

SYLLABUS

Foundations of Wave Phenomena

Phys 3750

Spring 2009

Instructor: D. Mark Riffe

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Office Hours: T T, 9:00 – 10:00 am

Prerequisites: Phyx 2710, Math 2210; Math 2250 (may be taken concurrently)

Texts: *Lecture Notes* (available on course website)

Foundations of Wave Phenomena (C. G. Torre) (available on course website)

Credits: 3 semester credit hours

Lecture: M W F, ENGR 206, 10:30 – 11:20 pm

Course Web Site: You can access all course information through **Blackboard** <https://online.uen.org/webct/entryPage.dowebct> . This includes **Texts** and **Homework Assignments**. A **discussion board** for the course is also available on Blackboard. You can also directly access course content at <http://www.physics.usu.edu/riffe/3750/index.htm>.

Goals of the Course

1. *Improvement of Mathematical Skills*

The main goal of the course is to bolster everyone's mathematical skills so that the upper-division physics courses are not mathematically too difficult.

2. *Practice with Computer Mathematics Packages*

For some of the homework problems you will be required to utilize a computer mathematics package, such as Mathcad, Maple, or Mathematica in order to help solve the problem or to plot the solution to a problem.

3. *Writing and Presentation Skills*

The class should help to develop both writing and presentation skills. Your writing skills should be improved through your homework write-ups. You will have many opportunities to improve your presentation skills through classroom presentations of selected homework problems. More detail on these aspects of the course are described below.

4. *Knowledge of Physics*

The course should increase your physics knowledge, especially in the area of wave phenomena, which, as we shall see, is ubiquitous in physics.

Class Time: Several different activities will take place during the scheduled class periods.

1. Lectures

Most class periods I will lecture on material that is also discussed in the text. **You will get MUCH more out of the lecture if you have read the associated material from the text ahead of time.**

2. Homework Presentations

We will also spend time going over some of the homework problems during the lecture time. During these class periods students will be (randomly) called upon to present their solutions to selected homework problems. **You should do the homework problems ahead of time so that you are prepared to present them during the scheduled class time.** As indicated below, the oral presentations count towards your grade in the class.

3. Exams

There will be three midterm exams during the semester.

Learning Assessment: The assessment of your learning will be done through the homework assignments – both written and oral, the midterm exams, and the final exam.

1. Homework – Written and Oral

There will be **8** homework assignments, posted on the web at <https://online.uen.org/webct/entryPage.dowebct>, or <http://www.physics.usu.edu/riffe/3750/index.htm>. The due dates are indicated on the schedule below.

The written part of each homework assignment is due at the beginning of class on the same day that we do the oral presentations in class.

I WILL NOT ACCEPT LATE HOMEWORK.

That is, you will receive zero credit for an assignment that is not turned in on time.

If you are randomly selected to present a homework problem and you are absent, then you will receive zero credit for that part of your oral homework grade. Part of your oral homework grade will be based on your attendance on Homework days.

Probably the most important thing that you can do to succeed in the course is to carefully do the homework assignments and understand the concepts and mathematics related to the homework questions and problems.

2. Midterm Exams

The exams will test on material in the lectures, reading assignments, and homework assignments. At the exam you may use the following: (1) a writing and erasing instrument and (2) a 3" × 5" card with anything you want handwritten on it. **The card may NOT be larger than 3" × 5", and whatever is on the card must be handwritten.**

There will be **three** 50-minute midterm exams.

THE MIDTERM EXAMS WILL BE INDIVIDUALLY RESCHEDULED ONLY AT THE DISCRETION OF THE INSTRUCTOR. If you know that you will be unable to attend the scheduled time, then you must have an *exceptionally good reason* and *make previous arrangements with the instructor to take the exam at some other time.*

3. Final Exam

The final exam will be **comprehensive**.

THE FINAL EXAM MUST BE TAKEN DURING THE SCHEDULED TIME.

The final exam is scheduled for Friday, May 1, 2009, 9:30 a.m. – 11:20 p.m.

Homework Assignments Details

Format of the written part of the homework assignments: Assignments are to be written using only one side of the paper. **Attach a cover sheet with your name, date, and assignment number. Staple all the sheets together with 1 staple in the upper left-hand corner.**

Writing: While often overlooked, the need for clear writing by scientists is a daily necessity. E.g., in the real world the scientist is continually faced with the task of communicating to his or her colleagues the results of scientific investigations or the reasons that future scientific endeavors should be carried out. Therefore, I strongly believe that one of the main goals of the university is the encouragement of clear writing (or clear oral communication) in all assignments. **To this end, I require that all homework assignments for this class be written in clear English sentences, including cases where mathematical equations are involved in the answer.**

N.B.: Your homework solutions should be clear and to the point, without all of the chicken-scratch-like attempts at deriving the solution that take place during the time that you are working on the problem.

