

FUNDAMENTALS of PHYSICS III (“Modern Physics”) *

PHY-2030 SECTION 01, FALL 2016

LECTURE: TTh 9:45 - 11:25 AM, LAB: T 7:40 - 9:40 AM; 129 CONGDON

Instructor: Dr. Brad N. Barlow, 363 Congdon Hall, Email: bbarlow@highpoint.edu

Office Hours: TBD; 363 Congdon Hall

Course Description: An introduction to space-time physics and quantum physics with applications in astronomy, cosmology, solid-state physics, nuclear physics, and particle physics. Four credits. Prerequisite: PHY 2020. Offered Fall Semester.

Course Website: physics.highpoint.edu/~bbarlow/courses/phy2030/phy2030.html

Attendance Policy: If you have more than two unexcused absences, you can be withdrawn from the class. I reserve the right to choose whether to withdraw you or not for lack of attendance.

Textbook: *Six Ideas that Shaped Physics* by Thomas Moore (required). We will use the 3rd edition of Unit R (Relativity) and Unit Q (Quantum). These are separate books published by McGraw Hill.

Expectations / Daily Schedule: Expect to work hard, to be challenged, to learn, and to work together. Unlearn what you have learned: many of the ideas we will discuss are not aligned with human intuition. Most days will begin with a reading quiz that covers the chapter content and exercises that you should have completed before coming to class. Reading quizzes and Two-Minute Problems are used for self-evaluation to assess how much you retained from reading the chapter. Daily preparation and participation is **absolutely required** for your success in the class, as well as the success of your classmates. Each class will be arranged according to the following schedule:

- Reading quiz and Two-Minute Problems
- Chapter review and discussion
- Activities and simulations
- Cooperative group problems
- Summary of big ideas

You are expected to do at least five hours of work outside of class each week, including reading, solving problems, and working on your class project.

Grade Policy: We are going to use a different approach to assessment this semester called “Standards-Based Grading” (SBG). Each chapter has a list of standards to be met that you can find on the course website, along with the “evidences” that must be provided for each standard. You will solve problems, write computer programs and do experiments to show your understanding (i.e. proficiency) on each standard. We will have periodic quizzes, exams, and collaborative problem solving sessions where you can demonstrate proficiency on each standard. You will also be given example problems that you can use to show your proficiency. At any time, you can re-assess *up to two standards per week* to demonstrate your proficiency. Your grade is not final until the end of the semester and you can use the entire semester to demonstrate your understanding. However, when being reassessed, it’s possible for your proficiency to *decrease* as well. Your current progress on standards will be accessible through a Google doc.

*I reserve the right to change this syllabus based on feedback from you and what I determine is best for the course.

Using SBG helps address several issues with ‘traditional’ assessment:

- Sometimes one focuses on points instead of learning.
- When one does poorly on an exam, there is no incentive to study the material that one did not understand. Additionally, one loses the points on that exam even if the material is understood by the end of the semester.
- When you get a grade on an exam, like 70%, it might mean that you understood 70% of the content and do not understand 30%. The overall score does not tell you which concepts/skills you are proficient at and which ones you still need to study or practice. By tying each question on an exam to a standard and grading each question (not the exam), you know exactly which standards you still need to study.
- Cramming for an exam is rewarded, not the habits that lead to life-long learning like persistence and independence.

You will be graded on a 4-pt scale for each standard. To convert each 4-pt standards rating to a percentage score, the following non-linear relationship will be used:

$$\text{Standards \% Score} = \left(\frac{\text{Standards Four Point Score}}{4} \right)^{0.7} \times 100 \quad (1)$$

For example, if you receive a rating of “3” on the standard “MQ,” that is equivalent to a percentage score of 81.7% for that standard. The rubric for the 4-pt scale is shown below and is borrowed from Aaron Titus and Andy Rundquist (who cites Frank Noschese).

Four-Point Scale:

0. **Not assessed:** 0 pts

1. **Doesn’t meet expectations:** 1 pt

- (a) I need lots of help from my instructor (one-on-one).
- (b) I have low confidence on how to do the skills and need more instruction.
- (c) I need my textbook/notes at all times.
- (d) I do not understand the concept/skills.
- (e) I cannot correctly identify concepts and/or define vocabulary.
- (f) I cannot make connections among ideas or extend the information.
- (g) My responses lack detail necessary to demonstrate basic understanding.
- (h) Cannot articulate most of the main ideas involved in the standard

2. **Approaches expectations:** 2 pts

- (a) I have a general understanding of the content/skills, but I’m also confused about some important parts.
- (b) I need some help from my instructor (one-on-one or small group) to do the skills correctly
- (c) I do not feel confident enough to do the skills on my own
- (d) I need my textbook/notes most of the time.
- (e) I can correctly identify concepts and/or define vocabulary; however I cannot make connections among ideas and/or independently extend my own learning.
- (f) My responses demonstrate basic understanding of some main ideas, but significant information is missing.

3. **Meets expectations:** 3 pts

- (a) I understand the important things about the content/skills.
- (b) I have confidence on how to do the skills on my own most of the time, but I need to continue practicing some parts that still give me problems.
- (c) I need my handouts and notes once in a while.
- (d) I am proficient at describing terms and independently connecting them with concepts.
- (e) I understand not just the "what," but can correctly explain the "how" and "why" of scientific processes.
- (f) My responses demonstrate in-depth understanding of main ideas.

