

## PY105 Honor Code

I agree to act with complete honesty in PY105. This includes, but is not limited to, the following:

All work I turn in will be my own, and not copied from any other source.

For in-class questions I will submit answers/responses based on my own work.

I will not submit answers/responses for anyone else.

I will not sign in for anyone else.

In addition to being reported to the Academic Conduct Committee, examples of grading penalties might include:

Zero on an assignment if you copy the assignment, or let someone copy from me.

Zero on a test if there are copying issues, or other examples of misconduct.

I will read the PY105 course syllabus. There is a link to the Academic Conduct Code on the PY105 learn.bu.edu web site, and I will read that, too. I will take all three exams on the dates provided in the syllabus.

Name (please, print): \_\_\_\_\_

BU ID: \_\_\_\_\_ BU Username: \_\_\_\_\_

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

## Disclaimer

It is a well-known fact that different people might have different taste in food or art, or anything else.

Your friends might love horror movies but you might hate them, or you might like sushi but your friends will never eat it.


The same is true for choosing your instructor. There is no ideal teacher who would be equally good for everyone. Different people have different learning styles, students have different backgrounds, different instructors have different teaching styles, and it is just impossible to equally accommodate every student in a classroom by offering the same lectures, exercises, questions, demonstrations, etc. That is why some students might find instructions as too fast but others as too slow; too easy or too challenging. This course is not for everyone, in the past some students liked it and some didn't. Everyone is welcomed to check what previous students thought of my teaching (more at <http://GoMars.xyz/cr.htm>).

In this disclaimer, I need to point out that summer courses are *always* more intense than fall or spring courses because the same amount of material is to be covered over a shorter period of time. The success in taking this course depends mostly on the effort put into the study, including lectures, home work, investigative laboratories, and, if needed, office ours.

Students should expect spending on average at least two hours every day on reading and homework (in addition to lectures and investigative laboratories).

It is advisable to distribute the homework uniformly over a week (not waiting until the deadline for HW will be approaching; solving all the problems in one seating is impossible).

Lecture	Professor	Contact Info.	Office hours
SA1 MTWRF 8:30-9:50 AM in SCI 109	Dr. Valentin Voroshilov Office: SCI 260/111	Phone: 617- 353-2634 E-mail: valbu@bu.edu	SCI 121

<b>Required Text</b>	College Physics, by openstaxcollege.org (free download at <a href="http://openstaxcollege.org/textbooks/college-physics/get">http://openstaxcollege.org/textbooks/college-physics/get</a> or buy from AMAZON)	
<b>Web site</b>	<a href="http://learn.bu.edu">http://learn.bu.edu</a> (PY105 A1 Elementary Physics 1 (Summer 1 2017))	
<b>Calculator</b>	You will need a standard scientific calculator for homework, labs, lectures, and all exams.	
<b>Internet Access</b>	For every lecture you will need to have a device which can be used to access the Internet (specifically, WebAssign.net)	
<b>Homework</b>	homework assignments will be delivered via WebAssign (you will need to purchase the access code; follow the instructions below)	
<b>Exams (no makeups!)</b>	Test 1 June 5; 8:00 am – 9:50 am, Test 2 June 19; 8:00 am – 9:50 am, Test 3 June 30; 8:00 am – 9:50 am.	
<b>Course Grade</b>	14 % homework + pre- and post- surveys 16 % unit sections (IL2 – IL10) 7 % lecture participation: in-lecture quizzes, class participation, IL1, IL11 20 % test 1, 21 % test 2, and 22 % test 3	
<b>Grading Scale</b> <i>(slight deviations up to 1.5 points in either directions are possible)</i>	We will use the following scale for grades (the scale is not relative but absolute; students are <i>not</i> competing with each other, collaboration is advisable): A: 95 - 100 B+: 85 – 89.9999 B-: 75 – 79.9999 C: 60 – 68.9999 D: 45 – 54.9999 A-: 90 – 94.9999 B: 80 – 84.9999 C+: 69 – 74.9999 C-: 55 – 59.9999 < 45 for F	

## About this course

It is advisable to sign up for the both PY 105 and PY 106 summer courses, in that case you will be using the same textbook for two courses and save on the access to WebAssing.

