33-231 **Physical Analysis** **Fall 2003**

Instructor: Hugh D. Young

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References: Chabay and Sherwood ***Matter and Interactions*** (2002)
Edwards and Penney ***Differential Equations*** (second edition, 2000)
Ellis, Johnson, Lodi, Schwalbe ***Maple V Flight Manual*** (1997)
Stewart ***Calculus - Early Transcendentals*** (fourth edition, 1999)
Young and Freedman ***University Physics*** (any edition)

I. Introduction to MAPLE (1 week)

A. Basic syntax
B. Numeric and algebraic operations
C. Derivatives, integrals, and series
D. Graphs

II. Systems with first-order differential equations (2 weeks)

A. Exponential behavior; capacitor discharge, radioactive decay, population growth
B. Exponential approach to steady state
C. Nonlinear equations
D. Graphical and numerical methods

III. Oscillating systems (2 weeks)

A. Harmonic oscillator; *L*-*C* circuit
B. Complex number representation
C. Linear approximations to nonlinear systems
D. Numerical and graphical methods for nonlinear systems
E. Phase plots and vector field plots

IV. Damped and forced oscillations (3 weeks)

A. Damped harmonic oscillator, *L*-*R*-*C* circuit
B. Sinusoidal driving force; resonance
C. Transient and steady-state behavior
D. Energy and power relations
E. Complex numbers; impedance
F. Driven nonlinear systems; approach to chaos

V. Coupled oscillators (3 weeks)

A. Normal modes of linear systems
B. Forced oscillations
C. Normal coordinates
D. Introduction to linear algebra
E. Matrix methods for coupled oscillators

VI. Waves (3 weeks)

A. Traveling waves in one space dimension
B. Longitudinal and transverse waves; transmission lines
C. Standing waves; normal modes
D. Reflection and transmission at boundaries
E. Energy in wave motion

Bulletin Boards:

There are two electronic bulletin boards and a Web page for this course:

<academic.physics.33-231.official> for my official announcements, etc.;
<academic.physics.33-231> for you to post items of interest for the course;
<www.andrew.cmu.edu/course/33-231> for material handed out in class.

Problems:

Usually problem assignments will be passed out on Wednesdays, and should be handed in the following Wednesday. Problems will be graded (usually on a scale of 0 to 10 for each problem) and returned as quickly as possible. Also please read pages 3 and 4 carefully.

Exams:

There will be four 50-minute exams and a three-hour final exam. The 50-minute exams will be given on the following days:

Friday, September 19
Friday, October 10
Friday, November 7
Friday, December 5

Grades:

Your final grade in the course will be determined *approximately* according to the following scheme:

50% four 50-minute exams
20% final exam

30% problems and class quizzes

About Problems:

Solving problems is an essential part of this course. You learn only from what you *do*. You can't learn to ski or play tennis by watching somebody else do it, and you can't learn to solve problems by reading or copying someone else's solutions.

The structure of the course is designed to encourage you to do problems. About a third of your final grade will be based on your work on problems and class quizzes. Usually problem assignments will be handed out in class (hard copy) and posted on the Web on Wednesdays and should be handed in the following Wednesday, *at the beginning of class*. The due date will always be given at the beginning of each assignment. In general, late problems will not be accepted unless the lateness is due to circumstances beyond your control (to be determined in individual cases).

Solutions should be written legibly on standard-size paper, with enough verbal explanation so they would be understandable to your classmates. Please write your name on each page of your solutions, and please fasten the pages together with a staple or a paper clip.

Throughout this course, when a problem asks for a Maple calculation or graph, please print out the Maple output and hand it in as part of the assignment. Be sure to indicate the problem number and the part of the problem to which each section of Maple output refers.

On the day a problem set is due, I will hand out in class (hard copy), and post on the Web, written-out solutions for the problems. Sometimes there will be several possible correct approaches to solving a particular problem. In such cases I will usually write up only one of several possibilities. Solutions will be graded and returned to you, usually no later than the following Monday. Usually each problem will be graded on a 10-point scale.

Many of the problems and other course materials will be the same as or similar to those used in previous years in this course. This is not because I am lazy. It takes years to develop good problems; the only reason to change good problems is to make cheating more difficult. It is better for you to work on the best problems that I have been able to find or make up during my years of teaching. I appeal to your sense of honor and personal integrity because this is what is best from a pedagogical point of view. Please read the following material carefully.

Ordinarily I expect each of you to solve the problems independently. Collaboration among students is healthy when it helps students to learn from each other. It is unhealthy (and unacceptable) when it becomes a substitute for independent thought and effort. On the next page are some guidelines concerning acceptable and non-acceptable behavior.

Acceptable Behavior:

- General *verbal* discussion concerning problems, among students (including students who took this course in prior years) or between students and the instructor. Please feel free to come to my office any time for general help and guidance in solving the problems or to discuss principles that need to be clarified.

Non-Acceptable Behavior:

- Discussing details of a problem solution with another student or with a student who took this course in previous years.
- Reading or copying any part of another student's detailed solution or Maple code for a problem.
- Permitting another student to read or copy any part of your detailed solution or Maple code for a problem.
- Reading or copying any part of a problem solution or Maple code distributed for this course in past years.
- Copying all or part of a problem solution that is published in a book or journal.
- Reading or copying any part of another student's paper during a quiz or exam.

University regulations require me to remind you that all of these non-acceptable behaviors are considered to be cheating and are subject to the usual penalties for cheating. These may include zero credit on the assignment, failure in the course, or academic probation, suspension, or expulsion.

To end on a more positive note: I *want* you to succeed in my course; I'll do everything I can to help you succeed. To do well on the exams, you have to do do well with the problems. You will learn only from what *you* do yourself. It's like weight training -- no pain, no gain! You will find some of the problems quite challenging. Always remember that if they don't kill you, they'll make you stronger. I'll help you any way I can. But I don't make house calls; if you need help, you have to come to me. I'll try very hard to make myself accessible and helpful.