COLLEGE OF DUPAGE

Physics 1180-001: Physics in the Modern Era: Quarks to Cosmos Spring 2025

Instructor: Dr. David R. Fazzini *Office:* BIC-3E04B

Office Hours: Mon..: 10:25 AM–11:50 AM & 4:00 PM–4:50 PM
Tues.: 2:20 PM–3:00 PM
Wed.: 10:25 AM–11:50 AM & 1:00 PM–1:50 PM & 2:00 PM–2:50 PM
Thur.: 2:20 PM–3:00 PM
Fri: 9:00 AM–9:50 AM & 10:00 AM–11:50 AM
(Additional times available by appointment.)

NOTE: During some of my office hours, I will be found in the Physics Lab Prep area (BIC-3E06) or one of the adjoining labs (BIC-3F03, -3F05, or -3F07).

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Course Description:

Survey of physics of the twentieth century for the non-science major. Topics include relativity, quantum mechanics, elementary particles and cosmology. Topics of classical physics (mechanics, electricity, and heat) as a foundation are included.

Semester Credit Hours: 3 (Weekly: 3 lecture hours + 0 lab hours)

IAI Course Code: P1-900 (for general education)

Prerequisites: MATH 0482: Foundations for College Mathematics II with a grade of "C" or better, or equivalent or MATH 0465: Preparatory Mathematics for General Education with a grade of "C" or better, or equivalent.

Text (required): Revolutions in Twentieth Century Physics by D. J. Griffiths, 2013
Material: Chapters 1-5

Supplement (required): The New World of Mr. Tompkins by G. Gamow & R. Stannard, 1999

Keypad: iClicker (Provided by instructor.)

Location: BIC-3E07 (Lecture) *Time:* TR: 1:00-2:15 PM

General Course Objectives:

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

1. Convert different units of measure
2. Express physics quantities using scientific notation

3. Express numerical results using appropriate significant digits
4. Explain relationships among an object's position, displacement, velocity, and acceleration
5. Apply Newton's laws of motion
6. Distinguish different types of forces
7. Apply conservation laws to deduce the outcome of physical events
8. Calculate different forms of energy (kinetic, potential, thermal)
9. Describe how energy is converted from one form to another
10. Describe the relationship among amplitude, frequency, period, wavelength, and speed of a wave
11. Calculate positions of maximum constructive and destructive interference for waves
12. Identify Einstein's postulates of special relativity
13. Recognize the constancy of the speed of light as the basis for special relativity
14. Calculate time dilations and length contractions for frames in relative motion
15. Calculate relativistic energy and momentum
16. Summarize the physical problems that led to the formulation of quantum mechanics
17. Explain the photoelectric effect
18. Recognize the meaning of the wave function in terms of probabilities
19. Calculate the uncertainties using the Heisenberg uncertainly principle
20. Explain the concept of quantum tunneling
21. Calculate the spectral line properties (energies, frequencies, wavelengths) of a hydrogen atom using the Bohr model
22. Describe the Pauli exclusion principle and its relationship to the periodic table of elements
23. Differentiate among the major types of radioactive decay processes (alpha, beta, gamma) in unstable nuclei
24. Describe the concepts of nuclear binding energy and its transformation into thermal energy in fission and fusion reactions
25. Identify the fundamental forces of nature (strong, weak, electromagnetic, gravity) and the field particles according to the Standard model
26. Apply conservation laws to determine allowable and forbidden particle interactions
27. Interpret simple Feynman diagrams
28. Use the Hubble law to calculate recessional velocities
29. Recognize the cosmic microwave background as evidence for the Big Bang
30. Explain the formation of light and heavy elements
31. Describe our current understanding of dark matter and dark energy

Course Logistics:

GENERAL COURSE INFORMATION can be found through the class webpage:

https://cod.edu/faculty/websites/fazzinid/physics-1180.aspx

and the **Blackboard** website: https://bb.cod.edu/webapps/login/

Check the class webpage and login to **Blackboard** regularly for general announcements and assignment updates. The site will provide important announcements and course updates such as reading and written homework assignments. The class web page will be updated on a regular basis and **Blackboard** site will only be used blanket emails and grade dissemination.

READING assignments will be announced in class and posted on the class webpage. It is assumed that you have read the assigned material by the due date (see QUIZZES). Check the class webpage regularly for assignment updates.

HOMEWORK assignments will be provided online using the (free!) *MyOpenMath* online homework platform found at the following URL below:

https://www.myopenmath.com/

You will need register using the following course ID: **263615**. You will also need the following (case sensitive) access key: **1180Sp25Q2C**. All of the homework for the entire term has been generated. Check the class webpage and the *MyOpenMath* calendar regularly for assignment updates. The homework will consist of two types: *Homework Questions* and *Homework Exercises & Problems*.

