



**Course Objectives:**

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

1. Calculate the pressure on an object at any depth in any static fluid
2. Formulate the buoyant force from a static fluid on objects of any size and density
3. Explain the differences among temperature, heat, and internal energy
4. Explain the concept of the ideal gas model and its predictions
5. Predict the amount of energy transferred during different types of phase transitions
6. Interpret and explain the concept of entropy and the 2nd law of thermodynamics
7. Calculate work completed and energy transferred during a thermodynamic cycle
8. Interpret pressure-volume (P-V) diagrams
9. Recognize the constancy of speed of light as the basis for special relativity
10. Calculate time dilations and length contractions for frames in relative motion
11. Calculate the relativistic energy and momentum of particles using the invariance of total energy
12. Explain the importance of photoelectric effect in the basis of quantum theory
13. Recognize the meaning of quantum mechanical wave function in terms of probability
14. Solve the time independent Schrodinger wave equation for simple cases (such as the infinite square well) and use this solution to determine basic attributes of the particle (such as average position)
15. Explain the concept of quantum tunneling using the Schrodinger wave equation
16. Calculate the positions of spectral line frequencies of a hydrogen atom using quantized energy states of the Bohr atomic model
17. Explain the importance of the Pauli exclusion principle and its relationship to the periodic table of elements
18. Explain the fundamental concept of statistical mechanics including Fermi energy and occupancy probabilities
19. Differentiate among conductors, insulators, and semi-conductors using band theory and apply this theory to simple solid-state devices such as p-n junctions
20. Differentiate among the different methods for measuring radioactivity and radiation dosage and explain their appropriate use
21. Use the activity law to calculate the half-life and age of a material
22. Differentiate among the major types of radiation (alpha, beta, and gamma) and explain the effects of each on different materials including the human body
23. Explain the concepts of nuclear binding energy and how it is transformed into useful thermal energy in both fission and fusion processes

24. Explain the fundamental mechanisms involved in nuclear power including electrical power generation, different reactor types, the nuclear fuel cycle, and spent fuel disposal
  25. Describe the concepts involved in the creation of nuclear weapons and the effects of their use
  26. Organize all elements of matter and force according to the Standard Model
  27. Determine allowable and forbidden decays according to conservation laws of the Standard Model
  28. Explain how the requirements of the Standard Model effect current cosmological theories
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### **Course Logistics:**

GENERAL COURSE INFORMATION can be found through the class webpage:

<https://cod.edu/faculty/websites/fazzinid/physics-2115.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 announcements, blanket emails and grade dissemination.

READING assignments will be from the Tipler & Mosca's text: Physics for Scientist and Engineers, 6<sup>th</sup> ed. If you prefer, you may refer to any other calculus-based introductory physics textbook for the assigned reading material or to the Openstax series (available for free online). It is assumed that you have read the assigned material prior to class on the due date.

HOMEWORK assignments will be provided online using the *Expert TA* homework system. You will need to subscribe to *Expert TA* at a nominal cost. You will also need the following access link:

<https://reg.theexpertta.com/USG15IL-C4ADCB-3FN>

The homework set for this course are in the process of being input into the platform. It is expected that the entire semester will be programmed into the platform with the first four weeks of the term. You can expect assignments to open one week before they are due. Check the class webpage regularly for assignment updates.

Any part of any homework problem that is submitted within 24 hours after the initial cut-off time of the due date will receive a 50% credit. After 24 hours from the initial cut-off time, you can no longer submit answers to exercises & problems for credit.

In addition to the homework described above, short in-class exercises are used to monitor conceptual understanding. (See “iCLICKERS.”) 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 doing 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 exam questions and problems generally require you to demonstrate applications of the assessed concepts. Be sure that you can answer any assigned question or solve any assigned problem since they may appear on an exam. It is your responsibility to seek assistance from your instructor and/or other resources if you are having difficulties.

