Formalities

If you'll just add the following text at the beginning of all your syllabi, you'll be good to go (this is the PREFERRED method so that any updates propagate to all syllabi:

> **Standard Lyon College Policies are incorporated into this syllabus and can be found at the following link: http://www.lyon.edu/standard-course-policies.**

If you really just want to copy and paste all the policies into your syllabi instead (NOT preferred), you can*, but be sure and use the exact wording found at the link above and include all of it.*

Tentative Syllabus for Physics 335: Fall 2024

Professor: Dr. Stuart Hutton
Office: Derby Center: 248 Research Lab: Derby 219: General Physics lab: 148
SMS: 307.*.8765 / lab email: lyonphysics@<*.com> web: physics.lyon.edu**
Phone: ***.307.7560 Email: stuart.hutton@lyon.edu

Class Meeting Details

Location Derby 148:Times: M 10-10:50, 14-14:50; T 11-11:50

I will schedule several office hour blocks. I will be very close to my office or research lab during these times. Otherwise, I will usually be close to my office or research lab. If you want to find me outside of office hours, make an appointment so that you will be sure to find me. My schedule is located on the physics home page which you may review to determine office hours.

Grading

As a general guide to grades, grades will be assigned as follows:

100-90]	(90-80]	(80-70]	(70-60]	<(60
A	**B**	**C**	**D**	**F**

In this course, you will have several grading opportunities, tests, homework, in-class problems and laboratory projects. The various weight of each of these activities in your final point grade is shown below. **Late assignments will normally not be accepted. Additionally, since we will be doing in-class problems, poor attendance will negatively affect your grade. About labs: A brief lab report will be normally due within 1 week of the lab completion. We will be doing approximately 5 labs during this course.**

Tests (3 tests)=75%
Each test is worth 25% of your grade.
Homework / in-class problems / participation=15%
Laboratory projects =10%
All lab projects must be completed or your course grade will be reduced by 10%.

Your work on tests will be graded for correctness and clarity. **Failure to supply details leading to a result will result in very little credit for a problem**. If you want full credit for a problem, **you must** supply the logical steps that led to the result and the result **must include proper units**. Diagrams should be included where appropriate to define quantities used in your result. Homework and worksheets will be graded for completion. Students are generally expected to commit two hours of study outside of class for each hour of lecture.

Course Description: Physics 335

In this course you will be exposed to the fundamentals of modern physics with topics including relativity and quantum mechanics.

Course Objectives: Physics 335

As a consequence of this course, you should obtain an enhanced understanding of the fundamentals of modern physics. In addition, you should come away from this course with an ability to solve fundamental problems involving physical principles. The particular topics covered in this course are outlined in the schedule. Depending upon class interest, the actual topics may vary slightly from those stated. Refer to Student Learning Outcomes for a discussion of minimal course outcome expectations.

Course Prerequisites: Physics 335

You are **expected** to be proficient with algebra and trigonometry . In addition students should have course work in calculus and should have completed [Phy210/240:241] and [Phy220/250:251].

Text

Physics 335:

Modern Physics for Scientists and Engineers
Third Edition
By: Stephen T. Thornton and Andrew Rex
ISBN: 0-534-41781-7

You may use earlier editions of this text (which can be obtained at much lower prices online {$0.25 for example is a low price}) but you will need to be sure to read the correct portions of the text.

The schedule is designed around this particular text edition. Again, you may use earlier or later editions but you will need to be sure to read the correct portions of the text. The text must be considered to be a very important resource so students are expected to be reading along in the text as the course progresses.

You have many resources on the campus: the library, your colleagues and your professor. Your prime learning resource, however, must be considered to be the classroom: **punctual** and **complete** class attendance is expected**.**

Punctual and complete class attendance is expected. Absences will negatively impact your final grade. Attendance will be taken.

Academic Honesty

It is expected and encouraged that students in this class will work together on homework problems. If you use reference work, be sure to include proper references. Questions during tests should be directed to the professor only and students are not permitted to communicate with each other during tests about any aspect of the course. Students are specifically prohibited from discussing any aspect of tests until all students have completed the test. Contravention of these conditions will be considered to be a violation of the Lyon College Honor Code.

