Assessment for Physics 160

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The Department of Physics and Astronomy has set the following goals for Physics 160.

1. Students will develop an increased understanding of the scientific method as it applies to theory and experiments.

2. Students will know and be able to apply basic physics concepts in mechanics, gravitation, and fluids. They will be able to solve problems at the level of standard first year calculus- based general physics texts.

3. Students will be able to use appropriate mathematical skills needed to solve problems. This includes the ability to use units, vectors, and graphs.

4. Students will develop a foundation of knowledge and problem solving skills that they will be able to use in later courses in science, engineering and related fields.

The success in meeting these goals will be assessed by the following outcomes. The outcomes were chosen to cover some of the most important topics and to demonstrate a range of skills in solving problems, not necessarily to cover all the topics in the course.

Outcomes:

Outcome 1: Motion with Constant Acceleration: Students will be able to solve problems involving motion with constant acceleration. Many practical events will be modeled as problems of this type. These include both horizontal motion (for example, an aircraft taking off on the

runway, an automobile coming to a stop) and vertical motion near Earth's surface where the acceleration of gravity can be considered constant (for example, a ball thrown straight up in the air). Projectile motion problems also fall into this category; these involve objects experiencing vertical and horizontal motion at the same time (for example, a baseball hit at an angle of 30 degrees above the horizontal).

NM HED Area III competencies 2, 4 and 5: Solve problems scientifically, Apply quantitative analysis to scientific problems, and Apply scientific thinking to real world problems.

Outcome 2: Newton's Second Law: Students will be able to solve a variety of problems with Newton's second law. This law which deals with forces, inertial mass and acceleration is a foundation of Newtonian Mechanics and has wide application to science and engineering. Problems of various types (possible examples include effects of forces on objects, circular motion, orbits of planets, inclined planes and motion with friction) will be analyzed.

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Outcome 3: Newton's Universal Law of Gravity: Students will be able to solve problems involving Newton's Universal Law of Gravity. Gravity is one of the 4 fundamental forces in the universe and is therefore one of the most important foundation topics for the future physics and engineers who take this course. Possible examples may include planetary orbits, calculation of the acceleration of gravity on a planet, derivation of Kepler's 3rd law and calculation of forces that masses attract each other.

NM HED Area III competencies 2, 4 and 5: Solve problems scientifically, Apply quantitative analysis to scientific problems, and Apply scientific thinking to real world problems.

Outcome 4: Conservation of Energy and Momentum: Students will be able to solve problems involving the Conservation of Energy and Momentum. These two laws enable introductory students to solve a wide variety of practical problems. Possible examples of problems include elastic and inelastic collisions and the basic concepts of impulse, momentum, kinetic energy, gravitational potential energy and elastic potential energy.

NM HED Area III competencies 2, 4 and 5: Solve problems scientifically, Apply quantitative analysis to scientific problems, and Apply scientific thinking to real world problems.

<u>Outcome 5: Rotational Motion:</u>   Students will be able to solve problems involving Rotational Motion. Many concepts and their application can be included in rotational motion; possible examples include angular momentum, moment of inertia, conservation of angular momentum, angular velocity, angular acceleration and torque.

NM HED Area III competencies 2, 4 and 5: Solve problems scientifically, Apply quantitative analysis to scientific problems, and Apply scientific thinking to real world problems.

Assessment Data Collection:

For each outcome the material will be covered in class using teaching strategies that can include lecture, demonstrations, example problems, clicker questions and other. Homework will include problems that require these outcomes skills. Students taking the lab will also cover some of the material in lab. Some students may also see the material in problem sessions and supplemental instruction sessions. Assessment will come from embedded questions in exams and/or from classroom clicker exercises.

Individual teachers will provide questions in coordination with the department assessment coordinator for each outcome. For multiple choice questions, several questions for each outcome should be used to test different aspects and difficulty levels.   These questions can be split across multiple exams such as a midterm and a final exam.   For workout problems more information can be gathered from each problem especially if a problem contains multiple parts or is scored with partial credit. Therefore for workout problems each outcome could have 2 problems. The workout problems have to be designed to assess more than one piece of an outcome and to assess various skill levels of an outcome.

Rubric:

Evaluation: Different teachers place different emphasis on the topics and only the teachers themselves are aware of the true difficulty and context of the questions (whether examples were worked in class, whether clicker exercises were used in class and how many homework problems addressed the subject are examples). Only the teacher of the class is in a reasonable position to determine the curve and grading scale for the test. Likewise, only the teacher of the class is in a position to correctly evaluate performance on the outcome questions.

For each SLO, there should typically be either three or more multiple choice questions covering the broad concept, or one or more workout problems that use the concept in more than one context and that can be graded to show different levels of mastery.

The SLO can be assessed with either of two methods. Method 1 assesses students' performance based on the percentage of questions they answered correctly in each rubric as a group. The instructor can then examine the percentage of students demonstrating Exemplary, Satisfactory, or

Unsatisfactory performance on each SLO. Method 2 is more simply based on the average score of all students on all questions in each rubric. The instructor can use this average score to decide if the class performance as a whole is Exemplary, Satisfactory, or Unsatisfactory. The table below provides more detail on what is meant by Exemplary, Satisfactory, or Unsatisfactory performance on each SLO.

Physics 160 Rubric for Grading Outcomes Assessment

Exemplary	Satisfactory	Unsatisfactory
Method 1: a student correctly solves all three problems (or at least 75% if more than 3 multiple choice problems). For a workout problem a score of 75% typically means that a student demonstrates understanding of solving the problem and correctly apply relevant definitions, equations and concepts. A student may make a small error in solving the problem. Method 2: the average score of students on the problems is at least 75%.	Method 1: a student correctly solves at least 50% of the problems. Makes a mistake in concepts or applying equations. For a workout problem a student makes an attempt consistent with course content but has misunderstood a needed concept or misremembered a formula or made several smaller mistakes. Method 2: the average score of students on the problems is 50-75%	Method 1: a student solves 50% or less of the problems correctly. Doesn't know definitions, equations and concepts. Cannot apply definitions, equations and concepts to a problem. Makes multiple errors. For a workout problem shows serious lack of understanding in solving problems. Method 2: the average score of students on the problems is less than 50%.