EXAMS will consist of two “1-hour” exams and a “2-hour” comprehensive final exam. Each 1-hour exams typically consists of about 5-6 problems and is worth 150 points. The 2-hour final exam typically consists of about 10-11 problems and is worth 250 points. However, there may be a multiple-choice component in lieu of problems on any exam. The problems are derived from homework sets, sample problems from the text and examples worked in class or the laboratory. All exams are closed book and closed note. However, you will be provided with a sheet of “possibly useful information” with formulas, constants, etc.

Tentative Exam Schedule:

Exam I:	Monday, March 10 <sup>th</sup>	(during lab session)	Chapters 13, 17-20
Exam II:	Monday, April 21 <sup>st</sup>	(during lab session)	Chapters R, 39, 34-35
Final Exam:	Tuesday, May 20 <sup>th</sup>	Noon-1:50PM	Chapters 13, 17-20, R, 34-41

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

“iCLICKERS” will be provided to each student during the lectures. 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. These questions can generally be answered by keeping up with the reading assignments and class discussions. Responses are recorded and scored. The scoring is used to measure class participation and can be used to determine grades in borderline situations.

LABORATORY sessions meet once 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 during the lectures. Laboratory handouts are provided for all sessions. During the lab, you will make predictions, answer questions, and record observations. Throughout the session and upon successful completion of the lab, the instructor will “stamp” your work and record attendance. Laboratory homework assignments are to be completed over the week and submitted at the beginning (that is, 1:00 PM) of the next laboratory session. Only officially stamped work will be accepted for credit. Each lab is graded in two parts: 1) completion of the requirement measurements and “in-lab” questions and 2) completion of the laboratory homework. Each piece is worth 50% of the total grade for that laboratory session.

Laboratory attendance is a required part of the course. Your final grade will drop one full letter for every two sessions that are missed regardless of exam/homework/quiz scores. As there are no make-ups, you are strongly advised to perform AND submit all lab activities.

PRE-LABS for each laboratory session will also be made available from the class webpage for you to print. Each pre-lab consists of a few short questions based on the reading of that week’s lab. These are to be completed **prior** to entering the lab for that session. Pre-labs are due at the beginning (1:00 PM) of the lab session. Pre-labs submitted by 1:00 PM for that session is worth 10% of the standard lab grade. The pre-labs **must** be submitted by 1:00 PM to be counted as “on time.”. Pre-labs submitted after 1:00 PM are considered late and subject to a 5% penalty on that week’s lab grade. Pre-labs not submitted before the end of the session incur a 10% penalty on that week’s lab grade.

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

GRADING is tentatively based on the following breakdown:

Homework:	20 %.	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.

\* See laboratory attendance requirement under LABORATORY section.

#### ATTENDANCE/TARDINESS:

In general, course attendance is recorded by means of “iClickers,” submitted quizzes, and officially submitted laboratory work. Students who have missed 4 or more classes or labs AND are not passing with a grade of “C” or better by Friday, March 21<sup>st</sup>, 2025, will be considered in “non-pursuit” and may be administratively dropped from the course by the instructor. (No refunds!) Students who do not “click in” during the class do to tardiness or any other reason will not necessarily have their attendance recorded. As safety instruction will be delivered at the start of the lab session, entrance to the lab will be denied 15 minutes after the lab starts.

In general, course attendance is recorded by means of polling, submitted quizzes, and punctually submitted laboratory work. Students who have missed 4 or more classes or labs AND are not passing with a grade of “C” or better by Friday, March 21<sup>st</sup>, 2025, will be considered in “non-pursuit” and may be administratively dropped from the course by the instructor. (No refunds!) Students who do not “click in” during the class due to tardiness or any other reason will not necessarily have their attendance recorded.

ACCOMODATIONS: 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](mailto:access@cod.edu).

Students may also initiate a request for services by going to

[www.cod.edu/access](http://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 your instructor.

#### 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, medical quarantine, or call to active military duty). If absent for a “1-hour” exam, then the percentage score of the final exam will be applied to one (and only one) missed exam. All online homework must be submitted by the cut-off time and all laboratory homework must be submitted at the beginning (1:00 PM) of next lab session to receive maximum credit. As stated above, any lab submitted after 1:00 PM of the due date lab session but

still during that session receive a 10% penalty. After that, the penalty is an additional 10% for every 24 hours past the original due date and time up to one week. After that, the lab will no longer be accepted 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 by the instructor and submitted on time.)