4. **Exceeds expectations:** 4 pts

- (a) I understand the content/skills completely and can explain them in detail.
- (b) I can explain/teach the skills to another student.
- (c) I have high confidence on how to do the skills.
- (d) I can have a conversation about the skills.
- (e) I can independently demonstrate extensions of my knowledge.
- (f) I can create analogies and/or find connections between different areas within the sciences or between science and other areas of study.
- (g) My responses demonstrate in-depth understanding of main ideas and of related details.

Assessments: There will be at least three 100-minute long assessments (exams). They will typically consist of two or three of the following sections: (1) conceptual and numerical multiple choice questions; (2) problem solving; (3) computational modeling. All assessments, including the final exam, are comprehensive and can include any standards that are "live" up to that point in the semester.

Project: You will do a class project that is experimental, computational, or theoretical in nature. The project must be approved by Dr. Barlow. It must be related to topics in the course. There are five categories that the project's grade is based on.

1. level of difficulty
2. level of creativity
3. level of independence
4. completeness (i.e. Does the simulation run and give correct results? or Did you report uncertainties in your measurements? or Did you include relevant background material and references)
5. quality of presentation and/or paper.

For full project credit, each student must:

1. write a paper of appropriate length (5000 words is a rough estimate) that describes the details of your project. LaTeX is required. Templates are at: <http://physics.highpoint.edu/Physics/LaTeX.html>.
2. present your project to the class.

Grade Breakdown:

Proficiency with Standards	80%
Participation/In-Class Assignments	10%
Class Project	10%

Letter grades will be assigned based off of the following scale:

≥ 97	A+
93.0 - 96.99	A
90 - 92.99	A-
87 - 89.99	B+
83 - 86.99	B
80 - 82.99	B-
77 - 79.99	C+
72 - 76.99	C
70 - 71.99	C-
60 - 69.99	D
< 60	F

Extra Credit: No extra credit is currently planned; however, the instructor reserves the right to provide extra-credit assignments to the entire class when deemed necessary. *If* such an opportunity is provided, details will be announced during the lectures.

Honor Code: The High Point University Honor Code asserts that:

- Every student is honor-bound to refrain from conduct which is unbecoming of a High Point University student and which brings discredit to the student and/or to the University;
- Every student is honor-bound to refrain from collusion;
- Every student is honor-bound to refrain from plagiarism;
- Every student is honor-bound to confront a violation of the University Honor Code;
- Every student is encouraged to report a violation of the University Honor Code.

My obligation is to promote academic integrity and to enforce the University Honor Code. This obligation includes appropriately interpreting the Honor Code, promoting conditions favorable to academic integrity, and reporting violations of the Honor Code.

I encourage collaboration on homework. I encourage you to work together to solve problems. You may check your work with others. You may use solutions manuals, tutors, books, and any other resource on homework. However, you must know how to solve problems independently so that you can solve unfamiliar problems on exams.

You must do your own work on an exam. You may not look at another persons exam. You may not use any other resource except the equation sheet that is given to you and your calculator. You may not store programs or equations in your calculator, and you may not use data stored in your calculator on an exam. Calculators may only be used to input numerical values and perform calculations.

Violation of the honor code will be handled according to procedures outlined in the Faculty Handbook.

Accommodations: Students who require classroom accommodations due to a diagnosed disability must submit the appropriate documentation to Disability Support Office on the 4th floor of Smith Library or by contacting Birshari Cox, Director of Disability Support Services, at bcox@highpoint.edu. A student's request for accommodations should be made at the beginning of each semester/course. Please note that accommodations are not retroactive.

Table 1: Tentative Schedule of Class Meetings

Day No.	Date	Chapter – Topic	Lab (tentative)
1	23 Aug	R1 – principle of relativity	Reference Frame Video Analysis
2	25 Aug	R2 – coordinate time	
3	30 Aug	R3 – the space-time interval	Speed of Light
4	1 Sep	R4 – proper time	
5	6 Sep	R5 – coordinate transformations	
6	8 Sep	R6 – Lorentz contraction	
7	13 Sep	R7 – the cosmic speed limit	
8	15 Sep	R8 – four-momentum	
9	20 Sep	R9 – conservation of four-momentum	
10	22 Sep	EXAM 1	
11	27 Sep	Q1– wave models	Standing Waves / Fourier Analysis
12	29 Sep	Q2 – standing waves and resonance	
13	4 Oct	Q3 – interference and diffraction	Young’s Double Slit Lab
14	6 Oct	Q4 – the particle nature of light	Photoelectric Effect Lab
15	11 Oct	Q5 – the wave nature of particles	
16	13 Oct	Q6 – spin	
	17-21 Oct	<i>Fall Break</i>	
17	25 Oct	Q7 –the rules of quantum mechanics	
18	27 Oct	Q8 – quantum weirdness	
19	1 Nov	EXAM 2	
20	3 Nov	NO CLASS – PhysCon	
21	8 Nov	Q9 – the wavefunction	
22	10 Nov	QA – complex numbers	
23	15 Nov	Q10 – simple quantum models	
24	17 Nov	Q11 – spectra	Atomic Spectroscopy
25	22 Nov	Q12 – the Schrödinger equation	Schrödinger Solver
	23-25 Nov	<i>Thanksgiving Break</i>	
26	29 Nov	nuclear <i>or</i> astrophysics (TBD)	
27	1 Dec	nuclear <i>or</i> astrophysics (TBD)	
28	6 Dec	nuclear <i>or</i> astrophysics (TBD)	
29	8 Dec	FINAL EXAM (8:00am)	

R = “Six Ideas That Shaped Physics Unit R”

Q = “Six Ideas That Shaped Physics Unit Q”