Miami Dade College

Course Competencies Template - Form 112

| GENERAL INFORMATION | |
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| Name: Dr. Jose Diaz | Phone #: 7-3112 |
| Course Prefix/Number: PHY 3504 | Course Title: Thermodynamics & Waves |
| Number of Credits: 4 | |
| Degree Type | ☐ B.A. ☒ B.S. ☐ B.A.S ☐ A.A. ☐ A.S. ☐ A.A.S. ☐ C.C.C. ☐ A.T.C. ☐ V.C.C |
| Date Submitted/Revised: 03/13/08 | Effective Year/Term: Fall 2008-1 |
| ☐ New Course Competency ☒ Revised Course Competency | |
| Course to be designated as a General Education course (part of the 36 hours of A.A. Gen. Ed. coursework): ☐ Yes ☒ No | |
| The above course links to the following Learning Outcomes:<br>☐ Communication<br>☒ Numbers / Data<br>☒ Critical thinking<br>☐ Information Literacy<br>☐ Cultural / Global Perspective<br>☐ Social Responsibility<br>☐ Ethical Issues<br>☐ Computer / Technology Usage<br>☐ Aesthetic / Creative Activities<br>☒ Natural Systems/Environmental Responsibility | |
| Course Description (limit to 50 words or less, **must correspond with course description on Form 102**):<br>This course is an introduction to mechanical waves and classical thermodynamics. The student will learn the physics of oscillations and mechanical waves and the postulates and results of the kinetic theory of gases, the laws of thermodynamics and their applications to heat engines. | |
| Prerequisite(s): PHY 2048 | Corequisite(s): |

Course Competencies

Competency 1. The student will demonstrate knowledge, comprehension, and the ability to analyze and apply the concepts of mechanical oscillations by:

1. Relating the concepts of amplitude, frequency, period, and phase to the motion of simple harmonic oscillator.
2. Analyzing the damped and undamped motion of a simple harmonic oscillator using energy principles.
3. Relating the frequency of a harmonic oscillator to the spring constant and the mass.
4. Comparing and contrasting natural and forced oscillations of a simple harmonic oscillator.
5. Relating the amplitude and phase of forced oscillations to those of the driving force.
6. Solving problems involving the simple harmonic oscillator.

Competency 2. The student will demonstrate knowledge, comprehension, and the ability to analyze and apply the principles of mechanical wave propagation by:

1. Comparing and contrasting the transfer of mass, energy, and information by waves.
2. Relating the inertia and elasticity of a medium to propagation of waves through that medium.
3. Comparing and contrasting the motion of the medium in transverse and longitudinal waves.
4. Classifying waves as either longitudinal or transverse.

5. Relating the concepts of wave speed, wavelength, frequency, period, and amplitude to each other.
6. Stating and applying the principle of wave superposition.
7. Explaining constructive and destructive interference using wave superposition.
8. Interpreting complex vibration patters in terms of the superposition of sinusoidal patterns using Fourier synthesis and analysis.
9. Distinguishing between phase and group velocity.
10. Solving problems involving mechanical waves.

Competency 3 . The student will demonstrate knowledge, comprehension, and the ability to analyze and apply the concepts of sound waves by:

1. Describing sound waves using the terms compression and rarefaction.
2. Deriving the speed of sound in terms of the properties of the medium.
3. Relating wave properties to sound perception.
4. Describing and applying the concepts of reflection, refraction, superposition, interference, and diffraction.
5. Relating the phenomenon of beats to interference.
6. Deriving the Doppler effect expressions from the speeds of the source, observer, and medium.
7. Comparing and contrasting the Doppler effect in sound and in light.
8. Describing the nature and formation of shock waves.
9. Relating the formation of sonic booms to the speed of the source.
10. Solving problems involving sound waves.

Competency 4 . The student will demonstrate knowledge, comprehension, and the ability to analyze and apply the concepts of mechanical waves on a string and sound waves in cylindrical gas columns by:

1. Deriving the speed of waves on a string in terms of the string's properties.
2. Comparing and contrasting the transmission and reflection phenomena at the boundaries.
3. Comparing and contrasting traveling and standing waves.
4. Relating the formation of standing waves to wave interference.
5. Deriving the characteristics of standing waves based on the specific boundary conditions.
6. Calculating the locations of the nodes and antinodes in standing waves.
7. Relating modes of vibration, standing waves, and resonance.
8. Comparing and contrasting the fundamental frequency, harmonics, and overtones.
9. Relating timbre to the fundamental frequency, harmonics, and overtones.
10. Relating non sinusoidal waves to harmonics and overtones through Fourier analysis and synthesis.
11. Relating qualitatively waves on strings and cylindrical columns to vibrations of two dimensional surfaces.
12. Solving problems involving waves on a string.
13. Solving problems involving sound waves in cylindrical columns.

Competency 5. The student will demonstrate knowledge, comprehension, and the ability to analyze and apply the theory of ideal and real gases by:

1. Comparing and contrasting ideal and real gases.
2. Comparing and contrasting microscopic and macroscopic variables.
3. Stating and applying the Ideal Gas law, the Van der Waals Equation and the Virial equation of state.
4. Stating and applying Dalton's law of partial pressure, Graham's laws, and Fick's laws.
5. Solving problems involving ideal and real gases.

Competency 6. The student will demonstrate knowledge, comprehension, and the ability to analyze and apply the kinetic molecular theory of gases by:

1. Stating the assumptions of the theory.

2. Deriving expressions for the pressure and temperature of an ideal gas in terms of microscopic variables.
3. Deriving expressions for the collision frequency and mean free path of gas molecules in terms of microscopic variables.
4. Stating and applying the Maxwell-Boltzmann distribution law.
5. Solving problems involving the kinetic theory of gases.

Competency 6. The student will demonstrate knowledge, comprehension, and the ability to analyze and apply fundamental concepts of thermodynamics by:

1. Defining and applying the concepts of heat, heat transfer, work, internal energy, temperature, and heat capacity.
2. Defining and applying the concepts of state function with particular emphasis on entropy.
3. Stating the laws of thermodynamics and applying them to processes and cycles.
4. Creating diagrams involving two thermodynamic variables and using them to apply the laws of thermodynamics to processes and cycles.
5. Relating the concepts of a process and cycle to heat engines and refrigerators.
6. Calculating the efficiency and coefficient of performance of heat engines and refrigerators.
7. Relating the concept of reversibility to processes and cycles.
8. Relating the concept of entropy to reversibility, spontaneous change, order-disorder, and information.
9. Solving problems involving the fundamental concepts of thermodynamics.