

# PHYS 224 Spring 2018

## Physics of Vibrations and Waves

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**Office hours** Tuesday-Wednesday: 9:30-10:30 am. I am also available to talk to you for as long as you need after class. If none of these times work, then please email me to set up an appointment.

### **Course description (from the registrar)**

This course emphasizes vibrations, wave motion and optics. Topics include mathematical characterization of vibrations and waves, sound, superposition of standing waves, diffraction and interference of light.

Prerequisite: PHYS 122.

I will assume that you have the Physics background provided by PHYS 121 and PHYS 122. We will use concepts from these classes daily.

Corequisite: MATH 251.

I will assume that you have a working knowledge of single variable Calculus that includes derivatives, formulas for algebraic and trigonometric functions, integration and computation of areas, power series, Taylor series, and polar coordinates.

### **Course Overview**

Although named introductory physics this course is not really a continuation of the first two introductory physics courses. The course is heavily mathematical as it sets the foundation for future upper level Physics courses. Understanding harmonic oscillations and wave motion is fundamental for all physics majors. You will find these concepts in Quantum Mechanics, E&M, Classical Mechanics, Solid State Physics etc.

### **Learning Objectives:**

To be successful in the course by the end of the semester you should be able to.

1. describe harmonic motion, write and solve the differential equation that describes oscillatory motion (free, damped and forced oscillators)
2. describe coupled oscillators and the normal modes of a system

3. describe wave motion, including standing and traveling waves, sound and light waves
4. understand the concept of superposition and apply it in electromagnetic waves (interference, diffraction)

### Textbooks

George C. King, Vibrations and Waves (main text).

### Course grade

Homework: 15%

Reading quizzes (on blackboard): 6%

3 Midterms (non-cumulative): 18% each

Final (cumulative): 25%

*In principle, everyone can get an A. I will not curve the grades but may change (lower) the limits depending on the difficulty of the exams and homework*

score > 90 : A

score > 80: B

score > 70: C

score > 60: D

score < 60 : F

### Course management

I will use **Blackboard** to post course announcements, reading assignments and homework assignments, and post grades.

### Course policies

#### Reading assignments and quizzes

A weekly reading assignment will be posted on Blackboard every Friday by 4:00 pm. I will not be able to cover every little part of the text book. I will try to cover the most difficult and important points of each chapter. You are responsible for all the material in the chapter unless it has specifically been excluded.

To ensure that you have completed the weekly reading assignment and studied the lecture notes a Blackboard administered quiz will be made available the following Thursday after 1:00 pm and will remain on Blackboard for 24 hours. You will have to complete the quiz in one sitting and you will be given one hour to do so. The first quiz will be available on Thursday February 1<sup>st</sup> at 1:00 pm until Friday, February 2<sup>nd</sup> at 1:00 pm. For the first quiz only, the questions will cover the class syllabus and the first reading assignment. You can drop the lowest quiz score.

## Homework

This is a fast-paced course that requires a solid mathematics background. You should expect to work hard outside the class. Do all the homework assignments. This is the only way to be successful. As a bonus your final grade will depend 15% on the homework.

Homework will be assigned every Wednesday and it will be due at the beginning of the class the following week. No late homework will be accepted for any reason. Solutions will be posted immediately after class. **It is to your advantage to do all the homework problems and though tempting not to use the solutions that are available through various sources.** This is the only way to develop your problem-solving skills and be successful in the class. You can drop the lowest homework score. This should take care of any illness, job and family related emergencies. You can talk to your class mates regarding the homework assignments, but each should submit his/her own original solutions. **Copying someone else's homework is cheating.**

Homework will be graded for completeness and accuracy. In general, each part of a problem will be worth 3 points and the points will be assigned as follows:

3: complete solution and correct results is reached

2: mostly correct solution: start with the correct assumption but did not reach the correct result;

1: Valiant efforts but there are issues with the logic and understanding

0: had no clue but thought I should write anything related even tangentially

Homework solutions should be neat and organized, including explanations of what and why you are doing things (think **partial credit!!!**). Equations and results that are subsequently used and/or referred to should be numbered. **I will not grade sloppy solutions.**

## Cell phone use:

Please turn off your cell phone as soon as you get in class and keep your phone in your pocket. You are welcome not to come to class; I will not hold it against you. But when you are in class please refrain from checking email, texting or posting on Facebook.