***Please, note: PY105 and PY106 courses cover about 80% of a standard MCAT prep course, hence do not represent a full equivalency to a MCAT prep course but rather can be seen as a prerequisite to that.***

This course might be perceived differently from traditional courses by its main philosophy and structuring. It is built upon the principles of constructivism and employs inquiry-based strategies of teaching.

In this course students develop the fundamental concepts and ideas while working through combined discussion/lab activities named Investigative Laboratories (IL). Investigative Laboratories are designed in such a way that every student will be developing a deep understanding of fundamental physical concepts via hand-on experience of building connections between experimental realization and theoretical descriptions of physical phenomena (this is the why some of the study material comes first at IL, and later at a lecture).

Our lectures will ensure the correct understanding of the fundamental principles and will guide students through problem solving techniques and procedures to help them to achieve a deeper understanding of how to apply the fundamental physical concepts to solving specific physics problems. During lectures, delivered in the form of Active Learning Group format, students are encouraged to form collaborative groups to discuss problem-solving strategies. Ideally, lectures become a place for a scientific communication between peers and for knowledgeable individual decision making in the field of physics.

**The ultimate goals of the course are 1) helping students to grasp the understanding of fundamental physical concepts, 2) helping students to learn how to apply those concepts for solving specific physical problems, 3) helping students to advance the ability to think critically about physical phenomena, and 4) to support positive attitudes toward study physics.**

Taking this course does not require taking physics before, but requires **fluency in basic arithmetic, algebra, and trigonometry, and also common knowledge about everyday natural phenomena.**

Everyone is encouraged to use as many office hours as possible to ensure the full understanding of the subject, and to collaborate with the fellow students via piazza.com.

### **Class Links:**

<https://piazza.com/bu/summer2017/py105s>

<https://piazza.com/bu/summer2017/py105s/home>

## Using WebAssign

WebAssign is a web-based homework system we will be using for the homework. The name of the course is "PY105 Summer I 2017". Please contact Prof. Voroshilov if you have any problems, particularly if you have problems logging in. The web address for WebAssign is: <http://www.WebAssign.net/student.html>

WebAssign will become available on May 19th and for two weeks you can use it for free. During that time you will need to buy the access directly from WebAssign with a credit card. To do this, log into WebAssign using the information below and then hit the button for registering with a credit card. Note that you can do the first assignment without paying for access - you get free access for the first two weeks of using WebAssign. If you confident you will take both PT105 and PY106 courses, you can purchase the lifetime subscription.

You will have to self register using the following class key: bu 9338 9160

### Important (!!!):

1. While registering you need to choose as you username your regular BU login name: for example, if your BU email is abcd123@bu.edu => your username must be abcd123 (just drop @bu.edu).
2. Institution name: BU
3. As your password you need to use your BU student number in the form **U12345678**. No dashes or spaces, *must start from capital U* !
4. As an email you have to use your BU email address ([yourbuusername@bu.edu](mailto:yourbuusername@bu.edu))

**Failing to fulfill the requirements above WILL lead to losing points on your homework assignments (!!!).**

\*\* Note that if you have used WebAssign previously at BU, such as in Chemistry, then WebAssign might be looking for your old account, but for this course you have to have the new access code and change your account credentials according to the requirements above.

### Getting the most out of WebAssign

You have six chances to submit each answer to each question of each problem of each homework assignment. Use your submissions wisely. Note that *you can submit the answers to each question individually* - you do not need to fill in answers for the whole problem or the whole assignment first. Each time when you click on SUBMIT, WebAssign tells you whether you are right or wrong (unless an assignment specifically designed not to give you a feedback).

Things to keep in mind when using WebAssign: - Start early. - Come to office hours for help; if you have left just two trials for a particular question, it is advisable to stop and seek some help.

- Feel free to work together with other students, but try to do as much as you can on your own.
- Do not hit the refresh button on your browser - that can count as a submission.