CLASS SCHEDULE / OFFICE HOURS Fall 2024

Professor: Stuart Hutton

Monday	Tuesday	Wednesday	Thursday	Friday
8:00-8:50 PHY240.01 Fundamentals of Physics I Derby 007	8:00-9:15	8:00-8:50 PHY240.01 Fundamentals of Physics I Derby 007	8:00-9:15	8:00-8:50 PHY240.01 Fundamentals of Physics I Derby 007
9:00-9:50 PHY210.01 General Physics 1 Derby 007	9:30-10:00	9:00-9:50 PHY210.01 General Physics 1 Derby 007	9:30-10:00	9:00-9:50 PHY210.01 General Physics 1 Derby 007
10:00-10:50 Phy335.01 Modern Physics Derby 148	10:00 – 10:50	10:10-10:50 Office Hours	10:00 – 10:50	10:10-10:50 Office Hours
11:00-11:50 Office Hours	11:00-11:50 Phy335.01 Modern Physics Derby 148	11:00-11:50 Phy390.01 Seminar Derby 148	11-11:50	11:00-11:50
12:00-12:50	12:00-12:50	12:00 - 12:50	12:00 - 12:50 Phy321.01 Astrophotography Derby 148	12:00 - 12:50 SGA
14:00-14:50 Phy335.01 Modern Physics Derby 148	13:00-14:50	13:00-15:50 PHY241.01 Fundamentals of Physics Lab 1 Derby 148	13:00-15:50 PHY241.02 Fundamentals of Physics Lab 1 Derby 148	13:00-15:50 PHY241.03 Fundamentals of Physics Lab 1 Derby 148
	16:00-16:50 Div Meetings	16:00-16:50 P&T Worthington		

Tentative Schedule for Physics 335.01 Fall 2024

Date	Information	Event Information
Week starting August 19		Course Initialization
	Partial Derivatives Worksheet	Worksheet 01
	Time Dilation Twin Paradox	Especially Simple Special Relativity Notes
		Gamma Factor vs. Beta Factor Spreadsheet
Week starting August 26	Simulations	Relative Motion: fixed , Comoving
	Time dilation, Length Contraction, Relativistic Velocity addition	Lorentz Transformations
Week starting September 02		Acceleration Transformations
	Space Time diagrams	Space-Time diagram Notes
	Simultaneity:Space - time intervals	Interactive Space-Time Spreadsheet 06
Week starting September 09		external: Interactive Space-time Diagram
		Twin Paradox and Muons
		Relativistic Doppler Shift Notes
		Classical Doppler Shift Animation
		Tabulated Results of Frank-Mary Experiment
		Relativistic Momentum
	2-D Collision in two frames	Mary and Frank Collision Frank's Frame : Mary's Frame
		Relativistic Energy Derivations
		Worksheet 02
Lab 01	The "Oh my God!" particle (backup)	Lab 01: Speed of Light Derivation Spreadsheet Calculator
(approximate date given here)	**Test 1**	**September 11, 2024**
Week starting September 16	Modern Physics timeline	Selected Topics from Chapter 3 e/m measurement determination of e Line spectra Photoelectric effect
		Millikan Oil Drop Experiment
		JJ Thompson Nobel Prize site From AIP
		Mass Spectrometer