#### RETURN POLICY:

In general, every effort will be made to return work/provide feedback in a timely fashion usually within one week after submission. Scores will be updated in **Blackboard**.

#### WITHDRAWAL POLICY:

The last day to withdraw from this course without appeal is Saturday, April 19<sup>th</sup>, 2025. 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. Students are strongly encouraged to speak to their instructor prior to withdrawing from this class.

As stated earlier, students who have missed 4 or more classes or labs AND are not passing with a grade of “C” or better by Friday, March 21<sup>st</sup>, 2025, 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 both the student and the instructor sign the contract, 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 and can be accessed at

<https://catalog.cod.edu/academic-policies-procedures/>

#### CONDUCT & DISRUPTIONS:

The proprietor of any cellular 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 a 5-point deduction off that exam score (10 points during the final exam).

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 & Applied 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/>

#### CALCULATORS, LAPTOPS & CELL PHONES:

Only TI-30 non-graphing calculators (available for check-out from your instructor) may be used during exams. Students are responsible knowing how to use it. During exams, there is no sharing of calculators, and the cover must be removed. Students may use their own calculator for all other activities.

No CELL PHONE CALCULATORS may be used during exams. Students may use laptops or tablets to take notes during lecture only under the following conditions: 1) the screen must be displayed upon request and 2) you show me that day's notes at the conclusion of the class. If these conditions cannot be met, then you may not use the device in class.

#### 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) it is possible to set up a one-on-one zoom meeting if a face-to-face meeting is not possible. Such 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 2115 TENTATIVE SCHEDULE for Spring 2025 Semester

Week	Dates	Chapter	Topic(s)
1	Jan. 27-30	13	Fluid Statics (Pascal's & Archimedes' Principles)
2	Feb. 3-6	13	Fluid Dynamics (Bernoulli's Principle)
		17	Temperature
3	Feb. 10-13	17	Ideal Gasses & Kinetic Theory
		20	Thermal Properties & Processes
4	Feb. 17-20	20	Heat Transfer Mechanisms
		18	Heat, Work & the 1 <sup>st</sup> Law of Thermodynamics
5	Feb. 24-27	18	Adiabatic Processes
			Equipartition Theorem
6	Mar. 3-6	19	Irreversible Processes & Heat Engines
			Entropy & 2 <sup>nd</sup> Law of Thermodynamics
7	Mar. 10-13	Exam I	Chapters 13, 17-20
		R	Einstein's Postulates & Special Relativity
8	Mar. 17-20	39	Relativistic Energy & Momentum
9	Mar. 24-27	34	Quantum Physics: Photons & Probability Waves
10	Mar. 31-Apr. 4	NO CLASSES	SPRING BREAK
11	Apr. 7-10	35	Schrödinger Equation & Wave Functions
12	Apr. 14-17	35	Potential Wells & Barriers
		36	Hydrogen Atom & Multi-electron Atoms
13	Apr. 21-24	Exam II	Chapters R, 39, 34-36
		37	Molecules & Bonding
14	Apr. 28-May 1	38	Electrical Conductivity in Solids
		40	Nuclear Properties & Radioactivity
15	May 5-8	40	Nuclear Fission & Fusion
16	May 12-15	41	Elementary Particles & Cosmology
17*	May 20	Final Exam	All material: Chapters 13, 17-20, R, 34-41

\* Shortened week due to final exams.

There are NO CLASSES during Week 10 due to Spring Break

NOTE: Not every topic in 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.

