# COLLEGE OF DUPAGE

## Physics 2111-002: Physics for Science and Engineering I          Summer 2023

*Instructor:*   Dr. David R. Fazzini          *Office:* BIC-3E04-B

*Hours:*        Monday & Wednesday:      10:00AM-11:45AM & 3:20PM-4:15PM
                Tuesday & Thursday:       3:20PM-4:15PM
                (Additional times by appointment.)

NOTE: During some of my office hours, I may be found in the Physics Lab Preparation Room (BIC-3E06) or in one of the adjoining labs (BIC-3E03, -3E05, or 3E07).

*Phone:*        630-942-3349                    *E-mail:*        fazzinid@cod.edu

*Mailbox:*      STEM Division                   *FAX:*           630-942-2759

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*Course Description:*   Semester Credit Hours: 5

Calculus-based study of classical linear and rotational kinematics and dynamics, including work, energy, impulse, momentum, collisions, gravitation, periodic motion and wave motion. (Students without a strong high school physics background are encouraged to complete PHYSI 1201 before enrolling in this course.) (4 lecture hours, 3 lab hours)

*Prerequisite:*   MATH 2231 with a C or better or equivalent.
                  (Proof required.)

*IAI Course Code:* PHY-911 (for majors)

*Official Text:* Openstax University Physics Volume 1 available free online at:

https://openstax.org/details/books/university-physics-volume-1

If you prefer, you may use any *calculus-based* introductory physics text of your choice. (Suggested authors: P. A. Tipler & G. Mosca; R. D. Knight; Halliday, Resnick & Walker; G. Gladding, M. Selen & T. Seltzer; just to name a few.)

*Lab Manual:*   Available free online from Physics 2111 Class webpage:

https://cod.edu/faculty/websites/fazzinid/physics-2111-aspx

*PRS Keypad:*   iClicker (provided by instructor).

*Material:*     Chapters 1-17 (Openstax University Physics Volume 1 online textbook)

*Location:*     Lecture: BIC-3535              MTWR: 12:00Noon-3:00pm
                Laboratory: BIC-3F05          TR: 7:40am-12:00 Noon

**Course Objectives**

Upon successful completion of this course the student should be able to do the following:

1. Describe the relationships among different units of measure
2. Interpret and explain the relationships among an object's displacement, velocity, and acceleration in multiple dimensions
3. Calculate the effect of external forces on an object's motion using Newton's Laws in multiple dimensions
4. Create and label simple free-body diagrams in multiple dimensions
5. Explain and apply the relationship between work and kinetic energy
6. Calculate the effect of external forces on an object's motion using work-energy methods for both conservative and non-conservative forces in multiple dimensions
7. Calculate the effect of both static and kinetic friction on the motion of an object using both force/acceleration methods and work/energy methods
8. Identify and calculate the different forms of energy in classical dynamics (potential, kinetic, and mechanical)
9. Explain and apply the relationship between impulse and momentum
10. Calculate the effect of external and internal forces on a system of objects using impulse and momentum methods in multiple dimensions
11. Identify situations in which a system's momentum is conserved
12. Predict the motion of a system of particles using center-of-mass methods
13. Formulate the outcome of collisions of particles in both elastic and inelastic cases
14. Interpret and explain the relationships among an object's rotational displacement, velocity, and acceleration in multiple dimensions
15. Create and label simple free-body diagrams for rotational situations
16. Formulate the effect of external torques on an object's motion using Newton's Laws in rotational form
17. Identify and calculate the strain of a solid for different applied stresses (tensile, hydraulic, and shearing)
18. Calculate gravitational forces and fields among systems of particles using superposition and integral methods
19. Calculate energies of orbits
20. Calculate kinematical characteristics of an object undergoing simple harmonic motion using the equations of motion for force, position, velocity, and acceleration
21. Describe the relationships among wavelength, period, frequency, angular frequency, angular wave number, and wave speed for a sinusoidal wave
22. Formulate the kinematical characteristics of a sinusoidal wave based on data in both graphical and numerical form
23. Interpret the motion of a sinusoidal wave and explain the superposition principle

