

PELLISSIPPI STATE TECHNICAL COMMUNITY COLLEGE  
MASTER SYLLABUS

**MECHANICS & HEAT W/ LAB I  
PHYS 1310**

**Class Hours: 3.0**

**Credit Hours: 4.0**

**Laboratory Hours: 3.0**

**Revised: Spring 05**

**Catalog Course Description:**

A calculus-based introduction to mechanics and heat. This course covers vectors, Newton's laws of motion, static and dynamic equilibrium of particles, work and energy, impulse and momentum, torque and rotational equilibrium, and elasticity. Course includes 3 hours of lecture and 3 hours of laboratory applications.

**Entry Level Standards:**

Students registering for this course must have a strong background in calculus and trigonometry.

**Prerequisite:**

MATH 1910

**Textbook(s) and Other Course Materials:**

*University Physics*, by Harris Benson, Revised Edition  
*Physics 2010 Lab Manual* plus a few handouts

**I. Week/Unit/Topic Basis:**

<b>Week</b>	<b>Topic</b>
1	Lecture: Introduction 1.1 What is Physics? 1.2 Concepts, Models, and Theories 1.3 Units 1.4 Power of Notations and Significant Figures 1.5 Order of Magnitude 1.6 Dimensional Analysis 1.7 Reference Frames & Coordinate Systems Lab: Group Experiment 1: Density Measurement
2	Lecture: Vectors 2.1 Scalars and Vectors 2.2 Vector Addition 2.3 Components and Unit Vectors 2.4 Scalar (Dot) Product

2.5 Vector (Cross) Product

**Test 1**

Lab: Group Experiment 2: Vector Addition: Graphical Method

- 3           Lecture: One-Dimensional Kinematics  
            3.1 Particle Kinematics  
            3.2 Displacement and Velocity  
            3.3 Instantaneous Velocity  
            3.4 Acceleration  
            3.5 The Use of Areas  
            3.6 The Equation of Kinematics for Constant Acceleration  
            3.7 Vertical Free-fall  
            3.8 Terminal Speed  
            Lab: Group Experiment 3: Vector Addition; Equilibrium of Concurrent Forces (The Force Table)
- 4           Lecture: Inertia and Two-Dimensional Motion  
            4.1 Newton's First Law  
            4.2 Two-dimensional Motion  
            4.3 Projectile Motion  
            **Test 2**  
            Lab: Group Experiment 4: Measurement of "g", The Accel. of Gravity
- 5           Lecture:  
            4.4 Uniform Circular Motion  
            4.5 Inertial Reference Frames  
            4.6 Relative Velocity  
            4.7 The Galilean Transformation  
            4.8 Non-uniform Circular Motion  
            Lab: Group Experiment 6: Centripetal Force
- 6           Lecture: Particle Dynamics I  
            5.1 Force and Mass  
            5.2 Newton's Second Law  
            5.3 Weight  
            5.4 Newton's 3rd Law  
            5.5 Applications of Newton's Laws  
            5.6 Apparent Weight  
            **Test 3**  
            Lab: Group Experiment 6: Newton's 2nd Law
- 7           Lecture: Particle Dynamics II  
            6.1 Friction  
            6.2 Dynamics of Circular Motion  
            6.3 Satellite Orbits  
            Lab: Group Problem Session