## Mathematica and programmable calculators

For the exams you will be expected to do algebra, trigonometry and calculus of the appropriate level. This means that I would expect you to take simple derivatives and perform simple integrals without a formula sheet. The best way to prepare is to take a similar attitude when doing homework. You can use Mathematica as a reference tool (see "Schaum's Outline of Mathematical Handbook of Formulas and Tables") but I expect you to be able to carry out all the calculations manually (with the exception of complicated integrals).

## Exams

Exam solutions should be neat and organized, including explanations of what and why you are doing things (think **partial credit!!!**). Equations and results that are subsequently used and/or referred to should be numbered. **I will not grade sloppy solutions.**

All the exams are closed book. You will be given a formula sheet for each exam. Unless otherwise told, the use of a calculator or any form of an electronic device during exams or quizzes is not allowed. You must turn off your cell phone during class and the exams. If you are caught using a cell phone during an exam you will be asked to turn in your paper.

### Midterm

There is going to be three midterm exams at dates to be announced. Make up exams will be given only if you miss the exam for a documented medical or legal problem or for a death in your immediate family. The instructor must be notified within 24 hours of the missed exam. Make up exams may be oral or written.

### Final Exam

**Date: FRI, MAY 18 1:00-3:00 PM**

The final exam will be cumulative. No make-up exam will be given for the final (see note on incompletes below).

### Incompletes

Please read carefully the catalog statement on acceptable grounds for incompletes. In this course, incompletes are given only if you miss the final exam due to a documented medical or legal problem or for a death in your immediate family. According to the catalog you must be doing "qualitatively satisfactory" work in order to qualify for an incomplete. For this course it means that your class average is at least a C.

### General guidelines.

To be successful in the course you should be able to handle the mathematical aspect with ease. If you are unsure about a concept or technique try to review it from your old textbook, notes or see me for help. Ignoring a weakness will come back to haunt you. Come to class prepared and ready to ask questions. I will not be able to cover every little topic but will focus on the most important points of each chapter.

Do not start on the homework the day before it is due. Giving yourself ample time to think about the problems and digest the material is important. Often you will catch yourself finding the solution to a "difficult" problem after thinking about it for some time, setting it aside and going back at it with a new approach. I do not discourage you from working in groups; however, to benefit the most you should go to your group's meeting prepared. Discuss with your classmates the merits of the various approaches to solve a problem and make sure that you understand why you are following the approach you have chosen. Remember that during exams you will not be able to bounce ideas off each other. If uncertain on how to get started on a problem go through the reading materials carefully. You will most certainly find hints to get you going. The

best way to prepare for an exam is to go over the lecture notes and homework problems then attempt a few extra ones from the compilation at the end of each chapter.

### Academic Integrity

By enrolling in this course, each student assumes the responsibilities of an active participant in UMBC's scholarly community in which everyone's academic work and behavior are held to the highest standards of honesty. Cheating, fabrication, plagiarism, and helping others to commit these acts are all forms of academic dishonesty, and they are wrong. Academic misconduct could result in disciplinary action that may include, but is not limited to, suspension or dismissal. To read the full Student Academic Conduct Policy, consult the UMBC Student Handbook, the Faculty Handbook, or the UMBC Policies section of the UMBC Director.

### Student Disability Services (SDS)

UMBC is committed to eliminating discriminatory obstacles that may disadvantage students based on disability. Services for students with disabilities are provided for all students qualified under the Americans with Disabilities Act (ADA) of 1990, the ADAAA of 2009, and Section 504 of the Rehabilitation Act who request and are eligible for accommodations. The Office of Student Disability Services (SDS) is the UMBC department designated to coordinate accommodations that would allow students to have equal access and inclusion in all courses, programs, and activities at the University.

If you have a documented disability and need to request academic accommodations, please refer to the SDS website at [sds.umbc.edu](https://sds.umbc.edu) for registration information and to begin the process, or alternatively you may visit the SDS office in the Math/Psychology Building, Room 212. For questions or concerns, you may contact us through email at [disAbility@umbc.edu](mailto:disAbility@umbc.edu) or phone (410) 455-2459.

**If you require accommodations for this class, make an appointment to meet with me to discuss your SDS-approved accommodations.**