SYLLABUS

Foundations of Wave Phenomena
Phys 3750
Fall 2016

TECHNICAL DETAILS

Instructor: Bela G. Fejer

Office: SER 308 and SER 310

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Office Hours: 2 – 4 p.m. (with exceptions, for travel, etc.)

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

Texts: (1) D. Mark Riffe *Lecture Notes* (required), (2) *Foundations of Wave Phenomena* by C. G. Torre (optional). Both available on course website.

Credits: 3 semester credit hours

Lecture: Tu, Th, Library 410, 9:00 – 10:15 Am

Course Web Site: http://www.physics.usu.edu/riffe/3750/index.htm.

COURSE GOALS

I. Improvement of Mathematical Skills

The main goal of the course is to ramp up everyone's mathematical knowledge and skills so that the upper-division physics courses are less daunting than they might otherwise be. Courses that extensively use material discussed in this course include PHYS 4600 (electrodynamics), 4650/4680 (wave optics), and PHYS 4700/4710 (quantum mechanics).

II. 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.

III. 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 the opportunity to improve your presentation skills through classroom presentation of selected homework problems.

IV. 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 make an appropriate graph.

CLASS TIME

I. Lectures

Most class periods will cover the material that is presented in **Prof. M. Riffe's Lecture Notes**, which are available on the class website, http://www.physics.usu.edu/riffe/3750/index.htm. For each lecture there is a self-contained set of notes (31 lectures total). I encourage you to print off the Lecture Notes and refer to them during the lecture, making notes on them as needed.

II. Exams

There will be three midterm exams during the semester.

HOMEWORK

Overview

Simply attending lectures is NOT sufficient for learning physics, doing homework is the KEY to learning physics. All homework problems for the course appear at the end of the Lecture Notes for each class. **It is highly recommended that you do all of these problems**. You can expect exam problems to be similar to **any** of these problems.

Due Dates

The written part of each homework assignment is due at the **beginning of class.**

HOMEWORK ASSIGNMENTS

HW Set	Due date		Required	Recommended
1	Sep 8		2.1, 2.2, 2.4, 2.6(a)(c), 2.7(b)(c),2.8 3.1, 3.2, 3.3, 3.5	2.3, 2.6(b)(d), 2.7(a)(d), 2.9 3.4
2	Sep22		4.2, 4.4, 4.5, 5.2, 5.5, 5.8, 6.1, 6.3, 6.4, 7.1, 7.4	4.1, 4.3, 5.1, 5.3, 5.4, 5.6, 5.7 6.2, 7.2, 7.3
3	Oct 6		8.1, 8.2,8.5,9.3, 10.1, 10.2, 10.3, 10.4,11.1,12.1, 12.4	8.3, 8.4, 9.1, 9.2,11.2, 11.3, 11.4, 11.5, 11.6, 11.7,12.2, 12.3
4	Oct 18		13.1, 13.3, 13.6,13.7,14.2,14.4, 14.5 15.2, 15.316.1,16.3	13.2, 13.4, 13.5,14.1, 14.3 15.1,16.2
5	Nov 3		17.1, 17.3,17.4,18.2, 18.3,19.1,19.2 20.1, 20.2	17.2, 17.5,18.1, 18.4, 18.5
6	Nov 15		21.1, 21.2,22.3,22.1,23.2, 23.3, 23.4 24.3,24.2,25.2	22.2, 22.4,23.1,24.1, 24.4,25.1, 25.3
7	Dec 1		26.1, 26.3, 26.7,27.3, 27.4,28.1, 28.328.5,29.1	26.2, 26.4, 26.5, 26.6, 27.1, 27.2, 27.5, 28.2, 28.4
8	Dec 8		30.1, 30.2,31.1, 31.3,31.5,32.2, 32.1, 32.3	30.3,1.2, 31.4

EXAMS

I. Overview

There will be a total of four exams, three during the semester and one during the final-exam time slot. Each midterm covers material in two homework assignments. The **final exam is comprehensive**. The (**tentative**) dates for the midterm exams can be found on the schedule on the next page. The final exam is scheduled for Wednesday, Thursday December 15, 9:30-11:20.

At each of the midterm exams you may use the a handwritten 3" × 5" card. At the final you may use a 8.5" × 11" sheet of handwritten paper.

To give you an idea of the format of the exams, there are copies of several previous midterm exams on the class website. Typically there are several short answer questions and a number of quantitative problems.

II. Rescheduling

There are **only** two valid reasons for rescheduling one of the first three exams. Documentation must be provided for both reasons, as described below.

(1) **Medical**. You may reschedule an exam if you are too sick to take the exam If you are to sick to take the exam, then you are sick enough to visit the infirmary and obtain an note explaining the extent of your illness. **You must provide the instructor with such a note in order to reschedule an exam for medical reasons..**

(2) **University business**. If you are on travel for university business, then you may reschedule an exam. **Again, you must provide written documentation from the sponsoring organization of your participation in said university business**.

The final exam must be taken on Thursday December 15, 9:30-11:20 AM.