- 8           Lecture: Work and Energy  
7.1 Work Done by a Constant Force  
7.2 Work done by a Variable Force  
7.3 Work-Energy Theorem in 1-D  
7.4 Power  
**Test 4**  
Lab: Group Experiment 7: Coeff. of Kinetic Friction
- 9           Lecture: Conservation of Mechanical Energy  
8.1 Potential Energy  
8.2 Conservative Forces  
8.3 Potential Energy and Cons. Forces  
8.4 Potential Energy Function  
8.5 Conservation of Mechanical Energy  
8.6 Mechanical Energy and Non-conservative Forces  
8.9 Gravitational Potential Energy  
Lab: Group Experiment 8: Conservation of Energy
- 10          Lecture: Linear Momentum  
9.1 Linear Momentum  
9.2 Conservation of Linear Momentum  
9.3 Elastic Collision in One Dimension  
9.4 Impulse  
**Test 5**  
Lab: Group Experiment 9: Conservation of Linear Momentum
- 11          Lecture:  
9.5 Comparison of Linear Momentum with Kinetic Energy  
9.6 Elastic Collision in 2-D  
9.7 Rocket Propulsion  
Lab: Group Problem Session
- 12          Lecture: Systems of Particles  
10.1 Center of Mass  
10.2 Center of Mass of Continuous Bodies  
10.3 Motion of Center of Mass  
10.4 Kin. Energy of a Sys. of Particles  
10.5 Work-Energy Theorem for a System of Particles  
10.6 Work Done by Friction  
**Test 6**  
Lab: Group Problem Session
- 13          Lecture: Rotation About a Fixed Axis  
11.1 Rotational Kinematics  
11.2 Rotational Kinetic Energy, Moment of Inertia  
11.3 Moment of Inertia of Cont. Bodies  
Lab: Group Problem Session
- 14          Lecture:  
11.4 Conservation of Mechanical Energy  
11.5 Torque  
11.6 Rotational Dynamics of a Rigid Body  
11.7 Work and Power  
Lab: Group Problem Session

**II. Course Objectives\*:**

- A. Explain Metric and American units and systems and perform various conversions between the two. V.3 & V.4
- B. Describe the straight-line motion of a particle as well as a rigid body and calculate the necessary parameters by using equations of motion in a practical situation. V.1, V.3, & V.4
- C. Add and multiply two or more vectors by graphical, analytical, and experimental methods in a lab setting. V.3
- D. Analyze force-motion relations in a practical situation by using Newton's Laws of Motion. V.1 & V.4
- E. Calculate the work done by a force as well as energy calculations and conversion to heat (calories). V.1, V.2, V.3,& V.4
- F. Explain different forms of energy and their conversion to each other as well as the Principle of Conservation of Energy in a practical situations. V.1, V.2, V.3,& V.4
- G. Apply the laws of conservation of energy and linear momentum. V.1, V.2 & V.4
- H. Calculate the parameters involved in the motion of a rotating object such as particle separators (centrifugal separating devices). V.1, V.3, & V.4
- I. Explain the effect of the center of mass of a rigid body in its rotation about an axis. V.2 & V.4
- J. Calculate the work done, energy involved, and energy conversions in a given problem involving rotational motion. V.1, V.2 & V.4
- K. Apply Newton's second law to rotating objects. V.1 & V.4
- L. Explain the effect of the geometry of objects on their mass moment of inertia. V.2 & V.4
- M. Resolve a vector into rectangular components by scalar and vector approaches. V.3
- N. Apply the force and torque concepts in the solution of problems that involve the static equilibrium of rigid-bodies. V.2 & V.4

\*Roman numerals after course objectives reference goals of the university parallel program.

**III. Instructional Processes\*:**

Students will:

1. learn in a cooperative mode by working in small groups with other students and exchanging ideas within each group (or sometimes collectively) while being coached by the instructor who provides assistance when needed ( *Active Learning Strategy*),
2. learn by being a problem solver rather than being lectured ( *Active Learning Strategy*),
3. explore and seek solutions to given problems that measures his/her level of accomplishment ( *Active Learning Strategy*),
4. visit industry sites or will be visited by a person from industry who applies the concepts being learned at his/her work site ( *Transitional Strategy*),
5. gradually be given higher- and higher-level problems to promote his/her critical thinking ability ( *Active Learning Strategy*),
6. search for the solution to the assigned projects by examining the available software and resources. ( *Transitional Strategy*),
7. get engaged in learning processes such as projects, mentoring, apprenticeships, and/or research activities as time allows ( *Transitional Strategy*),
8. use computers with appropriate software during class or lab as a boost to the learning process ( *Technological Literacy Outcome*)

\*Strategies and outcomes listed after instructional processes reference TBR' s goals for strengthening general education knowledge and skills, connecting coursework to experiences beyond the classroom, and encouraging students to take active and responsible roles in the educational process.