It is not very critical which textbook you would use for your reading (the theory is the same!) that is why we use a free textbook from Openstax.org. Additional useful sources are books by A. Duffy, Cutnell and Johnson, Giancoli, Ohanian, Halliday, Resnick, Walker. Also you can use online resource like Wikipedia.org; <http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html>; [physics.bu.edu/demos](http://physics.bu.edu/demos); etc.

Most of the exam problems will be based on problems from lectures, homework problems (which comes from the textbook), and problems solved during discussions and labs.

**Course web site:** <http://learn.bu.edu>

Your login name is your regular BU login name and your password is your BU Kerberos password. In case of any problems, please contact Dr. Voroshilov (valbu@bu.edu). **If you do not have a BU Kerberos account you must get one.** You can *start* the application process on-line at <http://www.bu.edu/computing/accounts/acsaccounts/creating/> (BU students should use the "Individual" instructions; non-BU students should use the "Guest" instructions); and you will *need* to go to IT Help center at 771 Commonwealth Ave (Mugar Library, 1<sup>st</sup> floor) to *complete* the process (please, call 617-353-4357 for more information). You may need to synchronize your BU account to have access to all BU websites.

The web site contains all course information. You will also be able to check all your grades. **It is your responsibility to regularly check your grades and make sure they have been recorded correctly; about any grade related issues contact Prof. Voroshilov as soon as possible** (a standard period for addressing any grade issues is a week after the grade has been posted). In order to watch lectures non-BU students might go to [www.bu.edu/kpw](http://www.bu.edu/kpw), select the 'Log In' button to authenticate and sync BU credentials.

**Homework:** To pass the course you must get *at least 50% of the maximum homework score (not including the ore- and post- survey grades)*. All homework assignments will be delivered via WebAssign. The numbers in the on-line assignments might be randomized so everyone gets a unique version of any problem. These assignments usually are due at 6 pm on the due dates, adjusted somewhat for schedule peculiarities. **All homework assignment will be accounted for the final grade.** You are strongly encouraged to obtain help (if needed) during lab sections and office hours, and from your fellow classmates using piazza. In addition to Dr. Voroshilov's office hours, you can use office hours of any TF of the class (the schedule and other course information is posted on the course board in the Science Building on the first floor by the undergraduate resource room SCI 121).

**Lectures:** Participation provides 7 % of the total grade. Students are allowed to miss up to 5 lectures due to legitimate reasons (every emergence case has to be reported as soon as possible). To get the most out of the lectures you are encouraged to read the material ahead of time and prepare questions (below you find the list of topics and concepts with which you should be familiar when coming to an exam).

**Discussion sections and traditional laboratories are combined together in 11 Investigative Laboratories (or shortly, IL, or units):** These begin on **May 23th**. Much of the time in IL will be spent working with your partner on discovering, analyzing and applying fundamental physical concepts and relationships. Laboratory activities are combined with problem solving activities. The *first* and the *last* ILs are *mandatory* (with the grade to be a part of the attendance grade). For the other 9 ILs the best 8 scores out of 9 will be counted toward the final grade. **To pass the course you must complete at least 7 IL** (from IL2 to IL10). Unit assignments are only complete when your personal report is checked by your TF/LA during and at the end of the unit session. Your unit report will consist of copies of your data together with your answers to questions on a sheet(s) handed out at the beginning of the unit session. Each student must have an individual report.

All sections are usually held in rooms SCI 134/128 but occasionally can be relocated (e.g. SCI 130, B9). The room assignments for a particular week will be posted on all lab doors - please, pay attention to the information provided on learn.bu.edu.

**Exams:** Three closed-book no-notes exams are required for the course. *Formally exams are not accumulative, but due to internal logical connections some of the new exam problems WILL be related to the previous ones.* Equation sheets will be provided, but it is advisable to memorize the most important physical laws and definitions.

Concerns about grading must be brought to Dr. Voroshilov's attention *within one week after the tests are returned* (the final exam will not be returned due the BU policies). A random sample of tests will be photocopied before being returned to discourage cheating on re-grade issues.

In exceptional (unforeseen, like unexpected illness or accident) circumstances an arrangement may be made to take a make-up test. In a case when due to unforeseen circumstances a student might lose more than 10 % of the possible total grade, the best approach would be taking an Incomplete for the course and finishing it later.