Week starting September 23	E over M calculator	Lab 02: Charge to Mass Ratio of the Electron Lab
		Images :Electron Beam E over M Experiment
		Wave Particle Duality
	Blackbody radiation Java Applets	BlackBody Radiation Notes Image from RPI
	Electromagnetic Spectrum Chart	
Week starting September 30	Photoelectric Effect Spreadsheet	L03:Photoelectric Effect Notes: lab : Java Simulation
		James Clerk Maxwell (1831-1879) Robert Bunsen (1811-1899) JJ Balmer (1825-1898) JJ Thompson (1856-1940) Ernest Rutherford (1871-1937) Niels Bohr (1885-1962) Prince Louis-Victor de Broglie (1892-1987) Albert Einstein (1879(Ulm)-1955) Leucippus of Miletus (480BC-420BC)
Week starting October 02	Elemental Discharge Spectra Another link	Discharge Spectra Classification
		Lab 04: Spectral Discharge
	Bohr Model Java applets:	Bohr Model Worksheet and solutions
	Thompson model Java Applet	Rutherford Scattering : Java applets
	Lab 05: Frank Hertz Experiment	x-ray and electron diffraction
	1924	De Broglie Waves
	Nobel Prize Site for Davisson and his lecture	
	1914 : NP 1925 James Franck (1882 -1964) N Franck Hertz Simulations a: requires shockwave b: under java (German) Another link Experiment Notes [P] Gustav Hertz (1887 -1975) N (nephew of Heinrich Hertz)	Franck Hertz Simulations a: requires shockwave b: under java (German) Another link Experiment Notes [P]Week
Week starting October 07		
	Elemental Discharge Spectra	Discharge Spectra Classification

	Nobel Prize Site	
	1914 : NP 1925 James Franck (1882 -1964) N Gustav Hertz (1887 -1975) N (nephew of Heinrich Hertz)	Franck Hertz Simulations a: requires shockwave b: under java (German) Experiment Notes [P]
	Lab 05: Frank Hertz Spreadsheet	An example of screen capture from Franck Hertz experiment
(approximate date given here)	**Test 2**	**October 9, 2024**
Week starting October 14		Wave Motion Notes
	animations	Superposition of waves (beat formation)
		Co-moving Observer
		Moving Spreading Gaussian Wave packet
		Spreading Wavepacket with cars
		Slinky: Longitudinal Pulse :Collision Transverse Pulse: Collision
		Harmonic Traveling Wave on an Infinite String : 001 and Spooky
	Java Applet (External)	Fourier Synthesis for Sound
Week starting October 21		Quantum Mechanics Notes 01
		1D Quantum Square Well Wave Functions
		1D QM square well java applet
		Mixed State 1D Quantum Square Well Wave Functions:2,3 : 2,4 : 3,5
		Quantum Mechanics Notes 02
Week starting October 28		QM Worksheet
	The "Halloween" operator :)	
		Rectangular Barriers
	Quantum Wave Functions	Quantum SHO [W :O: P]: sloped square well
	They make really nice movies here	Wave functions extrodinare
		3D Quantum Square Well
		3D Square Well Spreadsheet
Week starting November 04	Useful Page	QM solution for the Hydrogen Atom
		Magnetic Effects
		Probability Distribution Functions

		Total Angular Momentum
		How to use circles to show addition of angular momentum
	Health Physics Society	
Week starting November 11	IAEA	Nuclear Physics 01 [P]
		Nuclear Physics 02 [P]
		Decay Scheme
	Miscellaneous topics from Modern Physics	Stopping of radiation by physics text
(approximate date given here)	**Test 3**	**November 13, 2024**
Week starting November 18	Miscellaneous topics from Modern Physics	
		Information on Moe Berg
Week starting December 02	Miscellaneous Topics / Classical Gravitation	
Friday December 06	Last Day of Classes	labs not accepted after this day

Physics Problem Solving Rubric Rev FA2024

Note: this rubric indicates the process for completion of physics problems. Since our tests are multiple choice, this should be viewed as a self-guided checklist for successful and complete problem completion. For sample calculations in lab reports, you should follow this rubric closely.

