Bergen Community College
Division of Mathematics, Science and Technology
Department of Physical Sciences

Course Syllabus
PHY 185 Introduction to Physics

Semester and year:
Course Number:
Meeting Times and Locations:

Instructor:
Office Location:
Phone:
Office Hours:
Email Address:

COURSE TITLE: PHY 185 Introduction to Physics

CREDITS/HOURS: 3 hr lecture, 3 hr lab, 4 credits

PREREQUISITES: None

COURSE DESCRIPTION: Introduction to Physics covers a series of topics selected from the following: Newton's Laws of Motion, mechanical energy, work and power, heat and heat transfer, electricity and magnetism, light, sound, atomic structure, and radioactivity. Conceptual principles are emphasized without dwelling on the rigorous mathematical aspects of the topics studied. Application of principles to environmental and health problems is included.
This is a General Education course.

TEXTBOOK: Hewitt, Paul G., 2015: Conceptual Physics, 12th Edition. Pearson, Glenview IL. 722 pp. ISBN-13 978-0-321-9010-7

Opstbaum, Roger, 2001: Intro to Physics Notes, Kendall/Hunt, 147 pp including labs.

LAB MANUAL: Wilson, Jerry D., and Cecilia A. Hernandez-Hall, 2005 Physics Laboratory Experiments for PHY-185 Custom 6th Edition, Cengage Learning, Mason, OH, ISBN 13: 978-0-618-58767-4.

STUDENT LEARNING OBJECTIVES
The student will be able to:

1. Identify how the all-encompassing science of Physics impacts our everyday lives.
2. Develop a Physics vocabulary
3. Explain the background to look into our present and future ways of acquiring and utilizing energy.
4. Use the scientific method
5. Define speed, velocity, and acceleration
6. Explain the acceleration due to gravity and its consequences
7. Define the difference between mass and weight
8. State and give examples of Newton's 3 laws
9. Identify scalers and vectors
10. Define momentum and its conservation
11. Define work and energy
12. Identify conservation of energy
13. Identify the difference between torques and forces
14. Explain rotational motion

15. Explain the nature of the law of gravity
16. Explain how tides work
17. Explain projectile and satellite motion
18. Explain the atomic nature of matter
19. Identify the physical differences between solids, liquids and gases
20. Identify the difference between temperature and heat
21. State the laws of thermodynamics
22. Explain the fundamentals of wave physics
23. Identify how sound waves are generated
24. Explain the fundamentals and applications of electricity and magnetism
25. Demonstrate how electricity is sent from the power station to your home
26. Explain the basics of light and electromagnetic radiation
27. Explain the basics of quantum theory
28. Explain the basics of radioactivity, fission and fusion
29. Explain the basics of Einstein's special theory of relativity

ASSESSMENT: Student achievement of the above objectives will be assessed by their performance on tests and their laboratory reports.

TESTS:

1. There will be (four) modular exams
2. Your individual instructor will advise you how tests are composed, verbally, or under separate cover. There will be at least one essay on an exam.

TEST STRUCTURE: There will be 4 (four) modular exams consisting of:

I. 10 True-False (20 pts.)
II. 10 Multiple Choice (20 pts.)
III. 7 Fill-ins (14 pts.)
IV. 1 Diagram (6 pts.)
V. 5 Definitions (20 pts.)
VI. 1 Question/1 Exercise (10 pts.)
VII. 1 Essay (10 pts.)

NOTES:

- Tests will not specifically cover material discussed before the previous test.
- Concepts build from the beginning to the end of the semester and basic ideas are expected to be mastered to understand new ones.
- Definitions will come exclusively from underlined words in the notes, and from the "Summary of Terms" at the end of each chapter in the textbook encompassed by the test.
- Question/Exercises may be taken word for word and number for number from these chapters.
- Essay questions will come from the discussion topics in each section of the syllabus.

EVALUATION: Your composite grade will be determined according to the following formula:

20% Lab Grade
20% Each of 3 highest test grades
10% Lowest test grade
10% Instructor's Evaluation

However, please note: Unless the student meets the following minimum requirements, he or she will receive a grade of F:

1. The student must pass (achieve 60 or above) on at least one of the 4 tests, regardless of the (possibly high) quality of the lab grades.

2. The student must complete and hand in at least 70% of the lab assignments regardless of the (possibly high) quality of the test grades.

OTHER POLICIES: Electronic Devices:

1. The use of portable devices, such as pagers and cell phones is not permitted when class or laboratory is in session. Please silence these devices before entering class. The use of cell phone calculators is not permitted.

