the motion of vehicles, but rather we often seek to modify it to suit mission requirements. This course will give you a flavor of these advanced topics, laying the groundwork for more advanced studies in your junior and senior years.

Course Outline

1. Particle Kinematics and Kinetics
2. Particle Energy and Momentum Methods
3. Planar Rigid Body Kinematics and Kinetics
4. Rigid Body Energy and Momentum Methods
5. Vibrations
6. Systems and Control

Prerequisites

Calculus 1-2, Physics 1, ASEN2001 Introduction to Statics and Materials, and GEEN1300 Introduction to Computer Programming, are prerequisites for this course. APPM2360 is a pre or co-requisite. Much of the material covered in this class has been introduced in Physics and depends heavily on a solid understanding of statics. Students are expected to have a working knowledge of vector operations and vector calculus. Assignments regularly require the use of MATLAB; students are expected to be proficient in the use of MATLAB for problem solving.

Course Components

Material and concepts are introduced and student mastery is evaluated using several mechanisms throughout the course:

- **Reading Assignments** - The primary means for conveying factual information, techniques, and examples is reading assignments in the textbook and course notes. The textbook is excellent, providing clear explanations and numerous examples of varying difficulty - take advantage of this outstanding resource. Reading assignments are to be completed prior to the class lecture period. Reading quizzes may be given at the start of a lecture following a reading assignment.
- **Lecture & Discussion** – We typically start a new topic in each lecture session. The instructor will provide a complementary overview of the material covered in the reading assignment.
- **Homework** – Homework problems are assigned once or twice per week. They provide practice in solving problems of varying difficulty and sometimes will also involve computing. Collaboration on homework is allowed (copying is not); however, students are encouraged to use homework as a means to ensure their individual mastery of the subject. In class group problem solving and labs will allow for considerable collaborative problem solving.
- **Group Problem Solving** – In the lecture and lab periods we will sometimes have group problem solving sessions. A handout is provided with conceptual questions about the material and/or relevant problems (often from previous year's exams). Students work in groups of 3-4 to answer conceptual questions about the material and do practice problems in preparation for the unit exam. We discuss the questions and problem solutions in class.
- **Labs** - There are a variety of experimental and design labs in this course that offer a different perspective on the material. They vary in duration and requirements. Each lab handout will state the objectives of the assignment, the report requirements, and the weighting (number of points) in the overall lab grade. In some cases, students will observe dynamic phenomena in the lab before we formally discuss the theory and do practice problems. Why do it in this order? The idea behind this type of "discovery learning" is that it helps you develop a concrete mental picture to connect to abstract mathematical concepts; and, it allows the student to formulate the questions that need to be answered to fully understand the experiment. In particular, we have tried to avoid making the labs "canned" or "turn-key"; that is, you should not expect to be able to walk into the lab, collect some data, and crank out the answer to some lab questions. The labs are designed to require you to try something, ask questions of the instructors and TA's, make some calculations, and maybe redo the experiment based on what you observed. The final result of the lab is not a "right" answer, but rather a set of answers and a solid explanation, based on correct mathematical theory and good experimental practice, of why such results were obtained. In other laboratory exercises, we will stress data analysis skills. This includes extensive usage of computer programming and statistics. In these examples, we expect students to follow directions from the instructor and provide a lab write-up that demonstrates that students understood the key concepts of the lab. Presentation of results will be stressed and students are expected to properly describe what was measured, what was modeled, and whether discrepancies between observations and models are significant. Although the computer programs written for this class will not be graded, students are required to turn them in. Students will also be required to follow programming instructions made by the instructor. Our

purpose in making these programming requirements is to teach students new and efficient methods for conducting engineering analyses. Proper presentation of laboratory results is important throughout the ASEN curriculum.

- **Exams** – Four in-class exams will be conducted at ~ 4-week intervals. Exams will include both conceptual questions (similar to clicker questions) and more detailed problems similar to homework. The final exam will contain material from the entire course.

Logistics

1. T.A. Office Locations and Office Hours will be arranged and announced as soon as possible.
2. Attendance to all lecture and laboratory sessions is mandatory. In-class assignments may be given at any time and students are expected to come to class prepared to participate.
3. Homework - Collaboration is permitted on homework. This means you may discuss the means and methods for solving problems and even compare answers, but you are not free to copy solutions from classmates or from internet resources. The work that you turn in must be your own--copying is not allowed for any assignments. Students who are caught copying homework solutions will be reported for violation of honor code and may incur both academic and non-academic sanctions. We will have two forms of HW this semester, on-line and paper-hand-in.
   a. On-line HW will be accessed at the textbook website, which will be distributed to all students with instructions on its use. Access to this website should be free with your textbook, if you bought it new this semester from the book store. If you have an older or used book you may have to purchase access to the web-site.
   b. For traditional hand-in HW, multiple pages must be stapled in the upper-left corner. Please indicate clearly where each problem begins and ends. (You do not need to use a separate sheet for each problem.) Homework should be folded lengthwise with your work to the inside. Your name, lab section, assignment number, and due date should be visible on the outside in the upper portion of the each page, to the right of the fold. Written work must be neat and readable with adequate spacing and margins. Final answers must be indicated with an arrow, underline, or box. Very messy work will be returned to you without being graded and a score of zero recorded.
4. Exams & Comprehensive Final - Exams will be given during the class periods. The final exam is scheduled for Monday, May 7 from 7:30-10:00 PM. Any type of collaboration or copying on a reading quiz, exam, or final constitutes cheating and will result in an F for the course. An honor code violation or accusation report will be filed.
5. Lab Reports - Experimental and design lab exercises are conducted together with your team. Some lab reports are to be written and submitted individually. Collaborations including shared diagrams or extensive discussion of results must be acknowledged at the end of your report. Copying text or answers from another student on an individual lab report with or without their permission constitutes cheating and will result in an F for the course.