**PHYSICS 2115 TENTATIVE LABORATORY SCHEDULE for Spring 2025**

Week	Monday Date*	Investigation	Topic(s)
1	January 27 <sup>th</sup>	1	Archimedes' Principle
2	February 3 <sup>rd</sup>	2	Temperature vs. Heat
3	February 10 <sup>th</sup>	3	Specific Heat Capacity & Latent Heat
4	February 17 <sup>th</sup>	4	Thermal Processes
5	February 24 <sup>th</sup>	5	Heat Engines
6	March 3 <sup>rd</sup>	6	Entropy: A Statistical Interpretation
7	March 10 <sup>th</sup>	7	Exam 1 & Intro. to Relativity Pt. 1
8	March 17 <sup>th</sup>	8	Introduction to Relativity Pt. 2
9	March 24 <sup>th</sup>	9	Introduction to Quantum Phenomena
10	March 31 <sup>st</sup>	NO LAB	SPRING BREAK
11	April 7 <sup>th</sup>	10	Observation of the Photoelectric Effect
12	April 14 <sup>th</sup>	11	Quantum Tutorials
13	April 21 <sup>st</sup>	12	Exam 2 & Optical Spectroscopy
14	April 28 <sup>th</sup>	13	Radioactive Half-Life
15	May 5 <sup>th</sup>	14	X-ray Diffraction & Crystallography
16	May 12 <sup>th</sup>	15	Electromagnetic Interactions in Matter

## **COURSE EXPECTATIONS**

### Physics 2115

#### **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.)

#### **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 the course content, instructional techniques or grading policy during the term. (Any changes would always be in favor of the student.) 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.

## Detailed Topical Outline

### Fluids

- Definition of density and pressure
- Relationship between depth and pressure for a static fluid
- Buoyant force and Archimedes' principle
- Pascal's principle
- Bernoulli's equation and the relationship among depth, pressure, and velocity for a fluid in motion

### Temperature and heat

- Definition of temperature and different temperature scales
- Definition and units of heat
- Distinction among temperature, heat, and internal energy
- Mass specific heat capacity
- Thermal expansion
- Mechanisms of heat transfer (conduction, convection, and radiation)

### Kinetic theory of gases

- The first law of thermodynamics
- The ideal gas law
- Work done by a gas
- Molar specific heat capacity
- P-V diagrams
- The equipartition of energy

### Entropy and the 2nd law of thermodynamics

- Cycles, heat engines, and refrigerators
- Efficiency of a heat engine
- Carnot engines and Carnot cycle efficiency
- The second law of thermodynamics
- Conceptual and statistical definitions of entropy

### Relativity

- Basis of special relativity
- Length contraction and time dilation
- Relativity of simultaneity
- Lorentz transformation
- Relativistic Doppler effect
- Relativistic velocity addition
- Invariance of space-time and space-time 4-vectors

Invariance of momentum-energy and momentum-energy 4-vectors

### Wave-particle duality

Experimental foundations for quantum mechanics including photoelectric effect and Bragg scattering of electrons  
Momentum and energy from wave properties of matter  
Schrodinger wave equation  
Heisenberg uncertainty principle  
Quantum mechanical tunneling

### Applications of the Schrodinger wave equation

One-dimensional infinite square well  
Quantized energy levels of trapped particle  
One-dimensional finite square well  
Two- and three-dimensional infinite square well  
Quantized atomic structure  
Bohr model of the atom  
Quantized electromagnetic spectrum of hydrogen  
Electron spin  
Total angular momentum  
Magnetic resonance  
Pauli exclusion principle and the periodic table  
Lasers

### Solid state physics

Band theory and energy levels  
Insulators and metals  
Semiconductors p-n junctions  
Diodes and light-emitting diodes  
Transistors

### Nuclear physics

Components of the nucleus  
Properties of the nucleus  
Alpha, beta, and gamma decay  
Measuring radiation dosage  
Calculating material activity and half-lives  
Energy from the nucleus  
Basic process of nuclear fission  
Nuclear reactors  
Nuclear fuel production and disposal  
Basic process thermonuclear fusion

Fusion in nature and as a possible power source  
Processes involved in nuclear weapons  
Effects of nuclear weapons

#### Particle physics and cosmology

The Standard Model  
Hadrons from quarks  
Conservation laws  
Exchange model view of forces  
Vector bosons  
Cosmological models  
Interaction between particle physics and cosmology