24. Calculate the resonant frequencies and wavelengths for both transverse and longitudinal waves
25. Apply the superposition principle to calculate positions of maximum destructive and constructive interference for waves
26. Calculate sound wave intensities and intensity levels
27. Calculate Doppler shifts and beat frequencies

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**Course Logistics**

GENERAL COURSE INFORMATION can be found through the class webpage:

https://cod.edu/faculty/websites/fazzinid/physics-2111-aspx

and the **Blackboard** website:

https://bb.cod.edu/webapps/login/

Check the class webpage and log in to **Blackboard** regularly for general announcements and assignment updates. These sites will provide important announcements and course updates such as reading/online homework assignments and laboratory information. The class webpage will be updated on a regular basis and **Blackboard** will be used for blanket emails and grade dissemination.

READING and HOMEWORK assignments will be provided online using the *FlipItPhysics* homework system found at the following URL below:

https://www.flipitphysics.com/Account/LogOn?ReturnUrl=%2f

You will need to subscribe to *FlipItPhysics* at a nominal cost. You will also need the following (case sensitive) access key: **2111Su23FD**. All of the homework for the entire term has been generated. Assignments open five days before they are due. Check the *FlipItPhysics* calendar regularly for assignment updates.

It is assumed that you have read the assigned material by the due date. There are reading (gold) assignments, *Pre-lecture* (blue) assignments, *Checkpoint* (green) assignments, and Warm-ups (red) that are due by **7:30 AM for Tuesday and Thursday** due dates and **11:30 AM for Monday and Wednesday** due dates. There are also *Homework* (also red) assignments that are due by **11:30 PM** on the due date for maximum credit unless otherwise announced. Any part of any *Homework* (red) assignment submitted within 24 hours after the initial cut-off time of the due date will receive a maximum of 50% credit. After 24 hours from the initial cut-off time, you can no longer submit answers to the homework exercises & problems for credit. (The 24-hour 50%-credit does not apply to the blue *Pre-lectures*, green *Checkpoints*, or red *Warm-ups*.)

In addition to the homework described above, short in-class exercises are used to monitor conceptual understanding. (See IN-CLASS POLLING.) These can typically be answered by keeping up with the reading assignments and class discussions. These are designed to surface possible misconceptions and uncover some of the common pitfalls that confuse many students.

Be aware that it is very important that you make an honest attempt to work through the questions, exercises, calculations and problems since working the homework is a primary technique for learning the material. It is also very important that you be able to understand the solutions conceptually rather than just memorizing formulas since the quiz and exam problems generally require you to demonstrate application of the concepts being assessed. Be sure that you can answer any assigned question or solve any assigned problem since those of similar "style" may appear on the exam. It is your responsibility to seek assistance from you instructor and/or other resources if you are having difficulties. Reliance on Chegg, Course Hero, ChatGPT, etc. for the homework generally will not serve your ability to perform well on the exams.

EXAMS will consist of two "1-hour" exams and a "2-hour" comprehensive final exam. The 1-hour exams are of a multiple-choice format. Problems are standardized from homework sets, sample problems from the text, and examples discussed in class or the laboratory. The 2-hour final exam will be a multiple-choice standardized test. All exams are closed book and closed note. However, you will be provided with a sheet of "possibly useful information" that contains formulae, universal constants, conversions, etc. for all exams. See the "Physics 2111 Tentative Schedule" page for exam dates. All exams will start promptly at Noon on the dates indicated:

  Exam I:  Thurs., June 8th  OpenStax Vol. 1 Chap. 1-6
  Exam II:  Wed., June 21st  OpenStax Vol. 1 Chap. 7-11
  Final Exam: Thurs., June 29th OpenStax Vol. 1 Chap. 1-17 (except 14)

Important! You must take the exams at the times and dates scheduled. There are NO make-ups. If you know that you cannot take the Final Exam on Thursday, June 30th, from 12:00 Noon-3:00pm, then drop this course on Day 1 and get a 100% tuition refund.

