# MECHANICS & HEAT W/ LAB II

## PHYS 1320

<table>
<thead>
<tr>
<th>Class Hours:</th>
<th>3.0</th>
<th>Credit Hours:</th>
<th>4.0</th>
</tr>
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<tbody>
<tr>
<td>Laboratory Hours:</td>
<td>3.0</td>
<td>Date Revised:</td>
<td>Spring 03</td>
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## Catalog Course Description:

A calculus-based introduction to mechanics and heat. This course is a continuation of Mechanics and Heat I. It covers rigid body equilibrium, periodic motion, fluid mechanics, heat and thermodynamics, ideal gas behavior, oscillatory motion, and acoustics. 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:

PHYS 1310

## Co-requisite:

MATH 1920

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

*University Physics*, by Harris Benson, Revised Edition.
*Pellissippi State’s Physics Lab Manual for Physics 1310/1320*

## I. Week/Unit/Topic Basis:

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
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<tbody>
<tr>
<td>1</td>
<td>Lecture: Static Equilibrium &amp; Rolling Objects (12.1 Static Equilibrium, 12.2 Rotation and Translation (No-sliping), 12.3 Rotation and Translation (With slipping)) Lab: Group Problems Session</td>
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<tr>
<td>2</td>
<td>Lecture: Vector Description of Rotational Motion (13.1 Torque Vector, 13.2 Angular Velocity &amp; Acceleration Vectors, 13.3 Vector Relations Lab: Group Experiment #1, Newton's 2nd Law for Rotational Motion</td>
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<tr>
<td>3</td>
<td>Lecture: Oscillations (Simple Harmonic Motion, 14.1 Kinematics of SHM, 14.2 The Dynamics of SHM) <strong>Test 1</strong> Lab: Group Experiment #2, Simple Harmonic Motion</td>
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<tr>
<td>4</td>
<td>Lecture: Oscillations (Simple Harmonic Motion, 14.4 Uniform Circular Motion and</td>
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Lecture: One-dimensional Waves (15.1 Introduction, 15.2 Waves Traveling on a String, 15.3 Wave Velocity on a String, 15.4 Energy Transported by Sine-Waves) Lab: Group Experiment #3, Vibrating String

**Test 2**
Lab: Group Problems Session

Lecture: One-dimensional Waves (15.5 Superposition and Interference, 15.6 The Wave Equation)


Lecture: Solids, Liquids, and Gases (16.5 Newton's Universal Law of Gravity, 16.6 Fluid Dynamics, 16.7 Dynamic Viscosity) Lab: Group Experiment #5, Archimede's Principle

Lecture: Sound (17.1 Models for Sound Waves in a Gas, 17.2 The velocity of Sound, 17.3 Harmonic Waves in Air, 17.4 Sound Intensity and Intensity Level, 17.5 Sources of Sound, 17.6 The Doppler Effect) **Test 3** Lab: Group Experiment #6, Speed of Sound (Air Resonance Tube)

Lecture: Thermodynamics and Kinetic Theory (18.1 Temperature, 18.2 Thermal Expansion, 18.3 Heat Energy Transfer Mechanics) Lab: Group Experiment #7, Thermal Expansion Coefficient

Thermodynamics and Kinetic Theory (18.4 Heat Capacity and Latent Heat, 18.5 The Equation of State) **Test 4** Lab: Group Experiment #8, Heat Capacity Measurement


Lecture: Thermodynamics I: Processes & 1st Law (19.4 Specific Thermodynamics Processes, 19.5 Cyclic Processes) Lab: Group Problems Session

Lecture: Thermodynamics II: The 2nd Law (20.1 The 2nd Law and Heat Engines, 20.2 The Carnot Cycle, 20.3 Refrigerators and Heat Pumps, 20.4 The Abs. Temp. Scale & The 3rd Law) **Test 5** Lab: Group Experiment #10, Gas Expansion at Constant Volume

Lecture: Thermodynamics II: The 2nd Law (20.5 General Cyclic Processes, 20.6 A Formal Def. of State Variables, 20.7 Entropy: A State Variable, 20.8 Entropy Changes for Irreversible Processes, 20.9 Entropy and Disorder Lab: Group Problems Session

**COMPREHENSIVE FINAL EXAM (110 minutes)**
II. Course Objectives*:

A. Explain Metric and American units for heat and perform various conversions between the two, (Equipment gauges often use both types of units). I.5, VI.2

B. Experiment with and analyze the equilibrium of rotating, translating, and rolling objects. I.5

C. Use a vector approach in the description of rotational motion. I.5

D. Experiment with elasticity (Hooke's law) and Simple Harmonic Motion (SHM)

E. Experiment with periodic and oscillatory motion and be able to determine and measure the variables involved. I.5, VI.1-5

F. Experiment with oscillations on a vibrating string. Relate the oscillatory motion to wave motion and quantitatively calculate the variables involved in standing and traveling waves. I.5, VI.1-5

G. Calculate wave energy and describe wave interference and superposition VI.1-5

H. Explain different phases and properties of matter: solid and fluid mechanical and gas dynamics states I.5

I. Experiment with and quantitatively analyze buoyancy (Archimedes's principle.) I.5

J. Measure speed of sound experimentally. Quantitatively analyze sound, its velocity in matter, harmonic waves in strings and pipes, resonance, beats, and the Doppler effect. I.5, VI.1-5

K. Experiment with and explain temperature, heat, thermal expansion, heat energy transfer mechanisms, heat capacity and latent heat and the equation of state for gases. I.5

L. Experiment with and quantitatively apply the laws of thermodynamics to different selected processes and cycles. I.5

M. Explain the importance of entropy and the calculation of entropy losses in selected thermodynamic processes. I.5

N. Search for the solution to the assigned projects by examining the available software 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:

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

3. identify equipment and machines from the units used in their gauges (A-K)

4. calculate wave energy to estimate energy requirement in a given situation (F),

5. perform necessary conversions between metric and non-metric units and systems (A),

6. apply equilibrium equations to rotational motion situations (B),

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

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

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

10. apply the general equation of oscillatory motion to a practical situation in order to calculate and/or measure the necessary parameters (D),

11. apply the one-dimensional wave equation to determine the parameters involved in the motion of a wave such as radio waves (D and E),
12. apply wave energy calculations to determine the wave energy transported to a given point in space (F),

13. solve problems involving mechanical properties of solids, fluids, & gases (G),

14. apply the wave equation and properties of matter to problems involving sound propagation (H),

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

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

17. solve simple entropy change problems (K).

*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:

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

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

\[
\begin{align*}
\text{(80\%)} & \quad \text{(10\%)} & \quad \text{(10\%)}
\end{align*}
\]

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

B. Laboratory Expectations:

Ten 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 Pellissippi State's Web Site under Physics. No late lab reports will be accepted and there are NO lab make-ups.

\[
\text{Lab Grade} = \frac{\text{(the sum of report grades)}}{\text{(the number of the reports)}}
\]

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:

\[
\begin{align*}
91-100 : \text{A} & \quad 77-81 : \text{C+} \\
87-91 : \text{B+} & \quad 70-77 : \text{C} \\
81-87 : \text{B} & \quad 60-70 : \text{D}
\end{align*}
\]
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.