	1	**0.7**	**0.4**	**0**
1, Critical Thinking: Solution started correctly. Note: sketches may be considered here as required in problem statement.	correct approach If required, sketches were correct.	approach would lead to correct result Sketches miss one label or some other component absent or incorrect.	Something is right in the approach but insufficient to reach problem solution. Sketches miss multiple labels, directions incorrectly indicated	incorrect approach Sketch not present or not at all correctly labeled.
2. Quantitative Literacy: Solution proceeded quantitatively	Mathematical operations correct and units correct	Mathematical operations and units correct however an error usually related to incorrect units or the final numerical result present	Mathematical operations have some correct steps but misapplication or other errors prevented problem completion. Units reported in final result not present or incorrect .	Necessary mathematical operations incorrect and units absent
3, Scientific Thought & Informational Literacy Note: this may be contained within an equation starting the problem solution.	correctly stated physical principle or law and physical terminology needed to solve problem.	physical principle or law used shown however omission or extraneous material present. physical terminology needed to solve problem used but not complete or absent important concept.	statement of physical principle or law present but would not apply to present problem so as to lead to solution. physical terminology needed to solve problem incomplete and would not have lead to problem completion.	no statement of physical principle/ law or incorrect physical principle/ law. Did not use physical terms needed to solve problem or incorrect terms used.

Problem scoring: maximum per **problem section** is about 5 points, some sections may have fewer points. In a test containing 4 problems, this equates to 25% of the total test score. The final score per problem is calculated as follows:

$$P_i = \frac{\text{total number of points from rubric}}{\text{maximum rubric points per problem}} \times \frac{100}{\text{\# of problems on test (normally 4)}}$$

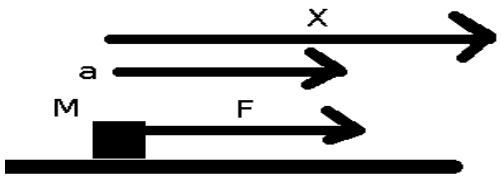
The test score is then determined by

$$\text{percentage test grade} = \sum_{i=1}^{i=\text{Number of problems on test}} P_i$$

Example of a complete solution

Find the vector position at time t of an object of mass M when subjected to a constant force $\vec{F}=F\hat{x}$ for a time t if the object was initially at x=0 and at rest. Provide a numerical result with correct SI units for F=1 N, M=1/2 kg and t=2 s. Include a correctly labeled sketch showing F acting on M, a and x.

Solution:



Newton's law: $\vec{F}=M\vec{a}\Rightarrow\vec{a}=\frac{\vec{F}}{M}:\vec{F}=F\hat{x}\Rightarrow\vec{a}=\frac{F}{M}\hat{x}$: $a_x=\vec{a}\cdot\hat{x}=\frac{F}{M}$

Constant force : kinematic equations of motion in x direction for position:

$$x=x_0+v_{x,0}t+\frac{1}{2}a_x t^2$$

Object initially at rest: $v_{x,0}=0\ \text{m/s}$. Object initially at x=0: $x_0=0\ \text{m}$.

Kinematic equation reduces to: $x=\frac{F}{2M}t^2$

With numerical values: $x=\frac{1\,\text{N}}{2\left(\frac{1}{2}\text{kg}\right)}(2\,\text{s})^2=4\frac{\text{Ns}^2}{\text{kg}}=4\,\text{m}$

Final answer with vectors: $\vec{x}=4\,\text{m}\,\hat{x}$

Score:

1: Started with Newton's law and used correct equation of motion, additionally a correctly labeled sketch was drawn showing correct vector directions as was required=1

2: Algebra (including vectors) correctly lead to final result, unit algebra correct=1

3: Correctly used physical information in the problem which were mass M, initial conditions (at x=0, at rest) , time t, constant force, vector directions. Correct numerical quantities (including correct vectors) provided in final result with correct SI units reported=1

Notes on the lab write-up for physics labs Fall 2024

Your first (cover) page should include the following information:
Your Name, Date, Partners, Title of Experiment and the abstract.
(Then insert a page break)

Each lab must be the unique written effort of the student submitting the report. You may NOT reference or use lab reports (prepared by others) in your report preparation although you are most certainly encouraged to talk to your lab colleagues.

Lab reports must be electronically submitted to the appropriate address as a single pdf document. Links to external documents are not accepted.

Title: Concise wording that describes the essence of the lab.

