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  Date Revised: Spring 03

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 (Calculus I)

Textbook(s) and Other Reference Materials Basic to the Course:

*University Physics*, by Harris Benson, Revised Edition
*Pellissippi State Physics Lab Manual for Physics 1310/2010*

I. Week/Unit/Topic Basis:

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
</tr>
</thead>
</table>
| 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 |
Lecture: Vectors
2.1 Scalars and Vectors
2.2 Vector Addition
2.3 Components and Unit Vectors
Lab: Group Experiment 2: Vector Addition: Graphical Method

Lecture:
2.4 Scalar (Dot) Product
2.5 Vector (Cross) Product
Test 1
Lab: Group Experiment 3: Vector Addition: Force Table Method

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 4: Measurement of "g", Accel. Of Gravity

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 5: Use of Computers to Study Motion

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: Use of Computers to Study Motion

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 7: Newton's 2nd Law

Lecture: Particle Dynamics II
6.1 Friction
6.2 Dynamics of Circular Motion
6.3 Satellite Orbits
Lab: Group Experiment 8: Coefficient of Friction
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 9: Centripetal Force

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 10: Conservation of Energy

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 11: Conservation of Energy

Lecture:
9.5 Comparison of Linear Momentum with Kinetic Energy
9.6 Elastic Collision in 2-D
9.7 Rocket Propulsion
Lab: Group Experiment 12: Collision in One-Dim.

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 Experiment 13: Simple Pendulum

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
11.4 Conservation of Mechanical Energy
Lab: Group Problems Session

Lecture:
11.5 Torque
11.6 Rotational Dynamics of a Rigid Body
11.7 Work and Power

Test 7
Lab: Group Problems Session
II. Course Objectives:

A. Explain Metric and American units and systems and perform various conversions between the two, (The gauges at work sites often use both types of units). I.5, VI.2

B. Qualitatively describe the motion of a body, quantitatively calculate the necessary parameters by using equations of motion, and gather and interpret data in a laboratory setting to measure motion and acceleration of a moving object. VI.2-5

C. Add and multiply two or more vectors by graphical, analytical, and experimental methods in a lab setting. VI.1-5

D. Quantitatively analyze force-motion relations in a lab setting as well as a real life situation by using Newton's Laws of Motion. I.5, VI.2

E. Calculate the work done by a force analytically and measure it experimentally as well as energy calculations and conversion of work to heat (calories). I.5, VI.1-5

F. Experiment and explain different forms of energy and their conversion to each other as well as the Principle of Conservation of Energy in a laboratory setting. I.5

G. Apply the laws of conservation of energy and momentum. I.5

I. Quantitatively calculate the parameters involved in the motion of a rotating object such as particle separators (centrifugal separating devices). VI.1-5

J. Search for the solution(s) to the assigned projects by examining the available software(s) and resources. VII

*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 (Communication Outcome, Problem Solving and Decision Making Outcome, Active Learning Strategy).

2. learn by being a problem solver rather than being lectured (Problem Solving and Decision Making Outcome, Active Learning Strategy).

3. explore and seek solutions to given problems that measures his/her level of accomplishment (Problem Solving and Decision Making Outcome, 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 (Problem Solving and Decision Making Outcome, Personal Development Outcome).

6. be tested more frequently for progress assessment while working independently on test problems (Problem Solving and Decision Making Outcome).

7. get engaged in learning processes such as projects, mentoring, apprenticeships, and/or research activities as time allows (Communication Outcome, Transitional Strategy).

8. be repeatedly given a review on the previous topics to enable him/her to see that physics is the science of equilibrium and how each physics phenomenon can be viewed from an equilibrium point of view (Problem Solving and Decision Making Outcome, Personal Development Outcome).

9. understand physics and recognize matter in all phenomena (even those that do not seem to be physical at the first glance) and analyze them to the extent of their physics knowledge in light of equilibrium (especially, the Law of conservation of mass and energy), and see how thinking in terms of equilibrium and equality can bring harmony to mankind (Problem Solving and Decision Making Outcome, Personal Development Outcome), and

10. use computers with appropriate software during class or lab as a boost to the learning process (Information Literacy Outcome, Technological Literacy Outcome).

*Strategies and outcomes listed after instructional processes reference Pellissippi State’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. prepare a laboratory report on each experiment and explain a scientific conclusion based on the experimental results,

2. discuss the undesirable results in all reports (where appropriate) to become proficient in expressing scientific arguments as opposed to non-biased reasoning,

3. apply the physics concepts to theoretical and practical situations (A-K),

4. estimate an unknown parameter in a given practical situation by using the physics principles involved (B, D, E, F, H, J, K),

5. identify the use of equipment and machines from the units used in their gauges (A-K),

6. calculate wave energy to estimate energy requirement and feasibility in a given situation (F),
7. perform conversions between metric and non-metric units (A),

8. apply the equilibrium equations to rotational motion (B),

9. apply the kinetics equation in torque-motion situations (B),

10. calculate the work done, energy involved, and energy conversions in a given problem involving rotational motion (B),

11. apply a vector approach in solving rotational motion problems (C),

12. apply the general equation of oscillatory motion to a practical situation in order to calculate the necessary parameter. (D),

13. apply wave energy calculations to determine the wave energy transported to a given point in space (F),

14. solve problems involving mechanical properties of solids, fluids, and gases (G),

15. apply the equations involving heat calculation due to temperature change and phase change (I),

16. apply the laws of thermodynamics to selected processes (I), and

17. solve simple entropy change problems (I).

*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:

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

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

    (80%) (10%) (10%)

    The number of tests vary from 5 to 7 at the discretion of instructor. The quizzes and homework percentages depends on the instructor.

B. Laboratory Expectations:
Eleven experiments are designed for the course. Each experiment requires a word-processed report that must be at least spell-checked. Other procedures for a standard lab report will be given by your instructor or may be found at the Pellissippi State's Web Page under Physics. No late lab report will be accepted and there are NO lab make-ups.

Lab Grade = (the sum of report grades) / (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 attendance as well as the visit report.

D. Other Evaluation Methods:

N/A

E. Grading Scale:

<table>
<thead>
<tr>
<th>Score Range</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>91-100</td>
<td>A</td>
</tr>
<tr>
<td>87-91</td>
<td>B+</td>
</tr>
<tr>
<td>81-87</td>
<td>B</td>
</tr>
<tr>
<td>70-77</td>
<td>C</td>
</tr>
<tr>
<td>60-70</td>
<td>D</td>
</tr>
</tbody>
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VI. Policies:

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.