GRADING

Written Homework 10%
Midterm Exams 20%
Final Exam 30%

As is typical of upper-division physics classes, there is no set scale for the assignment of grades. Historically, the class GPA is close to 3.1 (slightly greater than a B).

TENTATIVE SCHEDULE

The number in the upper right corner of each box is the lecture number. The page numbers at the bottom center of each box refer to Dr. Torre's text *Foundations of Wave Phenomena*.

Week of	Monday	Tuesday	Wednesday	Thursday	Friday
Aug 28		Course / Syllabus 1-2 Overview Harmonic Oscillations (pp. 1- 10)		Complex Numbers 2-3 Two Coupled Oscillators Normal Modes (pp. 10-27)	
Sep 4	**LABOR DAY**	3-4 Normal Coordinates / IVP Linear Chain Normal Modes (pp. 15 27)		5 Homework #1 Normal Modes (pp. 27-34)	
Sep 11		6 Traveling Waves, Standing Waves and the Dispersion Relation (pp. 27-34)		7 Long-Wavelength Limit / Normal Modes (pp. 40-45)	
Sep 18		8 1D Wave Eqn. - General Solution / Gaussian Function (pp. 46-55)		9 Homework #2 General Solution w/ Boundary Conditions (pp. 46-55)	
Sep 25		10-11 General Solution using Normal Modes (not in text) Introduction to Fourier Series (pp 59-64)		**Midterm Exam I** (HW 1 & 2)	
Oct 2		12 Complex Fourier Series (not in text)		13-14 Vector Spaces Space (pp. 170-176, 64) Homework #3	
Oct 9		15-16 Dirac Delta Function Fourier Transforms/Wave Equation (pp. 68-75)		17 Fourier Transforms and the Wave Equation (pp. 70-75)	
Oct 16		18 Wave Equation Differential Operators (pp. 81-87) Homework #4		**NO CLASS**	
Oct 23		**Midterm Exam II** (HW 3 & 4)		19-20 Separation of Variables The Wave Equation (pp 90-102)	
Oct 30		21 Separation of Variables in Cylindrical Coordinates (pp 92-102)		22 Separation of Variables in Spherical Coordinates (pp. 103-111) Homework #5	
Nov 6		23 Spherical Coordinates II / A Boundary Value Problem / Separation of Variables Summary (pp. 103-111)		24-25 Energy Density / Energy Flux 1D/ Total Energy in 3D (pp. 114-125)	
Nov 13		26 1D Schrödinger Equation for a Free Particle (pp. 128-133) Homework #6		27 Propagating Wave Packet - The Group Velocity (not in text)	

Nov 20		**Midterm Exam III** (HW 5 & 6)	**Thanksgiving**	**Break**	
Nov 27		28-29 Propagating Wave Packet Uncertainty Principle (not in text)		30 Divergence and Curl (pp. 139-143) Homework #7	
Dec 4		31-32 Maxwell's Equations Energy Density / Poynting Vector (144-153)		33 Review Homework #8	
Dec 11				**FINAL EXAM** **9:30-11:20**	

EXPECTATIONS

I. What to expect from the course

A. Content. This course is essentially a **mathematical methods of physics course**, couched in terms of wave phenomena. We introduce necessary mathematical concepts such as Fourier series, Fourier transforms, the Dirac delta function, separation of variables, and vector spaces. The concept of orthogonal functions is key, as are multivariable differential operators.

B. Level of Difficulty. This will likely be your **hardest physics course** to date. To be successful in this course you must be able to utilize the math that we are currently studying (or have previously studied) to a variety of problems. At times you may find it extremely helpful to review material from prerequisite math courses previously taken.

II. What the instructor expects from you

A. Participation. The instructor expects you to participate in all aspects of the course. This includes preparing for and attending the lecture, reading the lecture notes, and doing the homework.

B. Effort. The instructor expects you to put in the requisite effort to learn the material in the course so that you are prepared to pass the exams. This includes the steps listed below to get additional help, if needed.

C. Ownership of Learning. The instructor expects you, the student, to take ownership of the learning process. You are ultimately responsible for what you learn.

NEED HELP?

If you find yourself confused or stuck on a particular topic or are spending an inordinate amount of time on any given homework problem you should try one or more of the following.

(1) Review the relevant Lecture Notes and/or section in Dr. Torre's text.

(2) Talk with other students in your class. Ask them to explain things to you (rather than solving the problem for you).

(3) Seek help from the class instructor, preferably during designated office hours (see first page). If you cannot make it to the designated office hours, then stop by the instructor's office.

DISABILITY

Students with ADA-documented physical, sensory, emotional or medical impairments may be eligible for reasonable accommodations. Veterans may also be eligible for services. All accommodations must be coordinated through the Disability Resource Center (DRC) in Room 101 of the University Inn, (435)797-2444 voice. Please contact the DRC as early in the semester as possible. Alternate format materials (Braille, large print or digital) are available with advance notice.

POSSIBLE ERRORS

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