The *Homework Questions* consist of 10 or so multiple-choice questions and are based upon the reading and discussions from the assigned section (s). These tend to be conceptual in nature, but may also require a simple calculation. These *Homework Questions* must be submitted by **12:30 PM** on the due date unless otherwise announced. Once the final cut-off time has elapsed, you will not be able to submit answers or make any changes for credit. (In addition to the *Homework Questions*, 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.)

The *Homework Exercises and Problems* assignments typically consist of several computational exercises and are also due at **12:30 PM** of the date shown. In general, these assignments involve a numerical answer and may be printed for off-line completion if you desire. You may return to the computer to enter your answers and submit them. Only the electronic submissions will be accepted (prior to the cut-off time) for credit.

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 application of the concepts being assessed. 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.

QUIZZES consisting a few multiple-choice, matching, or short response questions based upon the chapter/section(s) reading assignment due that day are administered with warning or without warning after the discussion of each section of the text—essentially every class. (You must be in class for the quizzes at the time they are administered. There are no "make-ups." However, there will be extra credit quizzes administered from time to time.) These are primarily designed to make sure that students keep up with the assigned reading and thus have some familiarity with the topics that are about to be discussed.

iCLICKERS will be assigned to each student by the instructor. 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. The questions typically consist of surveys, conceptual questions or short calculations and are designed to uncover some of the common pitfalls and surface possible misconceptions and 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 as a measure of class attendance and participation and may be used for as part of the final grade determination particularly in borderline situations.

EXAMS will consist of three "one-hour" exams and a "2-hour" final exam. The one-hour exams typically consist of about 30 multiple-choice questions and 5-8 "short answer" problems. The final exam is comprehensive and typically has about 100 multiple-choice questions. The questions and problems are derived from homework sets, sample problems from the text and examples worked in class. All exams are closed book and closed note. However, you will be provided with a sheet of "possibly useful information" that contains formulas, constants, etc.

Tentative Exam schedule:

Exam I:	1:00 PM-2:15 PM, Tuesday, Mar. 4th	Sections 1.1-2.2
Exam II:	1:00 PM-2:15 PM, Tuesday, Apr. 8th	Sections 2.3-3.3
Exam III:	1:00 PM-2:15 PM, Thursday, May 15th	Sections 4.1-5.4
Final Exam:	1:00 PM-2:50 PM, Thursday, May 22nd	Sections 1.1-5.4

NOTE: Not every topic in the each assigned section 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.

GRADING is tentatively based on the following breakdown:

Homework:	150 points	A:	> 900 points
Quizzes / Clickers:	150 points	B:	> 800 points
Exam 1:	150 points	C:	> 700 points
Exam 2:	150 points	D:	> 600 points
Exam 3:	150 points	F:	< 600 points
Final Exam:	250 points		

Depending on other factors involved with the course, it is possible for the grade cut-offs to be lowered by up to 50 pts., but do not count on it.

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

ATTENDANCE/TARDINESS:
In general, formal attendance is recorded by means of "iClickers" and submitted quizzes. Students who have missed 4 or more classes AND are not passing with a grade of "C" or better by Friday, March 21st, 2025, will be considered in "non- pursuit" and may be dropped from the course by the instructor. 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.

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 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 either "one-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 set in the online platform to receive maximum credit. Two "homework late passes" will be allowed for the semester.

WITHDRAWAL POLICY:
The last day to withdraw from this course without appeal is Saturday, April 19th, 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 21st, 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 & 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/

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 the 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 a method to communication 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.

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

DELIVERY MODE:
This course is offered in a live "in-person" format, but could be modified for virtual classroom meeting (VCM) format.

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.

Additional online resources referenced during course may include but are not limited to:

- Phet Simulations (University of Colorado) https://phet.colorado.edu/
- The Physics Classroom: https://www.physicsclassroom.com/Physics-Interactives

COURSE EXPECTATIONS

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.)

PHYSICS 1180 TENTATIVE LECTURE SCHEDULE for Spring 2025 Semester

Week	Dates	Section(s)	Topic(s)	Descriptions(s)
1	Jan. 28-30	Introduction	(Syllabus)	(Syllabus)
		1.1	Units, Measurement & Scientific Notation	• Identify units • Convert different units of measure • Express physics quantities using scientific notation • Express numerical results using appropriate significant digits
2	Feb. 4-6	1.2	Kinematics & Forces	• Explain relationships among an object's position, displacement, velocity, and acceleration • Apply Newton's laws of motion
		1.3	Universal Gravitation & Coulomb's Law	• Distinguish difference types of forces • Apply inverse-square law
3	Feb. 11-13	1.4	Conservation Laws	• Apply conservation laws to deduce the outcome of physical events • Describe how energy is converted from one form to another Applying conservation of momentum • Calculate different forms of energy (kinetic, potential, thermal)
			Momentum, Energy & Charge	• Apply conservation laws to deduce the outcome of physical events
4	Feb. 18-20	1.5	Wave Motion	• Describe the relationship among amplitude, frequency, period, wavelength, and speed of a wave
			Interference & Standing Waves	• Calculate positions of maximum constructive and destructive interference for waves
5	Feb. 25-27	Exam I	Sections 1.1-1.5	

