Colonnade Program Course Proposal: Explorations Category

Following the Colonnade Implementation committee's request, the Department of Physics and Astronomy submits the following materials for the Exploration course and lab: PHYS 255/256 Introductory University Physics 1.

1. **What course does the department plan to offer in Explorations? Which subcategory are you proposing for this course?** (Arts and Humanities; Social and Behavioral Sciences; Natural and Physical Sciences)

The Department of Physics and Astronomy plans to offer PHYS 255/256 University Physics I and University Physics I Laboratory in the Natural and Physical Sciences subcategory within the Explorations Category.

2. **How will this course meet the specific learning objectives of the appropriate subcategory.** Please address **all** of the learning outcomes listed for the appropriate subcategory.

The overall objective of PHYS 255 and PHYS 256 is to provide a survey of the basic physics principles associated with motion. The course introduces the ideas associated with the scientific understanding of classical motion applied to a variety of physical phenomena including translation, rotation, equilibrium and basic thermal motion within the context of an empirical setting. The laboratory component emphasizes quantitative reproducible testing of an idea along the lines of hypothesis testing with respect to classical motion as an application of the scientific method.

How these course objectives fulfill the Colonnade Program's four objectives for the Natural and Physical Sciences subcategory of the Explorations Category:

Colonnade Learning Objective 1: Demonstrate an understanding of the methods of science inquiry.

Objective 1 is met by the following course objectives:

- Quantitative reproducible hypothesis testing is the cornerstone of the scientific method and the core of this class via the laboratory explorations that are closely coupled to the development of scientific thought related to classical physics in the lecture.
- Several topics are developed from the debates that centered on the development of Newtonian physics:
    a. Validity of the vector description of motion
    b. Application of reproducible measurements in lab
    c. Development of quantitative modeling of motion.

Colonnade Learning Objective 2: Explain basic concepts and principles in one or more of the sciences.

Objective 2 is met by the following course objectives:

- Apply the basic principles of measurement in the lab
- Apply the scientific method of hypothesis testing
- Describe the definitions needed to quantify motion
- Understand Newton's Laws of Motion and the nature of determinism
- Apply Newton's laws to isolated masses
- Use Newton's laws deterministically to find the outcome of an experiment
- Design an experiment to test an hypothesis
- Measure and describe the motion of a hovercraft
- Understand and measure objects undergoing collisions and rotational motion
- Understand thermal efficiency and engine design
- Realize that energy and power are related to finite resources
- Understand some shortcomings of classical deterministic methods.

Colonnade Learning Objective 3: Apply scientific principles to interpret and make predictions in one or more of the sciences.

- Define and understand the motion of a hovercraft
- Apply the basic principles of Newton's Laws in the lab
- Measure and describe forces of friction for a company
- Predict motion for a damped harmonic oscillator
- Measure energy usage of an engine and predict the power output.

Colonnade Learning Objective 4. Explain how scientific principles relate to issues of personal and/or public importance.

- Understand that the principles of motion apply to a wide range of physical phenomena from cars to fluids to atoms,
- The concepts of momentum are related to safety and impact survival in collisions,
- The ideas of energy and entropy give us insights about energy usage and finite resources and the fate of the universe.

3. Syllabus statement of learning outcomes for course. NOTE: In multi-section courses, the same statement of learning outcomes must appear on every section's syllabus.

The overall objective of PHYS 255 and 256 is to provide a survey of the physics principles related to forces and motion in its various classical forms. The laboratory component emphasizes quantitative reproducible testing of an idea: hypothesis testing.

Students who complete PHYS 255/256 will be able to:

- Understand the empirical departure from Aristotelian concepts for free fall
- Apply the basic principles of measurement in the lab
- Apply the scientific method of hypothesis testing
- Describe the definitions needed to quantify motion
- Understand Newton's Laws of Motion and the nature of determinism
- Use Newton's laws deterministically to find the outcome of an experiment
- Design an experiment to test an hypothesis
- Measure and describe the motion of a hovercraft
- Understand and measure objects undergoing collisions and rotational motion
- Understand thermal efficiency and engine design
- Realize that energy and power are related to finite resources
- Understand some shortcomings of classical deterministic methods.

4. Brief description of how the department will assess the course for these learning objectives.

Learning Objective 1: Demonstrate an understanding of the methods of science inquiry will be assessed through a hypothesis testing laboratory exercise.

Learning Objective 2: Explain basic concepts and principles in one or more of the sciences will be evaluated using an assessment on fundamental physics principles.

Learning Objective 3: Apply scientific principles to interpret and make predictions in one or more of the sciences will be assessed with an laboratory exercise on predicting the outcome of an experiment.

