

PHYS 224 Spring 2025

Physics of Vibrations and Waves

Class: MWF 2:00-2:50 pm,

Instructor Prof. Theodosia Gougousi

Office PHYS 317

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Office hours Monday: 10:00-11:00 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.

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 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 use these concepts repeatedly 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 to electromagnetic waves (interference, diffraction)

Textbooks

George C. King, Vibrations and Waves (main text). I may also provide links through Blackboard to course-related materials.

Course grade

Homework: 15%

Reading quizzes (on blackboard): 5%

3 Midterms: 20% each

Final (cumulative): 20%

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 materials, lab handouts, 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 textbook. 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 from Thursday, January 30th at 1:00 pm until Friday, January 31st at 1:00 pm. For the first quiz only, the questions will cover the class syllabus and the first reading assignment. Some quizzes may also have a review question or two from previous material. This is to help both me and you evaluate your understanding of the material. 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. To prove the value of doing the homework I include below some data from three years ago. As you can see **the only way to be successful in this class is to do the homework every week.**

Homework will be assigned weekly, and it will be submitted in person in 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 classmates 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:

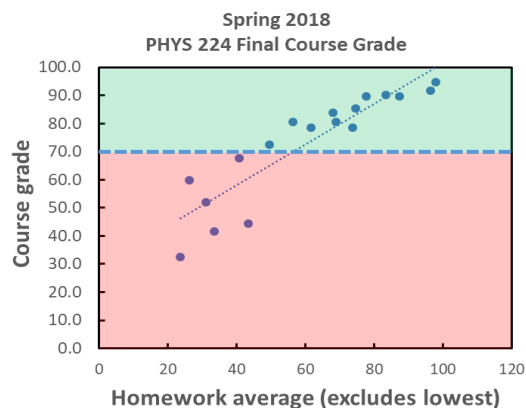
3: complete solution and correct results are reached.

2: mostly correct solution: start with the correct assumption but do 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!!!). Yes, you need to use words and write complete sentences. Equations and results that are subsequently used and/or referred to should be numbered. **I will not grade sloppy solutions.**



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 (except for 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.**

Exams are closed books and notes. You can bring one page (single-sided) of your own handwritten notes to the exam. Not all exams will be of the same type, mainly due to the nature of the material examined. You will be given ample warning about the date(s) and type of each exam. For the final, you can bring a **double-sided** page of handwritten notes.

Midterm

There are going to be three exams during the semester at dates to be announced.

Final Exam

Friday, May 16th, 1:00-3:00 pm (assigned by the registrar). The final exam will be cumulative. No make-up exam will be given for the final (see note on incompletes below).

Incompletes

Please read the catalog statement carefully 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 a death in your immediate family. According to the catalog you must be doing "qualitatively satisfactory" work 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, or 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, and 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 Directory.

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 for registration information and to begin the process, or 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 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.

Enrollment Dates and Deadlines

Students must be familiar with the academic policies and enrollment dates and deadlines as published in the [Undergraduate Catalog](#) and the [Academic Calendar](#). They are also responsible for managing their course enrollment(s) accordingly.

Hate, Bias, Discrimination and Harassment

UMBC values safety, cultural and ethnic diversity, social responsibility, lifelong learning, equity, and civic engagement.

Consistent with these principles, [UMBC Policy](#) prohibits discrimination and harassment in its educational programs and activities or with respect to employment terms and conditions based on race, creed, color, religion, sex, gender, pregnancy, ancestry, age, gender identity or

expression, national origin, veterans status, marital status, sexual orientation, physical or mental disability, or genetic information.

Students (and faculty and staff) who experience discrimination, harassment, hate or bias or who have such matters reported to them should use the [online reporting form](#) to report discrimination, hate or bias incidents; reporting may be *anonymous*.

Religious Observances

UMBC [Policy](#) provides that students should not be penalized because of observances of their religious beliefs, students shall be given an opportunity, whenever feasible, to make up within a reasonable time any academic assignment that is missed due to individual participation in religious observances. It is the responsibility of the student to inform the instructor of any intended absences for religious observances in advance, and as early as possible. For questions or guidance or to request an accommodation, please contact the [Office of Equity and Inclusion](#) at oei@umbc.edu.

