Lyon College Course Syllabus

Course: Phy335.01/FA19	**Modern Physics**	**M 13:00 – 15:30** **Derby 021**
Professor: Stuart Hutton	**Office:** Derby 248	**Office Phone:** ***.307.7560
Email: stuart.hutton@lyon.edu	**Office Hours:** **MWF** 10:00–10:50/AR	
Physics Email: lyonphysics@*****.***	**Physics Web Gateway:** physics.lyon.edu	**Physics SMS:** 307.***.8765

STANDARD POLICIES

Honor Code

All graded work in this class is to be pledged in accordance with the Lyon College Honor Code. The use of a phone for any reason during the course of an exam is considered an honor code violation.

Class Attendance Policy

Students are expected to attend all class periods for the courses in which they are enrolled. They are responsible for conferring with individual professors regarding any missed assignments. Faculty members are to notify the Registrar when a student misses the equivalent of one, two, three, and four weeks of class periods in a single course. Under this policy, there is no distinction between “excused” and “unexcused” absences, except that a student may make up work missed during an excused absence. A reminder of the college’s attendance policy will be issued to the student at one week, a second reminder at two weeks, a warning at three weeks, and notification of administrative withdrawal and the assigning of an “F” grade at four weeks. Students who are administratively withdrawn from more than one course will be placed on probation or suspended.

Disabilities

If a student has a disability that qualifies under the American with Disabilities Act (ADA) and requires accommodations, they should contact the Office of Disability Services in the Morrow Academic Center for information on appropriate policies and procedures. Disabilities covered by ADA may include learning, psychiatric, physical disabilities, and/or chronic health disorders. Students can contact Office of Disability Services if they are not certain whether a medical condition/disability qualifies.

Location: Morrow Academic Center
Staff: Danell Hetrick, Director of Academic Support
Email: danell.hetrick@lyon.edu
Telephone: 870-307-7021

Harassment, Discrimination, and Sexual Misconduct

Title IX and Lyon’s policy prohibit harassment, discrimination and sexual misconduct. Lyon encourages anyone experiencing harassment, discrimination or sexual misconduct to talk to Donald Taylor, Title IX Coordinator, or Patrick Mulick, Dean of Students and Title IX Deputy Coordinator, about what happened so they can get the support they need and Lyon can respond appropriately. Lyon is legally obligated to respond to reports of sexual misconduct, and therefore we cannot guarantee the confidentiality of a report, unless made to a confidential resource (Chaplain, Counselor, or Nurse). As a faculty member, I am required to report incidents of sexual misconduct and thus cannot guarantee confidentiality. I must provide our Title IX coordinator with relevant details such as the names of those involved in the incident.

Withdrawal Deadlines

Last day to drop with no record of the course is **Tuesday September 03, 2019.**

Last day to drop with a W is Wednesday October 23, 2019.

Tentative Syllabus for Physics 335: Fall 2019

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

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: in particular, you will not receive credit for class participation for unexcused absences. There are no make-ups for in-class worksheets. About labs: A brief lab report will be normally due within 1 week of the lab completion. Labs will be done in accord with topics which we are covering as shown on the syllabus. 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.

Maturity Expectations

Bathroom breaks: Bathroom breaks are sometimes necessary owing to the extended lengths of time that this class requires. As needed, we will take a short break if necessary. Aside from this, you are expected to be in class unless you have an accommodation from ODS.

Texting/game playing: Students who text/game play during class are considered to have an unexcused absence, which will automatically lower your grade. If you text during class, you will be asked to leave.

Late Arrivals: Students arriving after the lecture has started except in exceptional circumstances are automatically considered as having an unexcused absence for the entire day and your grade will automatically be lowered.

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. 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. Use of a networked device to communicate (aside from downloading class materials) during class will be considered equivalent to an unexcused absence. Tardiness is considered to be an unexcused absence and will negatively impact your final grade. In general you do not have permission to enter the classroom after class has started. Texting during class is a self-selection process that will invariably lead to less than stellar success for the person texting. Disruptive and/or persistent texting is not permitted and you may be asked to leave if you do this.
Unexcused absences will negatively impact your final grade: in particular, you will not receive credit for class participation for unexcused absences. Tardiness is considered to be an unexcused absence and will negatively impact your final grade. Absences will negatively impact your final grade. Tardiness is considered to be an unexcused absence and will negatively impact your final grade. Use of a networked device to communicate during class will be considered equivalent to an unexcused absence.

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. On tests, students are required to keep notes and books closed **except as instructed. Your professor will supply all the paper needed for the tests. All** questions during tests should be directed to the professor only and students are not permitted to communicate with each other during tests. **CELL PHONES AND ANY OTHER WIRELESS OR NETWORKED DEVICE (INCLUDING COMPUTERS, WATCHES, RINGS, GLASSES, CALCULATORS, CAMERAS, etc.) MAY NOT BE USED DURING TESTS except as authorized for specified internet locations to access reference material.** You **may not refer to old tests from previous years** in this course. Students are specifically prohibited from discussing any aspect of tests with other students until all students have completed the test. You can, and are encouraged, to discuss it with me. Contravention of these conditions will **automatically** be considered to be a violation of the Lyon College Honor Code.