FACULTY ABSENCE PROCEDURE: Please note well

A daily listing of cancelled classes will be listed at the BCC home page under Class Cancellations located at the bottom of the home page (www.bergen.edu). Students can consult this page before going to class. If students find a class cancelled which has not been listed, they should report this to the Evening/Saturday Office, Room C-107, or the Divisional Dean's Office, A-304.

STUDENT ABSENCES:
The student is expected to obtain notes and other assignments missed during office hours or by appointment. i.e., class time cannot be taken up by affairs resulting from an individual student's absence.

SERVICES FOR STUDENTS WITH DISABILITIES
Bergen Community College aims to create inclusive learning environments where all students have maximum opportunities for success. Any student who feels he or she may need an accommodation based on the impact of a disability should contact the Office of Specialized Services at 201-612-5269 or via email at ossinfo@bergen.edu for assistance.

BRIEF SYLLABUS

LABS:

A minimum of 12 laboratory exercises will be selected by the instructor from among the following:

#	Exper. # (keyed to Wilson)	Title
1	1	Experimental Error
2	1	Graphs
3	2	Mass, Volume, and Density
4	3	Uniformly Accelerated Motion
5	-	Velocity, Acceleration and Newton's Laws
6	4	Conservation of Linear Momentum
7	5	Torques, Equilibrium and Center of Gravity
8	9	Hooke's Law and Simple Harmonic Motion
9	7	The Specific Heats of Metals
10	8	Heats of Fusion and Vaporization
11	6	Archimedes' Principle: Buoyancy and Specific Gravity
12	10	Ohm's Law
13	11	Resistances In Series and Parallel
14	-	Coulomb's Law
15	12	Reflection and Refraction

LAB MATERIALS
Students are expected to purchase a pad of Cartesian (regular) graph paper, and bring this to each lab session. A bright green or xeroxed grid is not acceptable. A calculator is helpful, especially one with trig functions, squares, and square roots in addition to the arithmetic functions.

4. Detailed Syllabus

Class Number/ Introduction to Physics Lecture Number	Discussion Topic Number	Topic	Textbook Reading Assignment
1		I. Introduction	
		A. About Science	
		1. Introduction	1-7
		2. Mathematics - The Language of Science	8
		3. The Scientific Method	8-14
		4. Science and Technology	14-15
		5. Physics - The Basic Science	15-17
		B. Measurement; SI units	703-707
		II. Mechanics	
		A. Motion	
		1. Introduction	40
		2. Speed	41-42
		3. Velocity	42-43
2		4. Acceleration	43-46 709-712
		5. Free Fall	46-50
		B. Newton's Laws	
		1. Newton's First Law	21-34
		2. Newton's Second Law	57-67
		3. Newton's Third Law	74-85
3		C. Momentum	
		1. Momentum	90-92
		2. Impulse	92-93
		3. Impulse Changes Momentum	93-95
		4. Bouncing	96
		5. Conservation of Momentum	97-98
		6. Collisions	99-103
		D. Energy	
		1. Work	109-112
		2. Power	112
		3. Mechanical Energy	113-117
		4. Conservation of Energy	117-120
		5. Machines	120-121
		6. Efficiency	121-122
		7. Energy for Life	123-125
	(1)	**8. Population Growth in the U.S.**	719-722
	(2)	**9. Electric Energy Growth in the U.S.**	-
4		E. Rotational motion	
		1. Circular Motion	132-136
		2. Rotational Inertia	136-139
		3. Torque	139-140
		4. Center of Mass and center of gravity	140-145

Class Number/ Introduction to Physics Lecture Number	Discussion Topic Number	Topic	Textbook Reading Assignment
		5. Centripetal Force	145-146
		6. Centrifugal Force	147-150
		7. Angular Momentum	150-151
		8. Conservation of Angular Momentum	151-152
		F. Gravitation	
		1. Newton's Law of Gravitation	160-167
		2. Weight and Weightlessness	166-167
		3. Tides	167-170
		4. Gravitational Fields	170-173
		5. Einstein's Theory of Gravitation	173
5	**(3)**	**6. Black Holes**	174-175
		7. Universal gravitation	175-176
		G. Projectile and Satellite Motion	
		1. Projectile Motion	182-190
		2. Satellite motion	190-195
		3. Kepler's Laws	196-197
		4. Energy conservation and satellite motion	197-198
		5. Escape Velocity	198-200