Abstract - a summary of your research including general methods and major conclusions. This is usually one paragraph long and should convince someone to read your paper. Include a statement of your hypothesis here and if data supported it.

Introduction: An overview of your experiment, statement of hypothesis, what you did and what the theory was behind the experiment.

Methods: - A brief discussion of experimental techniques. Diagrams are usually appropriate in this section.

Results -written usually in the past perfect tense or passive voice; describes your findings, data collected, and includes data tables, graphs, general trends, derived formulas, etc. All work and data tables must be shown here. In general, you need to have a copy of your original data with you but the data included in the lab report can be copied from your original data. Data should be absent of obvious errors (since you would have tracked down these items).

Discussion and analysis - tense can vary, describes your results in relation to other data, discusses problem associated with the lab, postulates trends in the data, predicts results given different circumstances, suggests sources of error, etc. Discuss how the data supports, or does not support your hypothesis and how well such support is in terms of error analysis such as percent differences. **Be sure to include sample calculations in this section.**

Literature Cited - a list of books, articles, etc., that you used to assist you in presenting your data and which were referred to in the write-up. **When citing a reference from the internet, you MUST include the URL that points directly to the document so that a single click of the mouse will bring up that exact document. Every lab report will have at least 1 citation or the report will not be accepted.**

Your presentation of the lab is important. Be sure it is grammatically correct and neatly typed. Be careful of tense changes within a paragraph. Data collected during a lab must be authentic. "Fudging" is unacceptable and unnecessary.
Lab write-ups should be as **concise** as possible within these guidelines. I am not looking for exhaustive tomes of work in a lab write-up.

Physics Lab Grading Rubric Fall 2024

Note: Each student has the opportunity to revise deficient portions of the lab report during the lab period except for teamwork, arrival and departure. This should be regarded as a guide to required elements of a completed lab.

	1	0.5	0
Scientific Thought	Hypothesis in abstract and introduction. Supporting evidence (or non-supporting) discussed in conclusion.	Hypothesis in abstract and introduction but not relevant and supporting evidence (or non-supporting) not discussed in conclusion.	Hypothesis absent in abstract and introduction; Supporting evidence (or non-supporting) not discussed in conclusion
Critical thinking	Correct discussion of experiment, and how results relate to hypothesis.	Incomplete discussion of experiment iand how results relate to hypothesis	poor of absent discussion of experiment, and how results relate to hypothesis.
Inquiry and Analysis	Complete discussion of experimental technique and data results	incomplete discussion of experimental technique and data results	poor or absent discussion of experimental technique and data results
Informational Literacy	Correct physical terminology contained in report. At least one reference present.	incomplete physical terminology contained in report. Reference present but not correct.	incorrect or absence of physical terminology contained in report. Reference not present.
Quantitative Literacy	Correct usage of calculations including spreadsheets	correct usage of calculations including spreadsheets but something significant missing	Absent or incorrect usage of calculations including spreadsheets
Teamwork	Successful team completion of lab		Unsuccessful team completion of lab
Arrival	on time		tardy or absent
Departure	Work space returned as it was when arriving		Workspace left in disorder upon departure
Overall report	All required elements present		Required elements missing.
Quality	experimental results presented without obvious errors		experimental results presented with obvious errors

Student Learning Outcomes for the Physics Program at Lyon College

1. Students who complete modern physics (Phy335) are able to quantitatively apply

1a. special relativity and needed modifications of Newtonian Physics
1b. quantum mechanics as applies to simple situations.
1c. the basis of nuclear reactions and decay.

2. Students will have lab exposure to milestone experiments in modern physics.

2a. Phy335 students will also have lab exposure to several modern versions of important milestone experiments and fundamental experiments in modern physics.

The quantitative aspects (1a,1b,1c) can be measured of portions of currently-used standard exams and exam problems graded according to the problem solving rubric. For each exam, data will be recorded for 1 problem.

The Lab portions (2a) will be evidenced by very brief technical reports of several of the experiments performed in lab graded according to the standard lab grading rubric for two several selected experiments. Data will be recorded for two selected reports.