QUIZZES consisting a few short questions based upon material covered in the previous unit/chapter will be administered on occasion with warning or without warning. These short questions and exercises are used to monitor conceptual understanding. Quiz questions are typically in a multiple-choice format and answered by conceptual reasoning or with a couple of lines of algebra or explanation. All quizzes are closed book and closed note. No equation sheets will be provided for the quizzes.

IN-CLASS POLLING (iClickers) will be administered to each student during the lectures. using "iCLICKERS" that will be provided on loan to each student. The system will allow you to further interact with the instructor during the lecture. You will be able to respond to questions and give feedback as the course progresses. For instance, short in-class exercises used to monitor conceptual understanding will be administered from time to time. The questions typically consist of surveys, conceptual questions or short

calculations and are designed to surface possible misconceptions and uncover some of the common pitfalls that confuse many students.  Students are encouraged to participate in small group discussions with classmates while answering these questions.  Responses are recorded and scored.  The scoring is used to measure class participation and can be used to determine a final grade in borderline situations.

LABORATORY sessions meet twice per week and are required for this course.  The laboratory section is designed to provide you with hands-on experiences related to the topics that are discussed in the classroom.  The laboratory activities will come from the online manual that will be made available to you.  Handouts are provided for any additional activities.  (Due to the condensed format of the term, not all the investigations in the manual will be performed.)  During the lab, you will make predictions, answer questions, and record observations.  Laboratory homework assignments are to be completed during the session and submitted at the end of that laboratory session.  Each lab is graded based upon completion of three parts: 1) a completed Pre-lab submitted at the start of the laboratory session (worth 10%), 2) required measurements and "in-lab" questions (worth 45%), and 3) the laboratory homework (worth 45%).

As the laboratory is a required part of the course, your final grade will drop one full letter for every two sessions that are missed regardless of exams/homework/quiz scores.  As there are no "make-ups," you are strongly advised to perform and submit all lab assignments.

### Tentative Summer 2023 Lab Schedule for Physics 2111
### Mechanics Lab (BIC-3F05)

| Dates | | Lab |
|---|---|---|
| Tuesday, May 30th | #1 | FCI & Introduction to Motion |
| Thurs., June 1st | #3 | Changing Motion |
| Tues., June 6th | #4 | Newton's Laws |
| Thurs., June 8th | #5 | Gravitational Forces |
| Tues., June 13th | #6 | Frictional & Tension |
| Thurs., June 15th | #8 | Work & Energy |
| Tues., June 20th | #10 | Conservation of Momentum |
| Thurs., June 22nd | #11 | Static Equilibrium |
| Tues., June 27th | #12 | Periodic Motion |
| Thurs., June 29th | N/A | Universal Gravitation |

PARTICIPATION in the course can have a reflection in the overall final grade.  Items such as attendance, attitude, sincerity, changes in performance, etc. will be considered in borderline situations.

ATTENDANCE/TARDINESS: In general, formal attendance is recorded by means of "iClickers," submitted quizzes, and officially stamped laboratory work.  Students who have missed 3 or more classes or labs AND are not passing with a grade of "C" or better by Wednesday, June 14th, 2023 will be considered in "non-pursuit" and may be

administratively dropped from the course by the instructor.  Students who do not "click in" during the class or who miss a quiz due to tardiness or any other reason will not necessarily have their attendance recorded.

GRADING is tentatively based on the following breakdown:

| Pre-lectures & Checkpoints: | 10% | Grade Cut-offs[*] | |
|---|---|---|---|
| Post-Homework: | 10% | A: | > 90% |
| Laboratory: | 15% | B: | > 80% |
| Quizzes/Clickers: | 10% | C: | > 70% |
| 2 Hourly Exams: | 15% each | D: | > 60% |
| Final Exam: | 25% | F: | < 60% |

[*]Depending on other factors involved with the course, it is possible for the grade cut-offs to be lowered by up to 5%, but DO NOT count on it.

**Miscellaneous:**

ACCOMMODATIONS: The College of DuPage is committed to the equitable access of educational opportunities for students with disabilities in accordance with The Americans with Disabilities Act, As Amended and Section 504 of the Rehabilitation Act of 1973. Any student who feels they may need an accommodation on the basis of an illness, injury, medical condition, or disability should contact the Center for Access and Accommodations to determine eligibility for accommodations and to obtain an official Letter of Accommodation. The Center for Access and Accommodations can be reached via email at

access@cod.edu.