TEST 1

6		III. Properties of Matter	
		A. Atoms, Molecules, and States of Matter	207-222
		B. Solids	226-227
		1. Crystal structure	227-229
		2. Bonding	-
		3. Alloys	-
		4. Volume	706
		5. Density	229-230
		6. Elasticity	230-231
		C. Liquids	244-245
		1. Area	706
		2. Pressure	245-246
		3. Pressure in a liquid	246-249
		4. Buoyancy	249-250
		5. Archimedes' Principle	250-251
		6. What Makes An Object Sink or Float?	251-252
		7. Flotation	253-256
		8. Pascal's Principle	255-256
		9. Surface tension	257-258
		10. Capillarity	258
7		D. Gases and Plasmas	264-265
		1. Air and air pressure	265-269
		2. Boyle's, Charles' and the Ideal Gas Laws	270-271
		3. Buoyancy of Air	271-272
		4. Bernoulli's principle	272-275
		5. Plasmas	276-277
		IV. Heat	

Class Number/ Introduction to Physics Lecture Number	Discussion Topic Number	Topic	Textbook Reading Assignment
		A. Temperature, Heat and Expansion	
		1. Temperature	284-287
			337-339
		2. Heat	287-291
		3. Expansion	291-295
		B. Heat Transfer	302-303
		1. Conduction	303-304
		2. Convection	304-307
		3. Radiation	307-311
8		4. Newton's Law of Cooling	311-312
	(4)	**5. Greenhouse Effect and the CO_2 problem**	312-313
		C. Change of State	
		1. Evaporation and Condensation	320-325
		2. Boiling	325-327
		3. Melting and Freezing	327-328
		4. Energy and Changes of State	328-332
		D. Thermodynamics	
		1. 1st Law of Thermodynamics	336-340
		2. Adiabatic Processes	341
	(5)	**3. Temperature Inversions**	
		4. 2nd Law of Thermodynamics	344-348
		5. Entropy	349-350

Test 2

9		V. Sound	
		A. Vibrations and Waves	355-357
		1. Pendulums	357-358
		2. Wave description	358-360
		3. Wave motion	360-361
		4. Transverse waves	361
		5. Longitudinal waves	361-362
		6. Interference	362-363
			363-364
		7. Standing waves	364-365
		8. Doppler effect	365-366
		B. Sound	
		1. Origin	374-376
		2. Nature of sound in air	376-377
		3. Media that transmit sound	377-378
		4. Speed of sound	378-379
		5. Reflection of sound	379-380
		6. Refraction of sound	380-382
		7. Energy in sound waves	379
		8. Forced vibrations	382
		9. Natural frequency	382

Class Number/ Introduction to Physics Lecture Number	Discussion Topic Number	Topic	Textbook Reading Assignment
		10. Resonance	382-385
		11. Beats	385-387
		12. Radio Broadcasts	386
		13. Sound intensity and units	-
		VI. Electricity and Magnetism	
		A. Electricity at rest	405-408
		1. Electrical forces	408
		2. Electric charges	408-409
		3. Conservation of charge	409-410
		4. Coulomb's law	411-412
		5. Conductors and insulators	412-413
		6. Charging	413-415
		7. Polarization	416-417
		8. Electric field	417-419
		9. Electric shielding	419-420
10		10. Electric potential	421-422
		11. Electric energy storage	423-424
		B. Electric Current; Ohm's Law	430-431
		1. Flow of charge	431-432
		2. Voltage sources	432-433
		3. Resistance	433-434
		4. Ohm's Law	434-436
		5. Direct and Alternating Current	437-438
		6. Speed and source of electrons in a circuit	438-440
		7. Electric power	440-441
		8. Series and parallel circuits	441-445
		C. Magnetism	452-453
		1. Magnetic forces	453-454
		2. Magnetic poles	454-455
		3. Magnetic fields	455-456
		4. Magnetic domains	456-457
		5. Electromagnets	458-460
		6. Magnetic forces on moving charged particles	460
		7. Oersted's experiment	460-462
		8. Earth's magnetic field and Van Allen belts	462-464
		9. Magnetism, Evolution and Life	465
11		D. Electromagnetic Induction	
		1. Faraday's experiment	470-472
		2. Generators and alternating current	473-474
		3. Power production	474-475
		4. Transformers	475-478
		5. Self-induction	478
		6. Power transmission	479
	(6)	**7. The SO_2 problem**	-
	(7)	**8. The Fossil Fuel problem**	-
		9. Field induction	479-480
		VII. Light	
		A. Electromagnetic Radiation	
		1. Electromagnetic wave velocity	486-489