Learning Objective 4: Explain how scientific principles relate to issues of personal and/or public importance will be evaluated using an assessment on the public importance of the principles of thermodynamics, energy conservation and increasing entropy in terms of energy consumption in the US and around the globe.

5. How many sections of this course will your department offer each semester?

The Department of Physics and Astronomy will offer two sections per semester.

6. Please attach sample syllabus for the course.

Syllabus Physics 255
University Physics I: 4 CH

1. **Instructor:** Physics, Office TCCW 246, email: Physics137@wku.edu
2. **Class Meetings:** MTWF 8:00 AM, Room SH: 4115; TCNW 224-> changed to MWF TCCW 201; Tuesday, TCCW 237

   Prerequisites: algebra, geometry, trigonometry and a grade of C or better in Calculus I, Math 136/Math 126

   Corequisite: enrolled in or completed Calculus II and the associate lab class: University Physics I: PHYS 256

3. Text: Randall D. Knight, **Physics for Scientist and Engineers-A Strategic Approach 3ed, with Modern Physics with Mastering Physics**, Pearson; New York, 2013, ISBN-13: 978-0-321-74090, ISBN-10:0-321-74090-4 and web site: http://www.pearsonhighered.com/educator/product/University-Physics-with-Modern-Physics-with-MasteringPhysics8482-12E/9780805321876.page

- This textbook is available at the WKU Bookstore.
- It comes bundled with a student access code for MasteringPhysics (see below) and you will also gain online access to an electronic version of the book via the MasteringPhysics website.
- If you purchase a used textbook from an alternative source make sure you save at least $50 since this will be the cost of a stand-alone license to access MasteringPhysics. The $50 stand-alone access does not include eBook access.
- If you are comfortable using only an electronic copy of the book you can purchase a MasteringPhysics license and access to the eBook from www.masteringphysics.com for about $150.

- Mastering Physics is an on-line tutoring and homework system developed specifically for University Physics courses.
- It provides individualized on-line tutoring by responding to incorrect answers, and providing hints for solving multi-step problems. It will also give immediate and up-to-date assessment of progress, and show where more practice is needed.
- Mastering Physics will be used for a significant portion of your homework assignments.
- When you purchase a new textbook, you will get an access code to allow you to use Mastering Physics for 24 months (two years). It is likely that you will use this access code for the full University Physics sequence 255/256, 265/266.
- See Getting Started with MasteringPhysics for instruction on how to register and use MasteringPhysics.

4. **Office Hours**: MWF: 9:00 AM or by appointment

5. **References:** There are two other sections of this class, PHYS 255, on a similar schedule, material on the web site: http://physics.wku.edu/phys201/ from Dr. Harper may be useful in helping to understand the material. The general PHYS 255 material there is common to all of the classes.

6. Course Description

PHY 255 provides an introduction to the principles and applications of physics. The field of physics is concerned with the structure of matter and motion as determined by empirical observations. It is well known that matter is composed of atoms, atoms are composed of electrons, protons, and neutrons and that neutrons and protons are made of quarks. In some sense at all levels of structure we also observe motion. Motion is generally characterized by how far an object moves, how quickly it moves and in what direction it moves. The general principles of motion are so widely applicable they are collectively known as part of the Laws of Nature.

This is the first half of a year-long course in calculus-based physics suggested for students in the physical sciences and mathematics. Definitions, concepts and problem solving will be emphasized. Topics include kinematics, dynamics, energy, conservation laws, rotation, periodic motion, and thermodynamics. Many applied examples will come from the concepts based on the analysis of situations leading into the Failure-Fracture-Forensics analysis of events.

The course will emphasize rigorous problem-solving in physics using interactive instruction, educational software, computer applications important for science and engineering students, and cooperative learning. Class activities will require students to be responsive, to think, and to perform hands-on tasks. Key concepts of new material will be discussed in short lectures.

As a scientist or an engineer you will often be required to work in a group setting as well as alone. This course will encourage collaborative teamwork, a skill that is valued by most employers. As you study together, help your partners to get over misconceptions, ask each other questions, and critique your group homework. Teach each other! You will be surprised at how much you can learn by teaching.

The overall objective of PHYS 255 and 256 is to provide a survey of the physics principles related to forces and motion in its various classical forms. The laboratory component emphasizes quantitative reproducible testing of an idea: hypothesis testing.