#### **IV. Expectations for Student Performance\*:**

Upon successful completion of this course, the student should be able to:

1. apply the physics concepts to theoretical and practical situations, A-N
2. estimate an unknown parameter in a given practical situation by using the physics principles involved, B, D, E, F, H, J, K and N
3. recognize the use of equipment and machines from the units used in their gauges, A-N
4. perform conversions between metric and non-metric units, A
5. apply the equilibrium equations to rectilinear motion, B

6. apply the equilibrium equations to rotational motion, J, K, L
7. apply the kinetics equation in torque-motion situations, J, K, L
8. calculate the work done, energy involved, and energy conversions in a given problem involving rectilinear motion, E, F, G
9. calculate the work done, energy involved, and energy conversions in a given problem involving rotational motion, J, K, L
10. calculate the rotational kinetic energy and angular momentum for rotating objects, J

\*Letters after performance expectations reference the course objectives listed above.

## V. Evaluation:

### A. Testing Procedures:

Students are primarily evaluated on the basis of test/quiz type assessments and homework as outlined on the syllabus supplement distributed by the instructor. The following formula is used to evaluate the course grade:

$$\text{Course Grade} = (0.75) \times (\text{Theory Grade}) + (0.25) \times (\text{Lab Grade})$$

$$\text{Theory Grade} = 0.80 (\text{Tests} + \text{Quizzes} + \text{H.W.}) + 0.20 (\text{Comprehensive Final})$$

(80%)    (10%)    (10%)

The number of tests vary from 5 to 7 at the discretion of instructor.

The percentages given for tests, quizzes, and homework may vary depending on the instructor.

### B. Laboratory Expectations:

Ten experiments are designed for the course. Each experiment requires a report that must be at least spell-checked. Other procedures for a standard lab report will be given by your instructor. To avoid a ZERO Laboratory Grade, at least 6 reports must be turned in. No late lab report(s) will be accepted and there are No Lab Make-ups.

$$\text{Lab Grade} = (\text{the sum of report grades}) / (\text{the number of the reports})$$

### C. Field Work:

Site Visits: The necessary site visits will be announced as the arrangements are made. Evaluation will be based on of attendance as well as the visit report.

### D. Other Evaluation Methods:

N/A

E. Grading Scale:

91-100 : A	77-81 : C+
87- 91 : B+	70-77 : C
81- 87 : B	60-70 : D

**VI. Policies:**

A. Attendance Policy:

Pellissippi State Technical Community College expects students to attend all scheduled instructional activities. As a minimum, students in all courses must be present for at least 75 percent of their scheduled class and laboratory meetings in order to receive credit for the course. Individual departments/programs/disciplines, with the approval of the vice president of Academic and Student Affairs, may have requirements that are more stringent.

B. Academic Dishonesty:

Plagiarism, cheating, and other forms of academic dishonesty are prohibited. Students guilty of academic misconduct, either directly or indirectly through participation or assistance, are immediately responsible to the instructor of the class. In addition to other possible disciplinary sanctions which may be imposed through the regular Pellissippi State procedures as a result of academic misconduct, the instructor has the authority to assign an F or a zero for the exercise or examination or to assign an F in the course.

C. Accommodations for disabilities:

If you need accommodation because of a disability, if you have emergency medical information to share, or if you need special arrangements in case the building must be evacuated, please inform the instructor immediately. Privately after class or in the instructor's office.

To request accommodations students must register with Services for Students with Disabilities: Goins 127 or 131, Phone: (865) 539-7153 or (865) 694-6751 Voice/TDD.