Students may also initiate a request for services by going to

www.cod.edu/access

and clicking on the green box labeled "complete form to request accommodations." If you are already registered with the Center for Access and Accommodations, please email me your Letter of Accommodation as soon as possible. Please DO NOT send any private health documentation or doctor's notes to me.

LATE MATERIAL & MAKE-UPS: All quizzes and exams must be completed on the scheduled date at the time they are scheduled.  There are no make-ups for any reason (except jury service or call to active military duty).  If absent for either "1-hour" exam, then the percentage score of the final exam will be applied to one (and only one) missing exam.  All online homework must be submitted by the cut-off time and laboratory homework must be submitted at the end of the lab session (12:00 Noon) to receive maximum credit.  Any lab not submitted prior to the end of that day's session receives a 20% penalty.  After that, the penalty is an additional 20% for every 24 hours past the original due date and time. After a particular lab is returned, that lab cannot be submitted

for credit.  (Note that you can receive up to 50% credit just from the completion of the data acquisition and "in-lab" questions as long as it was officially stamped and submitted on time.)

RETURN POLICY: In general, every effort will be made to return work approximately in a timely fashion usually within one week after submission.

CALCULATORS, LAPTOPS & CELL PHONES: Only *TI-30 non-graphing calculators* may be used during exams.  These calculators are available for check-out from the Math Assistance Center and/or the Library although due to possible high demand, students should not depend on them being available at the time of an exam.  Students are responsible for bringing the correct calculator to the exams and knowing how to use it. During exams, there is no sharing of calculators and the cover must be removed.

Cell phone calculators may be used in class or lab, however, no CELL PHONES CALCULATORS may be used during exams (obviously).  Cell phones must be kept in "silent mode" during class or lab.  Students may use laptop computers or tablets to take notes during lecture only under the following conditions: 1) the screen must be displayed to the instructor on demand at any given time during the lecture and 2) you show your notes to the instructor at the end of class.  If these conditions cannot be met, then you may not use the device in class.

WITHDRAWAL POLICY: The last day to withdraw from this course without petition is Friday, June 23rd 2023.  After that date, students may file a *Petition for Late Withdrawal* through the Registration Office.  A *Petition for Late Withdrawal* will be granted for extenuating circumstances only, including student illness, death in the immediate family, family emergencies, call to active duty, or other appropriate extenuating circumstances. The student will be required to provide appropriate documentation for all requests for late withdrawal.  Prior to withdrawing from this class, students are strongly encouraged to speak to their instructor prior to withdrawing from this class.

As stated earlier, students who have missed 3 or more classes or labs AND are not passing with a grade of "C" or better by Wednesday, June 14th, 2023 will be considered in "non-pursuit" and risk being administratively dropped from the course.  (No refunds!)

INCOMPLETE POLICY: Under extraordinary circumstances (such as an extended medical emergency or family tragedy) a student currently earning "C" or better may not be able to complete all of the course requirements.  In such instances, the student may petition the instructor for an "incomplete" grade.  Only if the instructor deems the request as warranted will a contract agreement be made between the student and instructor as to how the course will be completed.  After the contract is signed by both the students and the instructor, the student will receive a grade of "I".  Note: The course must be completed with the same instructor and within one calendar year of the end of the term for which the student was enrolled.  If the student does not complete the requirements for the course as prescribed in the agreement, the "I" grade will automatically revert to a grade of "F."  It is advised that the students be fully aware of the consequences of

receiving an incomplete grade and understand the terms described in the COD Catalog, p. 111: *Incomplete Grade*.

CONDUCT: It is expected that you are aware of and follow the guidelines for conduct as described in the COD Catalog: *Student Rights and Responsibilities*. In particular, *Student Code of Conduct (Board Policy 20-35)*. Individuals that exhibit disruptive behaviors that interfere with the lectures and/or laboratory sessions will be removed from the class so that those individuals who wish to learn physics can do so. Those individuals removed must then conference with either the Dean or an Associate Dean in Natural & Applies Sciences Division. Those individuals may then rejoin the class pending the outcome of the conference.

