PELLISSIPPI STATE TECHNICAL COMMUNITY COLLEGE
MASTER SYLLABUS

MECHANICS & HEAT W/ LAB II
PHYS 1320

Class Hours: 3.0  Credit Hours: 4.0
Laboratory Hours: 3.0  Revised: Fall 09

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 Course Materials:

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

I. Week/Unit/Topic Basis:

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Chapter 12, Angular Momentum &amp; Statics</strong>&lt;br&gt;12.1 The Torque Vector&lt;br&gt;12.2 Angular Momentum&lt;br&gt;12.3 Rotational Dynamics&lt;br&gt;12.4 Conservation of Angular Momentum&lt;br&gt;12.5 Conditions for Static Equilibrium</td>
</tr>
<tr>
<td>2</td>
<td><strong>Chapters 12, Continued....</strong>&lt;br&gt;12.6 Center of Gravity&lt;br&gt;12.7 Dynamic Balance&lt;br&gt;12.8 Spin and Orbital Angular Momentum&lt;br&gt;12.9 Gyroscopic Motion&lt;br&gt;<strong>Test 1</strong>&lt;br&gt;Group Experiment #1&lt;br&gt;Newton’s Second Law Applied to Rotational Motion</td>
</tr>
<tr>
<td>3</td>
<td><strong>Chapter 13, Gravitation</strong>&lt;br&gt;13.1 Newton’s Law of Gravitation</td>
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</table>
13.2 Gravitational and Inertial Mass
13.3 The Gravitational Field Strength
13.4 Kepler’s Laws of Planetary Motion
13.5 Continuous Distribution of Mass
Historical Note: Background to *Principia*

Group Experiment #2
Rotational Equilibrium: Calculation of Supports
Reactions of a Loaded Beam

Chapter 14, Solids and Fluids
14.1 Density
14.2 Elastic Moduli
14.3 Pressure in Fluids
14.4 Archimedes’s Principle
14.5 The Equation of Continuity
14.6 Bernoulli’s Equation

Test 2
Group Experiment #3 Center of mass

Chapter 15, Oscillations
15.1 Simple Harmonic Oscillation
15.2 The Block-Spring System
15.3 Energy in Simple Harmonic Notion
15.4 Pendulum
Group Experiment #4
Archimedes’ Principle
Buoyancy

Chapter 16, Mechanical Waves
16.1 Wave Characteristics
16.2 Superposition of Waves
16.3 Speed of a Pulse on a String
16.4 Reflection and Transmission
16.5 Traveling Waves

Test 3
Group Experiment #5 Hooke’s Law

Chapter 16, Continued…
16.6 Traveling Harmonic Waves
16.7 Standing Waves
16.8 Resonant Standing Waves on a String
16.9 The Wave Equation
16.10 Energy Transport on a String
16.11 Velocity of Waves on a String
Group Experiment #6
Speed of Transverse Waves (In Stretched Strings)

Chapter 17, Sound
17.1 The Nature of Sound Waves
17.2 Resonant Standing Sound Waves
17.3 The Doppler Effect
17.4 Interference I Time: Beats
17.5 Velocity of Longitudinal Waves in a Fluid
17.6 Sound Intensity

Test 4
Chapter 18, Temperature, Thermal Expansion, and Gas Law
18.1 Temperature
18.2 Temperature Scales
18.3 The Zeroth Law of Thermodynamics
18.4 The Equation of State of an Ideal Gas
18.5 Constant-Volume Gas Thermometer
18.6 Thermal Expansion

Chapter 19, First Law of Thermodynamics
19.1 Specific Heat
19.2 Latent Heat
19.3 The Mechanical Equivalent of Heat
19.4 Work in Thermodynamics
19.5 First Law of Thermodynamics

Chapter 19, Continued…
19.6 Application of The First Law of Thermodynamics
19.7 Ideal Gases
19.8 Speed of Sound
19.9 Heat Transport

Chapter 20, Kinetic Theory
20.1 The Model of an Ideal Gas
20.2 Kinetic Interpretation of Pressure
20.3 Kinetic Interpretation of Temperature
20.4 Specific Heats of an Ideal Gas

Chapter 20, Continued...
20.5 Equipartition of Energy
20.6 Maxwell-Boltzmann Distribution of Speeds
20.7 Mean Free Path
20.8 Van der Waals Equation: Phase Diagrams