Students who complete PHYS 255/256 will be able to:

- Understand the empirical departure from Aristotelian concepts for free fall
- Apply the basic principles of measurement in the lab
- Apply the scientific method of hypothesis testing
- Describe the definitions needed to quantify motion
- Understand Newton's Laws of Motion and the nature of determinism
- Use Newton's laws deterministically to find the outcome of an experiment
- Design an experiment to test an hypothesis
- Measure and describe the motion of a hovercraft
- Understand and measure objects undergoing collisions and rotational motion

- Understand thermal efficiency and engine design
- Realize that energy and power are related to finite resources
- Understand some shortcomings of classical deterministic methods.

7. Homework and Laboratory

Homework is assigned from each chapter in the text. We will be reading material from the first nine chapters of the text. Notice that the problems in the text appear in three levels: questions in each section, problems separated by section at the end of the chapter, and general exercises at the end of the chapter. Each homework assignment is graded and the entire set is normalized to 100 points. Homework is due at the beginning of class on the assigned due date. In most areas of work, you will work in groups as well as alone. Social interactions are critical to their success. Most good ideas grow out of discussions with colleagues. **This course encourages collaborative teamwork, a skill that is valued by most employers.** As you study together, help your partners to get over confusions, ask each other questions, and critique your homework. Teach each other! You can learn a great deal by teaching.

While collaboration is the rule in technical work, evaluations of individuals also play an important role. Exams are to be done without help from others, unless instructed otherwise.

8. Grading Policies:

Your grade for the course will be based on your performance on the homework, quizzes and examinations according to the usual distribution as shown in Table 1 below. The weights assigned to the homework and exams are shown in Table 2.

$$G(t) = \sum_{i=1}^{N} w_j \frac{\left(HW_i + Q_i + Part\right)}{N} + \sum_{k=1}^{5} \frac{E_k}{5} + \left(\frac{FE}{250}\right)100$$

Table 1	
Average Score	**Grade**
90 - 100	A
80 - 89	B
70 - 79	C
60 - 69	D
< 59	F

Table 2	
Component	**Percent**
Homework: MasteringPhysics, Other Assignments	15 %
In Class Participation: Exercises, Quizzes	10 %
Exam 1	10 %
Exam 2	10 %
Exam 3	10 %
Exam 4	10 %

Exam 5	10 %
Final Exam	25 %

Reading Assignments - You are responsible for reading the textbook prior to coming to class. The assigned reading for each day of class can be easily found on the Class Calendar. Due to the interactive nature of this course we will not cover every detail in the lecture. In fact, lectures in the classroom will be rare. Instead we will work on interactive activities that emphasize how to apply the concepts covered in the reading. If you rely on having the instructor to tell you the material in lecture you will miss out!

Homework (15%) - Homework sets will be assigned on a routine basis. You may work with other students (especially in your group), receive help from tutors, or come to my office for assistance on the homework. A diligent effort on the homework is the best approach to a successful learning experience in this course.

Individual homework assignments in the course are to be done on the MasteringPhysics computer homework system. These assignments will generally be due just before class time. You will receive credit for correct solutions automatically by MasteringPhyiscs. You should make a habit of keeping written solutions (using a good problem solving strategy) for discussion in lecture. It is recommended to start a new page for each problem rather than cramming several problem solutions together in a small space. On occasion your problem solutions will be collected and graded in addition to the automatic scoring on MasteringPhysics. As a general rule homework solutions will not be posted. The burden is on you to make sure you find out how to solve the problems by getting help before they are due or asking about them in class. Grading in MasteringPhysics is such that you can enter answers without penalty (up to a limit of 10 attempts per question). You only lose credit if you turn in the assignment past the due date and time. Each part of an assignment that is not submitted by the due date will lose credit based on a linear scale where 25% is deducted for every day that it is late (roughly 1% per hour). This scale stops after two days and stays at a maximum possible credit of 50% until the final exam. Thus, it is in your interest to answer all questions even if you answer them late.

Occasionally, there will be additional assignments that you will work on outside of class. In some you will be responsible for completing the assignment on your own, without outside assistance. But in group assignments you will work with other students in an assigned group.

In-Class Activities (10%) - In class activities will include a variety of different things such as individual quizzes based on the reading material, computer-based activities, and group problem solving assignments completed during class time. Some of these will be assessed using the Turning Point clickers and some may require handing in worksheets or problem solutions.

Examinations (5 @ 10% each plus final at 25%)

The exams will be structured so that you should be able to complete them in a one-hour period. The exams will consist of both conceptual questions (similar in style to in-class activities) as well as problems (similar to homework). See the Course Calendar for details of when the exams

will be held. The final exam will be comprehensive. It will cover material from all four exams plus new material covered in class after Exam 5.

Everyone is expected to take exams during the regularly scheduled exam periods with the rest of the class. As a general rule, makeup examinations will NOT be given except for very unusual circumstances. If you are unable to take an exam you may schedule a makeup examination by requesting permission from the instructor before (except in the case of unforeseen circumstances) the regularly-scheduled exam period. A serious reason is required to warrant the scheduling of a makeup exam.