Anyone caught cheating or plagiarizing will receive an automatic failure for the course. You will not be allowed to drop the class if you are found in violation of this section. It is expected that you are aware of and follow the guidelines for conduct as described in the COD Catalog, pp. 163-164: *Students Code of Academic Conduct (Board Policy 20-41)* and that you are aware of the definitions of the terms described therein. Also, the college will not tolerate discrimination or harassment. It is also expected that you are aware of and follow the guidelines for conduct as described in the COD Catalog, page 167: *Prohibition of Discrimination, Harassment and Sexual Harassment (Board Policies 15-10 and 15-11)*. The policies described in this section can be accessed at

https://catalog.cod.edu/student-services-general-student-information/

DISRUPTIONS: The proprietor of any cell phone or other device that is heard to go off in class or the laboratory ensures him/herself a "0" on the next quiz. Disruption during an exam will result in 5-point deduction off that exam score. Individuals that exhibit disruptive behaviors that interfere with the lectures and/or laboratory sessions will be removed from the class so that those individuals who wish to learn physics can do so. Those individuals removed must then conference with the Dean of the STEM Division. Those individuals may then rejoin the class pending the outcome of the conference.

COMMUNICATION: You should use email or phone as methods to communicate with me if my office hours conflict with your schedule. You are strongly encouraged to ask questions about the syllabus during class time and office hours. For more in-depth discussions (such as guidance on assignments) in-person meetings are available. It is also possible to set up a one-on-one Zoom meeting if a face-to-face meeting is not feasible. Such guidance conversations should take place in person or over the phone rather than through email. This allows us to communicate more effectively and fosters a more collegial learning atmosphere.

RELIGIOUS OBSERVANCE: The College will reasonably accommodate the religious observances of individual students with respect to class attendance, and the scheduling of examinations and class requirements. The student should notify the instructor well in advance of any anticipated absence or a pending conflict between a scheduled class and the religious observance.

# Physics 2111 TENTATIVE SCHEDULE for Summer 2023 Semester
Classes start on Tuesday, May 30th

| Week | Date | Chapter | Topic(s) |
|---|---|---|---|
| 1* | May 30th | 1 | General Measurement & Intro to Motion |
| | May 31st | 2 & 3 | Vectors & Motion in One Dimension |
| | June 1st | 4 | Motion in Two & Three Dimensions |
| 2 | June 5th | 5 | Newton's Laws of Motion |
| | June 6th | 6 | Applications of Newton's Laws |
| | June 7th | 6 | Friction & Centripetal Force |
| | June 8th | Ex. I & 7 | Chapters 1-6; Work |
| 3 | June 12th | 8 | Conservation of Energy |
| | June 13th | 9 | Center of Mass, Momentum & Impulse |
| | June 14th | 10 | Rotational Dynamics |
| | June 15th | 11 | Angular Momentum |
| 4* | June 20th | 12 | Equilibrium & Elasticity |
| | June 21st | Ex. II & 15 | Units 7-11; Simple Harmonic Motion |
| | June 22nd | 15 | Simple & Physical Pendula |
| 5 | June 26th | 16 | Travelling & Standing Waves |
| | June 27th | 17 | Sound Waves |
| | June 28th | 13 | Universal Gravitation |
| | June 29th | Final Exam | Chapters 1-16 (except 14) |

* No classes on Monday, May 29th due to the Memorial Day holiday.
 No classes on Monday, June 19th due to the Juneteenth holiday.

NOTE: Not every topic in the each assigned chapter may be discussed in class. However, you are responsible for every topic in each assigned chapter unless otherwise stated. If you are having trouble with a topic that is not discussed in class, it is your responsibility to seek out the instructor and/or other resources to ensure understanding of that topic.

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**Disclaimer:**
To the best of the instructor's knowledge, the information in this syllabus was correct and complete at the start of the semester. However, the instructor reserves the right, acting within the policies and procedures of the College of DuPage, to make changes in course content, instructional techniques or grading policy during the term. (Any changes would always be in favor of the class as a whole.)