		2.1	Einstein's postulates of special relativity	• Recognize the constancy of the speed of light as the basis for special relativity • Identify Einstein's postulates of special relativity
6	Mar. 4-6	2.2	Time Dilation & Length Contraction	• Calculate time dilations and length contractions for frames in relative motion
		2.3	Paradoxes	• Describe the outcome of the twin paradox • Describe the outcome of the pole-in-the-barn paradox
7	Mar. 11-13	2.4	Relativistic Mechanics Relativistic Momentum & Energy	• Calculate relativistic energy and momentum • Describe the concept of relativistic mass
8	Mar. 18-20	2.5	Spacetime	• Describe the structure of spacetime
		3.1	Photons & Matter Waves	• Explain the photoelectric effect
9	Mar. 25-27	3.2	Bohr Model	• Calculate the spectral line properties (energies, frequencies, wavelengths) of a hydrogen atom using the Bohr model
		3.3	Quantum Mechanics	• Summarize the physical problems that led to the formulation of quantum mechanics • Recognize the meaning of the wave function in terms of probabilities • Calculate the uncertainties using the Heisenberg uncertainly principle • Explain the concept of quantum tunneling
10	Mar. 31-Apr. 4	NO CLASSES	SPRING BREAK	
11	Apr. 8-10	Exam II	Sections 2.1-3.3	
		4.1	Atoms & Periodic Table of Elements	• Describe the Pauli exclusion principle and its relationship to the periodic table of elements
12	Apr. 15-17	4.2	Radioactivity & Nuclear Reactions	• Differentiate among the major types of radioactive decay

				processes (alpha, beta, gamma) in unstable nuclei • Describe the concepts of nuclear binding energy and its transformation into thermal energy in fission and fusion reactions
		4.3	Elementary Particles & the Standard Model	• Identify the fundamental forces of nature (strong, weak, electromagnetic, gravity) and the field particles according to the Standard model
13	Apr. 22-24	4.4	Interactions	• Apply conservation laws to determine allowable and forbidden particle interactions
			Feynman Diagrams	• Interpret simple Feynman diagrams
14	Apr. 29-May 1	5.1	Big Bang & Evolution of the Universe	• Cite evidence for the Big Bang and our current understanding for the evolution of the universe
			Stars, Galaxies & the Hubble Law	• Use the Hubble law to calculate recessional velocities • Explain the formation of light and heavy elements
15	May 6-8	5.2	Blackbody Radiation	• Interpret spectral distributions of blackbody radiators
		5.3	Cosmic Background Radiation	• Recognize the cosmic microwave background as evidence for the Big Bang
16	May 13-15	5.4	Dark Matter & Dark Energy	• Describe our current understanding of dark matter and dark energy
		Exam III	Sections 4.1-5.4	
17*	May 22	Final Exam	All covered material: Sections 1.1-5.4	

*Denotes shortened week due to final exams.

Your first lecture takes place on Tuesday, January 28th starting at 1:00PM in BIC-3E07.

There are NO CLASSES during Week 10 due to Spring Break.

Topical Outline:

1. Units and scientific measurement
2. Scientific notation
3. Kinematics (position, velocity, acceleration)
4. Forces
5. Universal gravitation and Coulomb's law
6. Conservation laws (energy, momentum, charge)
7. Momentum
8. Energy
9. Wave description and motion
10. Wave interference and standing waves
11. Einstein's postulates of special relativity
12. Time dilation and length contraction
13. Simultaneity
14. Twin paradox
15. Relativistic mechanics (energy, momentum, mass)
16. Spacetime
17. Wave-particle duality
18. Photons and the photoelectric effect
19. deBroglie hypothesis
20. Uncertainty principle
21. Quantum tunneling
22. Bohr model of the atom
23. Atoms and the periodic table
24. Radioactivity
25. Nuclear reactions
26. Fission and fusion
27. Elementary particles (hadrons and leptons)
28. Standard model
29. Interactions and Feynman diagrams
30. Big bang and evolution of the universe
31. Blackbody radiation and the cosmic microwave background
32. Dark matter and dark energy

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.