Examples of Acceptable and Unacceptable Homework Solutions (Partial solution to problem 2.3 from Marion and Thornton, an undergraduate Classical Mechanics text.):

Acceptable (Notice the complete sentences!):

The equation of motion is

$$\mathbf{F} = m\mathbf{a}.$$

The gravitational force is the only applied force; therefore

$$F_x = m\ddot{x} = 0 \text{ and } F_y = m\ddot{y} = -mg.$$

Integrating these equations and using the initial conditions,

$$x(t=0) = v_0 \cos(\alpha) \text{ and } y(t=0) = v_0 \sin(\alpha),$$

yields

$$x(t) = v_0 \cos(\alpha) \text{ and } y(t) = v_0 \sin(\alpha).$$

N.B: All symbols used in a homework solution should be explicitly defined unless they are standard symbols that have been used frequently in the book or in class. It is also quite helpful to number any equations that are later referenced in the text of the homework problem.

Unacceptable (just a bunch of equations!):

$$\mathbf{F=ma.}$$

$$F_x = m \ddot{a} = 0$$

$$F_y = m \ddot{a} = -mg$$

$$x(t=0) = v_0 \cos(\alpha)$$

$$y(t=0) = v_0 \sin(\alpha)$$

$$x(t) = v_0 \cos(a)$$

$$y(t) = v_0 \sin(a)$$

Grading Scale

Homework 30%

Oral Presentations (including attendance on Homework days) 15%

Tests 30%

Final Exam 25%

Mathematical Packages: There are available several computer math packages such as Mathcad, Mathematica, Derive, Maple, Macsyma, MATLAB, etc. I encourage you to use one (or more) of these programs in doing your homework, even when not required. For those with no experience with any of these packages, Mathcad is the easiest to learn. It also includes text, equation, and graphics regions so that within a Mathcad sheet you can write up your homework according to the guidelines discussed above. Mathcad is available in the university's computer labs.

Disability: If you have a disability which requires accommodation in order for you to take this class, please contact me. The disability must be documented by the Disability Resources Center.

Phyx 3750 Spring 2009 Schedule

--Lecture Material, Reading Assignments, Homework, and Exams--

Week of	Monday	Tuesday	Wednesday	Thursday	Friday
Jan 5	Course / Syllabus Overview ¹		Harmonic Oscillations / Complex Numbers (pp. 1-10) ²		Two Coupled Oscillators / Normal Modes (pp. 15-27) ³
Jan 12	Normal Coordinates / the Initial Value Problem (pp. 15-27) ⁴		Linear Chain / Normal Modes (pp. 27-34) ⁵		Homework #1
Jan 19	Martin Luther King Day		Traveling Waves, Standing Waves and the Dispersion Relation (pp. 27-34) ⁶		Long-Wavelength Limit / Normal Modes (pp. 40-45) ⁷
Jan 26	1D Wave Eqn. - General Solution / Gaussian Function (pp. 46-55) ⁸		General Solution w/ Boundary Conditions (pp. 46-55) ⁹		Homework #2
Feb 2	General Solution using Normal Modes (not in text) ¹⁰		Introduction to Fourier Series (pp. 59-64) ¹¹		Midterm Exam I (HW 1 & 2)
Feb 9	Complex Fourier Series (not in text) ¹²		Vector Spaces / Real Space (pp. 170-176) ¹³		A Vector Space of Functions (p. 64) ¹⁴
Feb 16	Presidents Day	Homework #3	Dirac Delta Function (pp. 68-69) ¹⁵		Introduction to Fourier Transforms (pp. 65-68) ¹⁶
Feb 23	Fourier Transforms and the Wave Equation (pp. 70-75) ¹⁷		3D Wave Equation and Plane Waves / 3D Differential Operators (pp. 81-87) ¹⁸		Homework #4
March 2	Separation of Variables in Cartesian Coordinates (pp. 90-92) ¹⁹		The Wave Equation in Cylindrical Coordinates (pp. 92-102) ²⁰		Midterm Exam II (HW 3 & 4)
March 9	Spring Break	Spring Break	Spring Break	Spring Break	Spring Break

March 16	²¹ Separation of Variables in Cylindrical Coordinates (pp 92-102)		²² Separation of Variables in Spherical Coordinates (pp. 103-111)		Homework #5
March 23	²³ Spherical Coordinates II / A Boundary Value Problem / Separation of Variables Summary (pp. 103-111)		²⁴ Energy Density / Energy Flux / Total Energy in 1D (pp. 114-120)		²⁵ Energy Density / Energy Flux / Total Energy in 3D (pp. 120-125)
March 30	²⁶ 1D Schrödinger Equation for a Free Particle (pp. 128-133)		²⁷ A Propagating Wave Packet - The Group Velocity (not in text)		Homework #6
April 6	²⁸ A Propagating Wave Packet - Group Velocity Dispersion (not in text)		²⁹ The Uncertainty Principle (not in text)		Midterm Exam III (HW 5 & 6)
April 13	³⁰ Divergence and Curl (pp. 139-143)		³¹ Maxwell's Equations (pp. 144-151)		Homework #7
April 20	³² Energy Density and the Poynting Vector (pp. 151-153)		³³ Review		Homework #8

FINAL EXAM
(comprehensive)
Friday, May 1, 2009,
9:30 a.m. – 11:20 p.m.

Possible Errors: The instructor reserves the right to correct any possible errors to this syllabus.