It is assumed that you have read this course syllabus. Your continued enrollment in this course means that you accept the terms and conditions outlined in this syllabus.

**COURSE EXPECTATIONS**
Physics 2111
Dr. Fazzini

**What Dr. Fazzini Expects from You:**

- You will have read the syllabus.
- You will be punctual to class.
- You do not make or receive telephone calls or text messages during class or lab sessions.
- You demonstrate respect for what I and your fellow students have to say.
- You will come to class prepared (pencils, calculator, iClicker, etc.)
- You will come to class ready to ask and answer questions of substance on the day's topic(s).
- You will concentrate exclusively on this course during the class hours of this course.
- You will notify me prior to class if you have to leave early.
- You will "check your entitlement at the door" and take responsibility for your own learning.

**What You Can Expect from Dr. Fazzini:**

- I will be punctual to class.
- I will give each of you a fair share of my attention.
- I will work to make the class interesting and relevant.
- I will make myself available as a helpful resource outside of class.
- I will work to help you learn the material and perform at your best.
- I will be the sole arbiter of partial credit.
- I will grade the QUALITY of your work rather than the amount of time and effort you spent on it. (In other words, you will be assessed on your demonstrated performance rather than on anecdotal testimony.)

## Detailed Topical Outline:

General measurement
      Units of measurement
      Change of units and compound units

Motion in one dimension
      One-dimensional kinematics (position, velocity, and acceleration)
      Average and instantaneous kinematics
      Relations between kinematic variables
      Special cases of constant velocity and constant acceleration

Vectors and vector operations
      Vectors and vector algebra
      Commutivity and associativity for addition and subtraction
      Resolution and vector components
      Multiplication by a scalar
      Vector operations and components
      Scalar (dot) products and vector (cross) products

Motion in two and three dimensions
      Position, velocity and acceleration as vectors
      Two and three dimensional kinematics
      Projectile motion
      Uniform circular motion and centripetal acceleration
      Relative motion

Force and motion
      Dynamics and Newton's laws of motion
      Inertial mass
      Principle of linear superposition
      Applications of Newton's laws (weight, tension, and normal forces)
      Static and kinetic friction
      Radial and tangential components of acceleration

Energy and work
      Work-energy theorem
      Calculation of work done by multiple forces
      Applications of the work-energy theorem
      Conservative and non-conservative forces
      Power
      Conservative and non-conservative forces and potential energy
      Gravitational and spring potential energies
      Conservation of mechanical energy
      Applications of energy conservation
      Graphical representation of energy conservation

Systems of particles
    Measurement and calculation of the position of the center of mass
    Velocity and acceleration of the center of mass
    Relative motion and frames of reference
    Galilean transformation equations
    Review of Newton's laws for macroscopic body motion

Impulse and momentum
    Impulse-momentum theorem for one and two or more particles
    Conceptual meaning of impulse
    Net impulse, internal forces, and momentum conservation
    Vector momentum conservation
    Applications of momentum conservation

Collisions
    Elastic collisions
    Inelastic collisions
    Macroscopic motion and the center of mass
    Collisions in two dimensions

Rotational kinematics
    Kinematics and dynamics of a particle
    Simple applications of particle rotational dynamics
    Rotational dynamics for a rigid object

Rotational dynamics
    Definition of moment of inertia and net external torque
    Applications of rotational dynamics
    Rotational kinetic energy and energy conservation
    Angular momentum conservation

Equilibrium and elasticity
    Requirements for mechanical equilibrium
    Examples of equilibrium
    Elasticity of materials
    Stress-strain relationships

Gravitation
    Newton's law of universal gravitation
    Superposition
    Gravitational potential energy

Oscillations
    Hooke's law and simple harmonic motion (SHM)
    Examples of SHM
    Damped and forced harmonic motion

# Waves

- Waves and their mathematical description
- Speed of a string wave
- Sinusoidal waves and wave trains
- Superposition principle and standing waves
- Longitudinal and transverse waves
- Waves in two and three dimensions
- Interference of waves
- Intensity and intensity level
- Doppler shift and beat frequency