**If any accommodation may be needed, the request must be processed within the first week of the course and be supported by the required paperwork.**

**Makeup policy:** It is your responsibility to take all exams, and do all homework and lab assignments according to the posted schedules. *There are NO makeups*. In exceptional circumstances please contact Dr. Voroshilov as soon as possible.

**Switching sections:** We encourage you to switch from a full to less occupied unit sections. For any section change you need Dr. Voroshilov's signature on a drop/add form.

**Getting help:** The best way to get help is to come to office hours and using piazza for collaboration. Between the professor and the teaching fellows there are about 20 office hours per week - please come and see any of us. All office hours are held in SCI 121 (unless rescheduled due to room unavailability).

**Ethics Policy:** You are expected to be familiar with and adhere to the College of Arts and Sciences Academic Conduct Code, in particular, cheating in any form will not be tolerated. Evidence of cheating will be reported immediately to the Academic Conduct Committee. **Students found guilty of cheating on exams may be penalized by reducing the grade, by suspension or even expulsion.**

**All students will have to sign an honor code on the first day of class**

**At the beginning of every lecture, every student will have to access the Internet and login to wenassign.net. In order to have this option every student has to bring a device with the Internet access (a laptop, a tablet, a smartphone). It is highly recommended to check the access to WebAssign before the beginning of the course.**

## Concepts, definitions, and laws/relations to learn

### week 1

a scalar (*the first topic of test 1*)

a vector

a component

a right triangle

sin, cos, tan

the Pythagorean theorem

Coordinate system

Cartesian coordinate system

an axis

an origin

a coordinate

Cartesian vector components

linear equation

quadratic equation

quadratic formula

a unit

fundamental (base) units

SI system of units

unit conversion

conversion factor

prefix words

etalon

measurement

significant figures

motion

1 D motion

2 D motion

translational motion

linear motion (LM)

position

position vector

displacement

distance

elapsed time

velocity

speed

average velocity

average speed

instantaneous velocity

motion equation

motion diagram

position graph

velocity graph

meaning of the slope

meaning of the area

constant velocity motion (CVM)

properties of CVM

acceleration

average acceleration

instantaneous acceleration

motion with constant acceleration (MCA)

properties of MCA

relative motion

velocity addition

“crossing the river”

projectile motion (PM)

properties of PM

range, maximum height, flight time



## **week 2**

inertia

force

list of forces

Newton's 1<sup>st</sup> law

Newton's 2<sup>nd</sup> law

Newton's 3<sup>rd</sup> law

principle of superposition of forces

FBD

force of gravity vs. apparent weight

weightless

kinetic friction vs. static friction

coefficient of friction

a pulley

an ideal string

an Atwood's machine

methods for applying Newton's laws (*the last topic of test 1*)

## **week 3**

circular motion (CM) (*the first topic of test 2*)

circumference

radius

uniform circular motion (UCM)

period

frequency

centripetal acceleration

properties of horizontal UCM

properties of vertical UCM

properties of vertical CM

kinetic energy

work

work-force connection

force-position graph

power

power-force connection

work-kinetic energy theorem

conservative force

potential energy

gravitational potential energy

mechanical energy

non-conservative force

law of conservation of energy

impulse of a force

linear momentum

force-time graph

closed (isolated) system

law of conservation of linear momentum

a collision

elasticity

four types of collisions

methods for solving collision problems

center of mass (COM)

calculating COM

#### **week 4**

a solid object

rotational motion

axis of rotation

an arc

angular displacement

angular velocity

angular acceleration

degrees vs. radians

connections RM to LM

torque

lever arm

calculating torque

rotational inertia (RI)

Newton's 1<sup>st</sup> law for RM

Newton's 2<sup>nd</sup> law for RM

static equilibrium

conditions for static equilibrium

solving problems on static equilibrium

Table of RI

parallel axis theorem

applications of Newton's laws for RM

angular momentum

rotational kinetic energy

rotational impulse

rotational work

work-kinetic energy theorem

rolling

rolling without slipping

special cases of rolling (a spool, racing objects, Atwood's machine)

law of conservation of energy

law of conservation of angular momentum (*the last topic of test 2*)