Class Number/ Introduction to Physics Lecture Number	Discussion Topic Number	Topic	Textbook Reading Assignment
		2. Electromagnetic Spectrum	489-490
		3. Transparent materials	491-493
		4. Opaque materials	493
		5. Shadows	494-495
		B. Color	504-511
		C. Why the sky is blue	511-512
		D. Why sunsets are red	512-514
		E. Why clouds are white	514
		F. Why water is greenish-blue	514-515
		G. Reflection	520
		1. Principle of least time	520-521
		2. Law of reflection	521-522
		3. Plane mirrors	522-523
		4. Diffuse reflection	523-524
		H. Refraction	524-527
		I. Cause of refraction	527-528
		J. Dispersion in a prism	529-531
12		K. Total internal reflection	531-533
		L. Lenses	533-537
		M. Huygen's principle	544-547
		N. Diffraction	547-548
		O. Interference	549-551
		P. Interference colors by reflection from thin films	522-554
		Q. Light Emission	562-564
		R. Blackbodies	-
		S. Stefan-Boltzmann's Law	-
		T. Wien's Law	-
		U. Planck's Law	-
		V. Emission, continuous, and absorption spectra	564-567 569-570
		W. Incandescence	567-568
		X. Fluorescence	570-571
		Y. Phosphorescence	571-572
		Z. Lamps and Lasers	572-577

Test 3

13		VIII. Atomic and Nuclear Physics	
		A. Introduction	582-583
		B. Birth of the Quantum theory	583-585
		C. Photoelectric effect	585-587
		D. Wave-particle duality	588
		E. Double-slit experiment	588-590
		F. Particles as waves; electron diffraction	590-592
		G. Uncertainty principle	592-595
		H. Complimentarily	595-596
		I. Discovery of the Atomic Nucleus and Electron	601-606
		J. Spectra and the Bohr model	606-608

Class Number/ Introduction to Physics Lecture Number	Discussion Topic Number	Topic	Textbook Reading Assignment
		K. Electron waves	608-609
		L. Quantum mechanics	610-611
		M. Correspondence principle	611-612
		N. X-, Alpha-, Beta-, and Gamma- Rays	615-618
		O. Environmental Radiation	619-622
		P. The Atomic Nucleus And The Strong Force	622-624
14		Q. Half-life	625
		R. Radiation detectors	626-628
		S. Natural transmutation of elements	628-630
		T. Artificial transmutation of elements	630
		U. Radioactive isotopes and dating	630-631
		V. Carbon and uranium dating	632-633
	(8)	**W. Effect of radiation on humans**	-
		X. Nuclear fission	
		1. Fission	637-641
		2. Nuclear Fission Reactors	641-645
		3. Mass-energy equivalence	645-649
		Y. Nuclear Fusion	
		1. Fusion	640-652
		2. Controlling fusion	652
		IX. Energy Sources for the Future	
	(9)	**A. Are nuclear reactors safe?**	-
	(10)	**B. The solar energy alternative**	123-125
15		X. Relativity	
		A. Special theory of relativity	657-659
		1. Relative motion	659-660
		2. Michelson-Morley experiment	660-661
		3. Postulates of the special theory	661-662
		4. Simultaneity	662-663
		5. Space-time	663-664
		6. Time dilation	664-668
		7. The twin trip	668-673
		8. Addition of Velocities	673
		9. Space travel	674-675
		10. Length contraction	675-677
		11. Relativistic Momentum	677-678
		12. Mass-energy equivalence	678-680
		13. Correspondence principle	680-681
		B. General theory of Relativity	686-687
		1. Principle of equivalence	687-689
		2. Bending of light by gravity	689-691
		3. Gravity and time-gravitational red shift	691-693
		4. Gravity and Space: Orbit of Mercury	694
		5. Gravity, space, and a new geometry	694-696
		6. Gravity, space, time, and gravitational waves	696
		7. Gravity, Newton, and Einstein	697

Test 4

5. Laboratory Rules:

1. Safety first - If you are unsure a piece of equipment is working safely, call the instructor or lab technician over **BEFORE PROCEEDING ANY FURTHER.** Reckless behavior endangers everyone. Having fun in lab is encouraged (as long as the work gets done), but there is a clear boundary between fun and recklessness.

2. Lab manuals are to be brought to every lab session except week 5. Lab reports are due the week following the lab. There are fairly stiff penalties for lateness: -5 the first week; -10 for each day after that since corrected labs will usually be handed back 1 week after they are due. XEROXES OF LAB MANUAL PAGES ARE UNACCEPTABLE.