6. Deadlines - Late assignments are not accepted except under extenuating circumstances such as a school closure or sudden illness. If such an event occurs you are expected to contact the instructor immediately by phone or email. A hectic schedule or crashed computer is not an acceptable reason for a late lab submission. If you know in advance that you will not be on campus for a due date, you may submit your assignment to the instructor any time prior to the due date.
7. Grading - Grades on individual assignments and for the overall course are set based on the following criteria. **Grades do not correspond to pre-specified ranges of scores.**

   A, A- Demonstrates superior understanding of the material beyond the course requirements, excellent technical work

   B+, B Demonstrates comprehensive understanding of the material, very strong technical work

   B-, C+ Demonstrates good understanding of the material, complete technical work

   C Demonstrates adequate understanding of the material to proceed to the next level; sufficient technical work

   C- Does not demonstrate adequate understanding of the material to proceed to the next level

   D Poor technical work

   F Unsatisfactory performance

   To receive a course grade of C or better, a student must earn a C or better on the exams (exams and final) given in this class. A C is the minimum grade that allows you to proceed to a course for which this is a prerequisite. If the exam and final scores are below a C, a student will not be assigned a grade higher than a C- regardless of their lab and homework scores.

   If you have complaints about your grade on any item, you must bring it to the appropriate professor and not raise it with the TAs.
8. Safety is the number one priority for laboratory activities. If you have not already done so, you are required to attend an orientation and safety lecture presented both by ITLL and by course staff during the first week of the semester. Anyone violating rules of safe conduct may receive a zero for the laboratory exercise and may be restricted from ITLL. Use of ITLL facilities is a privilege, not a right. Those endangering themselves, others, or laboratory equipment by their unsafe conduct will not maintain their access privileges.

GRADING

Individual Effort:

Homework 10

4 Exams 40 total

2 Scheeres Exams (20 points)

2 Schaub Exams (20 points)

Final Exam 20

Group Effort:

Laboratories 30*

*** Groupwork only counts toward final grade if total individual grade is C or better. Peer evaluations of your contribution to the labs will be incorporated into lab grades.**

University Policies

Students are required to be familiar with the University of Colorado policy on classroom behavior as described in: http://www.colorado.edu/policies/classbehavior.html.

Honor Code: All students of the University of Colorado at Boulder are responsible for knowing and adhering to the academic integrity policy of this institution. Violations of this policy may include: cheating, plagiarism, aid of academic dishonesty, fabrication, lying, bribery, and threatening behavior. All incidents of academic misconduct shall be reported to the Honor Code Council (honor@colorado.edu; 303-725-2273). Students who are found to be in violation of the academic integrity policy will be subject to both academic sanctions from the faculty member and non-academic sanctions (including but not limited to university probation, suspension, or expulsion). Other information on the Honor Code can be found at

http://www.colorado.edu/policies/honor.html

and at

http://www.colorado.edu/academics/honorcode

Harrassment: The University of Colorado at Boulder policy on Discrimination and Harassment, the University of Colorado policy on Sexual Harassment and the University of Colorado policy on Amorous Relationships apply to all students, staff and faculty. Any student, staff or faculty member who believes s/he has been the subject of discrimination or harassment based upon race, color, national origin, sex, age, disability, religion, sexual orientation, or veteran status should contact the Office of Discrimination and Harassment (ODH) at 303-492-2127 or the Office of Judicial Affairs at 303-492-5550. Information about the ODH, the above referenced policies and the campus resources available to assist individuals regarding discrimination or harassment can be obtained at

http://www.colorado.edu/odh.

Disabilities: Students with disabilities who qualify for academic accommodations must provide a letter from Disability Services (DS) and discuss specific needs with the professor, preferably during the first two weeks of class. DS determines accommodations based on documented disabilities (303-492-8671, Center for Community, Suite N200, http://www.colorado.edu/disabilityservices/studentinfo.html)

Religious Observances: Students who, because of religious obligations, have conflicts with scheduled exams, assignments, or other required attendance, should notify faculty at least two weeks or as early as possible in advance of the conflict to request special accommodation. http://www.colorado.edu/policies/fac_relig.html.

The final exam is scheduled for Monday, May 7 from 7:30-10:00 PM. If you have 3 or more finals schedule for the same day, university policy allows you to request a rescheduling of the exams in excess of 2. Please check your schedule and notify the instructor within the first 2 weeks of the semester if you will require a rescheduled exam for this class.