#### **week 5**

stable equilibrium

unstable equilibrium

restoring force

oscillations

small oscillations

Hooke's law

Newton's 2<sup>nd</sup> law for SHM

simple harmonic motion (SHM)

SHM for horizontal spring

analogy between SHM and UCM

motion equation for SHM

S, V, A graphs for SHM

period

frequency

angular frequency

amplitude

elastic potential energy

energy graphs

conservation of energy

SHM for a vertical spring

a simple pendulum

SHM for a simple pendulum

a physical pendulum

SHM for a physical pendulum

fluids

density

pressure

pressure in a static fluid

atmospheric pressure

gauge pressure

absolute pressure

the Pascal's law

the buoyant force

Archimedes' principle

A static equilibrium for objects in liquid

solving buoyancy problems

fluid dynamics

an ideal fluid

streamline flow

an incompressible fluid

mass flow rate

volume flow rate

the continuity equation

the Bernoulli's equation

solving fluid dynamics problems

gravity (*the first topic of test 3*)

force of gravity

Newton's law of gravitation

principle of superposition

gravitational field

gravitational potential energy

bound system

energy of a bound system

orbits

escape speed

## **week 6**

temperature

temperature scales

thermal contact

thermal conduction

thermal equilibrium

measuring temperature

heat

internal energy

meaning of temperature

meaning of heat

thermal expansion

coefficient of thermal expansion (CTE)

linear, areal, and volumetric CTE

heat capacity

specific heat (capacity)

thermally insulated system

heat balance equation (an equation for thermal equilibrium)

phase transition

critical temperature

latent heat (capacity)

method for solving thermal equilibrium

problems

convection, thermal radiation

thermal conduction

thermal conductivity

the ideal gas	the first law of thermodynamics
absolute temperature	work done by gas
a mole	calculating specific heat ( $C_v$ , $C_p$ )
the Avogadro's number	isothermal process
the universal gas constant	adiabatic process
RMS values	thermodynamic cycle
the ideal gas law	work done over a cycle
iso - laws	heat engine
graphs for gas processes (PV, VT, PT diagrams)	entropy
the Boltzmann's constant	second law of thermodynamics
the meaning of the absolute temperature	heat engine efficiency
the meaning of the pressure	the Carnot cycle
degree of freedom	maximum (ideal) heat engine efficiency
the equipartition theorem	a heat pump and a refrigerator
monatomic, diatomic, polyatomic gas	<i>(the last topic of test 3)</i>
calculating internal energy	

**Some helpful questions for solving physics problems**  
**(more at [www.GoMars.xyz/general\\_algorithm.htm](http://www.GoMars.xyz/general_algorithm.htm))**

1. What objects are involved? What processes are happening to them? (use your imagination - make a picture showing the objects and the processes they are involved into)
2. What properties of the objects and the processes might be important?
3. What physical quantities should be used for describing those properties, what connections might be important?
5. What laws or definitions should be used to describe important connections mathematically?
6. How can I solve my equations mathematically?
8. Does it make a sense?
9. Could I solve a similar problem again? How much time would it take? Who could help me (if I need it)?

