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University of Oregon; Fall 2007

Physics 351 – Vibrations and Waves

List of things to study for the Midterm Exam

NOTE: This list is intended only as an approximate guide to the topics with which you should be familiar, in preparation for the upcoming exam. There will certainly be topics listed here that are not present on the exam. And of course, this list won't spell out exactly everything that will show up in the midterm – it is meant only as an approximate guide.

Format of the exam: The exam (in class, Wed. Nov. 7) will be closed book / closed notes / no calculators, and 50 minutes long. Some information will be supplied to you (see below).

General advice: Study your homework assignments, lecture notes, and the textbook (Chapters 1-4). Be sure to study the posted solutions to homework problems you didn't understand. Understand the *derivations* of everything, not just the results. Understand the general properties of oscillating systems.

Some topics.

- Be familiar with Taylor expansions – in general and especially for common functions like e^x, sin(x), etc..

- Be familiar with basic trigonometry. Any necessary identities (e.g. sin(A+B) = ...) will be provided.

- Be familiar with dimensional analysis (and of course, know how to check the dimensional accuracy of anything you derive).

- Be familiar with the "complex exponential" method for solving differential equations for oscillators.

- Be able to derive the equations of motion of simple pendulum and mass-on-a-spring systems. Be familiar with the basic properties of springs – extension, force, energy, etc. Know how frequency, period, and angular frequency are related.

- Be able to analyze the vibrations of other oscillators covered in the course: electrical circuits, floating objects, etc. (Voltage drops across resistors, inductors, and capacitors will be given to you, if needed.)

- *Damped oscillators.* Understand the quality factor, Q (and how it is defined). Know how amplitude and energy decay with time. Know (remember) conditions for over-, under-, and critical-damping. Understand the derivation of x(t), and be familiar with the form of x(t) for underdamped oscillators.

- Know the properties of forced oscillators – e.g. what the amplitude, phase, and power absorption curves "look like" as functions of frequency. Equations for A(ω), δ(ω), and $\bar{P}(\omega)$ will be given to you if needed; you don't have to memorize them.

- Know how to analyze the frequency of oscillation about equilibrium for objects subject to arbitrary potential energy functions.

- Initial conditions – be able to determine x(t) for a system given the appropriate initial conditions.