Chapter 21, Entropy and The Second Law of Thermodynamics
21.1 Heat Engine, Kelvin-Planck Statement of the 2nd Law
21.2 Refrigerators and the Clausius Statement of the 2nd Law
21.3 Equivalence of the Kelvin-Planck & Clausius Statements
21.4 Reversible and Irreversible Processes
21.5 The Carnot Cycle
21.6 The Gasoline Engine (Otto Cycle)
21.7 Entropy
21.8 Entropy and The Second Law
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),(V.1 & V.3)

B. Describe the motion of a body and calculate the necessary parameters by using equations of motion in a practical situation,(V.1 & V.4)

C. Analyze force-motion relations in a practical situation , (V.1 & V.4)

D. calculate the work done by a force as well as energy calculations and conversion to heat (calories),(V.1 & V.4)

E. explain different forms of energy and their conversion to each other as well as the Principle of Conservation of Energy in practical situations at work sites,(V.1, V.2, V.3,& V.4)

F. apply the laws of conservation of energy and momentum, (V.2, V.3,& V.4)

G. calculate the parameters involved in the motion of a rotating object such as particle separators (centrifugal separating devices),(V.2 & V.4)

H. apply the laws of fluid pressure and density to measure the necessary parameters in a practical situation at work, (V.1 & V.3)

I. make temperature measurements in different scales and convert and use them for heat and energy calculations with or without phase change,(V.3)

J. apply the equations for thermal expansion of solids, liquids, and gases, (V.3)

K. Describe oscillatory motion by measuring wavelength, amplitude, and the phase of motion of mechanical waves such as sound, (V.1 & V.3)

L. apply the knowledge of sound parameters such as frequency, wavelength, and in interpreting the signals on measurement devices in sonography and ultrasound, (V.3)

M. apply the conditions of static equilibrium to find the forces acting on an object in a given situation, (V.1 & V.3) and

N. use the concept of torque of a force to analyze the static equilibrium of a rigid body. (V.3)

*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 through K),

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

3. recognize and identify the use of equipment and machines from the units used in their gauges, (A),

4. master energy calculations to estimate energy requirement and feasibility in a given situation, (D, E, and F),

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

6. apply the kinematics equations to describe motion, (B and C),

7. apply the kinetics equation in force-motion situations (B and C),

8. calculate the work done, energy involved, and energy conversions in a given problem (D, E, and F),

9. solve problems involving circular motion as well as torque, energy, and momentum calculations (E, F, and G),

10. solve temperature and heat problems with or without phase change, (I),

11. solve problems involving heat effect and thermal expansion in solids, fluids, and gases (J),

12. solve problems in oscillatory motion in order to find the parameters involved (K and L),

13. solve and analyze fluid pressure, air pressure, and density problems (H),
14. apply a vector approach where vector quantities are involved (M),
15. resolve a vector into two components graphically and analytically (M), and
16. apply force and torque equilibrium concepts in solving rigid-body problems (M, N, and O).

*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:

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

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

\[
(80\%) \quad (10\%) \quad (10\%)
\]

The number of tests may vary from 5 to 7. The percentages given for tests, quizzes, and homework may vary depending on the instructor.

Final Exam must be taken during the Final Exam Week. No early Final Exam will be given.

B. Laboratory Expectations:

**Laboratory Grade** = \((\text{the sum of reports grades}) / (\text{the number of the reports})\).

10 experiments* are designed for the course. Each experiment requires a report that must be at least spell-checked. 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.**

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:

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<th>Grade</th>
<th>Percentage</th>
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<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>77-81</td>
<td>C+</td>
</tr>
<tr>
<td>70-77</td>
<td>C</td>
</tr>
<tr>
<td>60-70</td>
<td>D</td>
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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 Learning, 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:

Students who need accommodations because of a disability, have emergency medical information to share, or need special arrangements in case the building must be evacuated should inform the instructor immediately, privately after class or in her or his office. Students must present a current accommodation plan from a staff member in Services for Students with Disabilities (SSWD) in order to receive accommodations in this course. Services for Students with Disabilities may be contacted by going to Goins 134 or 126 or by phone: 694-6751(Voice/TTY) or 539-7153. More information is available at www.pstcc.edu/departments/swd/.