Day	Date	Schedule for PY105 - Summer 1 - 2017 (adjustments might be done over the course of the class; Lectures: M – F 8:30 – 9:50; IL sections: M, T, W, R 11 – 2:30, 2:30 – 6, 6 – 9:30)								
		Chapter	Topic	IL Section Topic	HW Issued	Homework Due	Section			
M		<b>NO CLASS</b>	<b>NO CLASS</b>	<b>NO CLASS</b>						
T	5/23	1.1 – 1.2, 3.2 – 3.3	Introduction, Math, Measurement, Units, 1D, and 2D motion	Collecting data (online)	HW 1 (P1, 2, 3,4)		A2, A3, A4, A5			
W	24	2.1 – 2.4		Introduction into Kinematics			A2, A4, A5			
R	25	3.1, 3.5	MCA, free fall				A3			
F	26	2.5 - 2.9, 3.4	Vectors, Relative motion,	NO IL sections						
M	29	Holiday								
T	30	4.1 – 4.7, 5.1	Projectile motion, Newton's Laws	2 D Kinematics			A3			
W	31		Newton's Laws, Application of NL				A2, A4, A5			
R	6/1		Newton's Laws, Application of NL	Newton's Laws			A3			
F (M)	2	7.1 – 7.9	Work Energy, Power		HW 2	HW 1	A2, A3, A5			
M	5	Exam 1	8:00 – 9:50 am; SCI 109 (No IL sections)		(P1, 2, 3, 4)					
T	6	8.1 – 8.3	Conservation of energy	No IL sections						
W	7	8.4 – 8.6	Impulse and Momentum, Law of conservation of linear momentum, Collisions	Work and Energy			A2, A4, A5			
R	8						A3			
F	9	6.2 – 6.4	Circular Motion	No IL sections						
M	12	6.1, 10.1 – 10.5, 9.1 – 9.6	Torque, Equilibrium, Rotational kinematics and dynamics, Rotational Inertia, Rotational KE Angular Momentum, Rolling	Collisions and Center of Mass			A2, A4, A5			
T	13						A3			
W	14					Torque and Rotational Dynamics		A2, A4, A5		
R	15						A3			
F	16	16.1 – 16.5	Hook's law, Properties of SHM	No IL sections	HW 3	HW 2				
M	19	Exam 2	8:00 – 9:50 am; SCI 109 (No IL sections)		(P1, 2, 3, 4)					
T	20	16. 6 – 16.9	Hook's law, Properties of SHM	No IL sections						
W	21	11.1 – 11.7	Statics and Dynamics of Fluids	SHM			A2, A4, A5			
R	22	12.1 – 12.3						A3		
F	23	6.5 – 6.6	Gravity, Orbital Motion	No IL sections						
M	26	13.1, 13.2, 14.1 – 14.7	Temperature and Heat, Expansion, Heat Capacity, Heat Balance Equation	Fluids			A2, A4, A5			
T	27							A3		
W	28					13.3 – 13.4	Ideal Gases	Temperature and Heat and Ideal Gases		A2, A4, A5
R	29					15.1 – 15.6	Heat Engines			A3
F	30	Exam 3	8:00 – 9:50 am; SCI 109 / Online IL section: IL11			HW 3	A 2,3,4,5			



## PY 105S Lab Schedule

<b>Days</b>	<b>IL</b>
May 23	IL1: Collecting data (online)
May 24, 25	IL2: Introduction into Kinematics
May 30, 31	IL3: 2D Kinematics
June 1, 2 (F=M)	IL4: Newton's Laws
June 7, 8	IL5: Work and Energy
June 12, 13	IL6: Collisions and Center of Mass
June 14, 15	IL7: Torque and Rotational Dynamics
June 21, 22	IL8: SHM
June 26, 27	IL9: Fluids
June 28, 29	IL10: Temperature and Heat and Ideal Gases
June 30	IL11: Online: Collecting data

**IL1, and IL11 are *mandatory*; they require an access to the Internet.**

**For other 9 IL (from IL2 to IL 10) any seven must be finished to graduate from the course.**

**For other 9 IL (from IL2 to IL 10) 8 best grades will be accounted toward the final grade.**

<b>Taking a physics course</b>	<b>Becoming a physician</b>
When study physics students have to memorize definitions and laws.	To become a doctor, students have to memorize a lot of stuff (way more than when taking physics course), for example names of all muscles, bones, diseases, and treatments.
When solving physics problem students have to be able recognize the underlying model.	A doctor has to recognize a disease, i.e. make a diagnosis.
For solving physics problem students have to formulate the sequence of steps leading to the solution.	A doctor has to formulate the course of treatment for treating a disease.
If the proposed solution of a problem did not work, a student has to reflect on the own work and to make a correction, and to try a new approach.	If the treatment did not work a doctor has to reflect on possible reasons for that and to offer a correction.

More at [www.GoMars.xyz/6LT.html](http://www.GoMars.xyz/6LT.html)