CLASS SCHEDULE / OFFICE HOURS Fall 2019

Office		General Lab		Research Lab
Derby 248		Derby 148		Derby 219

PROFESSOR Stuart Hutton

Monday	Tuesday	Wednesday	Thursday	Friday
8:00-8:50 PHY240.01 Fundamentals of Physics I Derby 011	8:00-9:15	8:00-8:50 PHY240.01 Fundamentals of Physics I Derby 011	8:00-9:15	8:00-8:50 PHY240.01 Fundamentals of Physics I Derby 011
9:00-9:50 PHY210.01 General Physics 1 Derby 011	9:30-10:00	9:00-9:50 PHY210.01 General Physics 1 Derby 011	9:30-10:00	9:00-9:50 PHY210.01 General Physics 1 Derby 011
10:10-10:50 Office Hours Derby 248	10:00 - 10:50	10:10-10:50 Office Hours Derby 248	10:00 - 10:50	10:10-10:50 Office Hours Derby 248
11:00-11:50 Lunch	11:00 - 11:50 Cor100.16 Derby 148	11:00-11:50 Lunch	11:00-11:50 Lunch	11:00-11:50 Lunch
12:00 - 12:50 Phy390.01 Physics Seminar Derby 021	12:00-12:50 Lunch	12:00 - 12:50	12:00 - 12:50	12:00 - 12:50 SGA Derby 016
13:00-15:30 Phy335.01 Modern Physics Derby 021	13:00-14:50	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
16:00-16:50 FPC Derby 021				

Schedule for Physics 335.01 Fall 2019

Date	Information	Event Information
Week starting August 26, 2019		Course Initialization
	Partial Derivatives Worksheet	Worksheet 01
	Time Dilation Twin Paradox	Especially Simple Special Relativity Notes
		Gamma Factor vs. Beta Factor Spreadsheet
	Labor Day Holiday	**September 2, 2019**
Week starting September 09, 2019	Simulations	Relative Motion: fixed , Comoving
	Time dilation, Length Contraction, Relativistic Velocity addition	Lorentz Transformations
Week starting September 16, 2019		Acceleration Transformations
	Space Time diagrams	Space-Time diagram Notes
	Simultaneity:Space - time intervals	Interactive Space-Time Spreadsheet 06
		external: Interactive Space-time Diagram
		Twin Paradox and Muons
		Relativistic Doppler Shift Notes
		Classical Doppler Shift Animation
		Tabulated Results of Frank-Mary Experiment
Week starting September 23, 2019		Relativistic Momentum
	2-D Collision in two frames	Mary and Frank Collision Frank's Frame : Mary's Frame
		Relativistic Energy Derivations
		Worksheet 02
	The "Oh my God!" particle (backup)	Lab 01: Speed of Light Derivation Spreadsheet Calculator
(approximate date given here)	**Test 1**	**September 23, 2019**
Week starting September 30, 2019		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 October 07, 2019	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	
	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)
	Fall Break	**October 14 - October 15**
Week starting October 21, 2019	Elemental Discharge Spectra Another link	Discharge Spectra Classification
	Bohr Model Java applets:	Bohr Model Worksheet and solutions
	Thompson model Java Applet	Rutherford Scattering : Java applets
	Lab 04: Spectral Discharge	
	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
	Service Day	**October 23, 2019**

Week starting October 28, 2019	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 28, 2019**
Week starting November 04, 2019		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 November 11, 2019		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 November 18, 2019		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 25, 2019	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	
	IAEA	Nuclear Physics 01 [P]
		Nuclear Physics 02 [P]
		Decay Scheme
		Stopping of radiation by physics text
(approximate date given here)	**Test 3**	**November 25, 2019**
	Thanksgiving Break	**November 27 - December 01**
Week starting December 2, 2019		Black Holes, General Relativity and nice movies
		Information on Moe Berg
	Last day of classes	**December 6, 2019**
	Final Exams	**December 9 - December 12**

Physics Problem Solving Rubric Rev Fall 2019

	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:

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

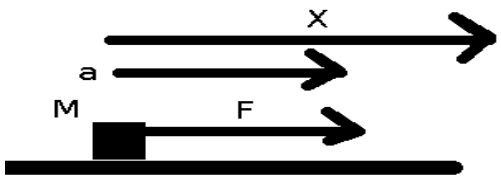
The test score is then determined by

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

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: $\vec{F}=M\vec{a}\Rightarrow\vec{a}=\frac{\vec{F}}{M}:\vec{F}=F\,\hat{x}\Rightarrow\vec{a}=\frac{F}{M}\hat{x}$: $a_x=\frac{F}{M}$

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

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

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

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

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 2019

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 team submitting the report. You may NOT reference or use lab reports (prepared by others, outside your team) in your report preparation.

Lab reports must be electronically submitted to the appropriate address as a single pdf document.

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 2019

Note: Each student has the opportunity to revise deficient portions of the lab report during the lab period except for teamwork, arrival and departure.

	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

Safety regulations for General Physics Labs

(1) Anytime springs are used in lab, safety goggles must be worn.
(2) Anytime boiling water is used in lab, safety goggles must be worn.
(3) You should not look at laser light or point it towards other people.
(4) In the event of a spill (which will be water), dispense a towel from the spill kit (aka towel dispenser) and wipe up the spill.
(5) The sink in the physics prep room is not a sink and should not be used as one.
(6) Food and drink are not permitted in lab.
(7) Appropriate clothing is required in lab although lab aprons are not required.

Attach this form to your email (as an extra attachment today) when you send in your introductory lab report. In your lab report, right below your name, you should say this:
I have read the safety regulations attached to this email.

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.