3. Absence from labs so that data acquisition must be obtained from a neighbor, without performing the experiment yourself, means that you can get at most a 50 for that lab. You must note you are doing this at the top of the lab report. If this is not noted and an attendance check by the instructor indicates absence, you receive a 0 for the lab and 1 point off personal evaluation for the term for each such offense.

4. Late labs are not acceptable until the next time the instructor has your class lab folder available.

5. **THIS IS IMPORTANT:** Although many experiments involve the acquisition of data in groups, calculations involving the experimental data are to be done **INDIVIDUALLY.** The college policy on plagiarism will be strictly enforced.

6. Lab reports are expected to be neat and organized - a grader is in a much better mood (is more lenient?) when he has an easy time going through the work.

7. A reminder - Failure to complete and had in at least 70% of the lab assignments is also grounds for an automatic F grade.

8. Schedule (Pages refer to Wilson's Lab Manual)

Week #	Lab # (in manual)	Page	Title
1	1	3	Experimental Error and Data Analysis
2	1-handout	9-14	Graphs
3	2	23	Mass, Volume and Density
4	3-handout	37	Uniformly Accelerated Motion - Free Fall
5	Handout	--	Velocity, Acceleration and Newton's Laws
6	4-handout	61	Conservation of Linear Momentum
7	5	83	Torques
8	6-handout	95	Archimedes' Principle: Buoyancy and Specific Gravity
9	7,8-handout	107,119	Calorimetry
10	9-handout	141	Hooke's Law and Simple Harmonic Motion
11	10,11-handout	159,181	Electricity
12	12	201	Reflection and Refraction

6. Summary of Helpful Hints in Intro to Physics Lab

I. Rules for significant digits
   1. The left-most non-zero digit is the most significant
   2. If there is no decimal point, the right-most non-zero digit in a number is the least significant. e.g. in 4620 and 46200 the two is the least significant.
   3. If there is a decimal point, the right-most digit is the least significant, even if it is 0, e.g. in 4620., 46200., and 462.00, the right-most zero is the least significant.
   4. All digits between and including the least and most significant digits are considered to be significant. e.g. 4620 and 46200 have 3 significant digits, 4620. has 4; 46200. and 462.00 have 5.

II. Special rules for significant digit operations in Intro to Physics:

   1. All constants in a formula have as many significant digits as the lest significant multiplicative or dividing entry.

   2. Subtractions (e.g. in the numerator of a percent error or percent difference computation) which reduce the number of significant digits because of the close approximation of the subtracting numbers to each other should be stated to the number of digits of the least significant entry. e.g. 1.00-0.99=0.010.

   3. All averages should be expressed to the number of significant digits of the least accurate entry with one exception: Two numbers averaged can (temporarily) be expressed to one more significant digit than the least significant entry so the average makes sense. e.g. the average of 969 and 970, is taken as 969.5.

III. Graphs
   1. All graphs should have titles, labelled axes with units, and numerically scaled axes. Name of preparer is necessary only if it is not on other materials to be handed in with the graph.
   2. Straight-line fits to data should be passed through the data points so that the best fit to the data is obtained. It is possible that none of the data points will fall on the line. For any remaining analysis of the graph, now use the line, not the points it was obtained from !!!!

   3. Try to use dashed lines, where appropriate, to show interpolations, extrapolations, where a slope of a straight line was taken, etc., on any graph you analyze.

IV. Reading a vernier (consult figs. 2-4 and 2-5 p. 25 Wilson)
   1. In units of cm, use the main scale's position over the zero on the vernier scale to get x.y cm.
   2. See which mark on the vernier scale lines up best with the mark above it on the main scale to get the hundredth's place, z, of the measurement for x.yz cm. Remember that the first tick mark on the vernier scale is 0!
   3. Subtract a positive 0 error; add a negative 0 error.

V. Reading a micrometer (consult fig 2-6 and caption p. 26 Wilson)
   1. In units of mm, read to the nearest 0.5 mm, where the edge of the thimble has intersected the main "sleeve". If a bottom tick mark has been passed by the thimble edge the reading is a 0.5 mm; if not, just a 0.0 mm.
   2. Read the value of the thimble where the 0 line of the sleeve intersects the thimble, estimating to the nearest 10th of the distance between the thimble tick marks. This translates so that, e.g. 224, with the 4 estimated means 0.224 mm. Add to the result of 1 above to get a "raw" answer in mm.
   3. Subtract a positive 0 error; add a negative 0 error to get a.bcd mm.
   4. Convert to cm by moving the decimal 1 digit to the left to get .abcd cm.