Sexual Assault, Sexual Harassment, and Gender Based Violence and Discrimination

UMBC's [Policy on Sexual Misconduct, Sexual Harassment and Gender Discrimination](#) and Federal Title IX law prohibit discrimination and harassment on the basis of sex in University programs and activities. Any student who is impacted by sexual harassment, sexual assault, domestic violence, dating violence, stalking, sexual exploitation, gender discrimination, pregnancy discrimination, gender-based harassment or retaliation should contact the University's Title IX Coordinator to make a report and/or access support and resources:

Mikhel A. Kushner, Title IX Coordinator (she/her/hers)
410-455-1250 (direct line), kushner@umbc.edu

You can access support and resources even if you do not want to take any further action. You will not be forced to file a formal complaint or police report. Please be aware that the University may take action on its own if essential to protect the safety of the community.

If you are interested in or thinking about making a report, please see the [Online Reporting Form](#). Please note that, while University options to respond may be limited, there is an anonymous reporting option via the online form and every effort will be made to address concerns reported anonymously.

Notice that Faculty are Responsible Employees with Mandatory Reporting Obligations:

All faculty members are considered *Responsible Employees*, per [UMBC's Policy on Sexual Misconduct, Sexual Harassment, and Gender Discrimination](#). Faculty are therefore required to report possible violations of the [Policy](#) to the Title IX Coordinator, even if a student discloses something they experienced before attending UMBC.

While faculty members want you to be able to share information related to your life experiences through discussion and written work, students should understand that faculty are required to report Sexual Misconduct to the Title IX Coordinator so that the University can inform students of their [rights, resources and support](#).

If you need to speak with someone in confidence, who does not have an obligation to report to the Title IX Coordinator, UMBC has a number of [Confidential Resources](#) available to support you:

- The [Counseling Center](#): 410-455-2742 / After-Hours 410-455-3230
- [University Health Services](#): 410-455-2542
- Pastoral Counseling via [Interfaith Center](#): 410-455-3657; interfaith@umbc.edu

Other Resources:

- [Women's Center](#) (for students of all genders): 410-455-2714; womenscenter@umbc.edu.
- [Shady Grove Student Resources](#), [Maryland Resources](#), [National Resources](#).

Child Abuse and Neglect:

Please note that Maryland law and [UMBC policy](#) require that I report all disclosures or suspicions of child abuse or neglect to the Department of Social Services and/or the police.

Pregnancy

UMBC's [Policy on Sexual Misconduct, Sexual Harassment and Gender Discrimination](#) expressly prohibits all forms of discrimination and harassment on the basis of sex, including pregnancy. Resources for pregnant, parenting and breastfeeding students are available through the University's [Office of Equity and Civil Rights](#). Pregnant and parenting students are encouraged to contact the Title IX Coordinator to discuss plans and ensure ongoing access to their academic program with respect to a leave of absence – returning following leave, or any other accommodation that may be needed related to pregnancy, childbirth, adoption, breastfeeding, and/or the early months of parenting.

In addition, students who are pregnant and have an impairment related to their pregnancy that qualifies as disability under the ADA may be entitled to accommodations through the [Office of Student Disability Services](#).

Disclosures of Sexual Misconduct and Child Abuse or Neglect

As an instructor, I am considered a Responsible Employee, per UMBC's Policy on Prohibited Sexual Misconduct, Interpersonal Violence, and Other Related Misconduct (located at <http://humanrelations.umbc.edu/sexual-misconduct/umbc-resource-page-for-sexual-misconduct-and-other-related-misconduct/>). While my goal is for you to be able to share information related to your life experiences through discussion and written work, I want to be transparent that as a Responsible Employee I am required to report disclosures of sexual assault, domestic violence, relationship violence, stalking, and/or gender-based harassment to the University's Title IX Coordinator.

As an instructor, I also have a mandatory obligation to report disclosures of or suspected instances of child abuse or neglect (www.usmh.usmd.edu/regents/bylaws/SectionVI/VI150.pdf).

The purpose of these reporting requirements is for the University to inform you of options, supports and resources; you will not be forced to file a report with the police. Further, you are able to receive supports and resources, even if you choose to not want any action taken. Please note that in certain situations, based on the nature of the disclosure, the University may need to take action.

If you need to speak with someone in confidence about an incident, UMBC has the following Confidential Resources available to support you:

The Counseling Center: 410-455-2472
University Health Services: 410-455-2542
(After-hours counseling and care available by calling campus police at 410-455-5555)

Other on-campus supports and resources:

The Women's Center, 410-455-2714

Title IX Coordinator, 410-455-1606

Additional on and off campus support and resources can be found at:

<http://humanrelations.umbc.edu/sexual-misconduct/gender-equitytitle-ix/>.