Attendance

Regular and punctual attendance is expected of everyone during every class meeting. Class time will be spent doing activities that should help you understand the material we are studying and if you miss class then you are jeopardizing yourself and the members of your group.

Drop/Audit Policies

Due to the nature of this course, students will not be allowed to audit PHYS255. If you choose to not complete the course for a grade then your only option is to drop the course and receive a grade of W by the University deadline for dropping a course. If you choose to drop the course you MUST also drop the lab since they are co-requisites.

Student Disability Services

In compliance with university policy, students with disabilities who require accommodations (academic adjustments and/or auxiliary aids or services) for this course must contact the Office for Student Disability Services in DUC A-200 of the Student Success Center in Downing University Center. Please DO NOT request accommodations directly from the professor or instructor without a letter of accommodation from the Office for Student Disability Services.

Additional Classroom Policies

- Food and drinks are NOT allowed in the classroom.
- Cell phones, pagers, beepers, and similar devices MUST be silenced and stored away during class time.
- The laptops in the classroom are for specific classroom activities ONLY.
    - Do not install or modify any software on the laptop computers.
    - Do not use the computers to check email during class time.
    - Do not use the computers to instant message or chat with anyone ever.
    - Do not browse the internet during class time unless it is part of an activity.
    - Do not submit or review Mastering Physics assignments during class time.

9. CALCULATION OF GRADE

Grades are based upon the percentage of the total number of points, plus 2%, accumulated at the end of the semester. Generally any g > 90 % is an A and any g<50 % is an F. All grades are calculated on a class curve that depends upon the average and standard deviation of the class grade. Instantaneous grade values are available from the computer class grade roster.

10. Resources

Free tutoring is available in the Help Center in room 236. The schedule of when it will be open will be posted about the second week of the semester.

"Students with disabilities who require accommodations (academic adjustments and/or auxiliary aids or services) for this course must contact the Office for Student Disability Services, DUC A201. The OFSDS telephone number is (270) 745-5004. TTY is (270)745-3030. Per university policy, please DO NOT request accommodations directly from the professor or instructor without a letter of accommodation from the Office for Student Disability Services."

11. FINAL EXAM

Friday: December 14, 2012 @ 8:00 AM -10:00 AM

12. Safety and Evacuation: A review of safety and evacuation procedures include exit from the room during an active alarm. Normally we will exit to the main stairwell and the front of the building moving to the sidewalk. If the main stairwell is blocked we will go to the east stairwell to exit. Do not attempt to use the elevators.

PHYS 256 University Physics I Lab
Laboratory Topics and Class Material

The laboratory experiments develop the critical aspects of empiricism required for science. The detailed use of the scientific methods of hypothesis testing and empirical feedback needed to develop a better understanding of natural phenomena will be aggressively pursued.

	Date	Lab	Topic	Due Date
1.	9-01-11	Measurement and Error Cord Parameters	Lab format introduction	9-2
2.	9-8	Acoustic Sonic Ranger and Speed	Minimizing the squared differences as a fit to data.	9-9
3.	9-15	Two Competing Methods for g	Local measurement of the value of g.	9-16
4.	9-22	Basketball Accelerations and Impact	Force probe and sonic ranger to compare precisions and accuracy.	9-23
5.	9-29	Hovercraft and Frictional Forces	F=ma and work energy on an incline.	9-30

6.	10-13	Company Competition-Plastic Friction: Part 1	Energy for a glider on an airtrack that is level and inclined.	10-14
7.	10-20	Surface Friction: Part 2	Inelastic and elastic collisions for gliders on an airtrack.	10-21
8.	10-27	Energy is Conserved	Moment of inertia and conservation of angular momentum.	10-28
9.	11-3	Harmonic Motion	Force probe and sonic ranger for mass in SHM.	11-4
10.	11-10	Damped HM the Decay Curve	SHM with damping present using the force probe and glider.	11-11
11.	11-17	Equation of State: Ideal Gas Law	Height displacement to get volume and measure dV for PVT test.	11-18
12.	12-1	Cyclic Thermal Engine	PVT work for a closed thermal cyclic process	12-2
13.	12-8	Final Exam	Lab based Practicum Final Exam	Final

Each lab write-up must follow the style guide described in greater detail in the Laboratory Manual. The lab report must always include (1) a title, (2) your name and your lab partner's name, (3) an introductory abstract focused on the purpose and outcome, (4) the data, (5) a conclusion with the correct units and significant figures determined by your error analysis.