

## WTCS Repository

10-806-158 Calc Physics 1 Enhancement

# Course Outcome Summary

### Course Information

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|  | Description | 10-806-158 CALC PHYSICS 1 ENHANCEMENT ...mathematical enhancement transforming General Physics 1 (4 cr) into Calc-based Physics 1 (5 cr). Topics include deriving fundamental kinematic equations, time- and position-varying forces, impulse, work, rotational  motion, moments of inertia, simple-harmonic motion,  thermodynamics. |
|  | Total Credits | 1 |

### Course History

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|  | Last Revision Date | 4/5/2023 |

### Course Competencies

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| 1. | Apply Translational Kinematics to One-Dimensional Motion |
|  | Assessment Strategies |
|  | 1.1. | Written Product |
|  | 1.2. | Simulation |
|  | 1.3. | Drawing/Illustration |
|  | Criteria |
|  | 1.1. | you diagram one-dimensional kinematic systems correctly |
|  | 1.2. | you utilize equations to relate measurements of time, velocity, acceleration, and displacement in one-dimensional systems. |
|  | 1.3. | you graph kinematic variables correctly. |
|  | 1.4. | you determine the instantaneous velocity and instantaneous acceleration by taking the derivative of the appropriate kinematic equations.  |
|  | 1.5. | you calculate the displacement and velocity of a particle in free fall by taking the derivative of the appropriate kinematic equations.  |
|  | 1.6. | you use the slope or area under a curve to solve for velocity or acceleration. |
|  | 1.7. | you calculate solutions to one-dimensional systems utilizing the kinematic equations and their derivatives. |
|  | Learning Objectives |
|  | 1.a. | Differentiate between distance, displacement, average speed, average velocity, instantaneous velocity, and acceleration.  |
|  | 1.b. | Relate variables to a frame of reference thru proper construction of diagrams and graphs of one-dimensional systems.  |
|  | 1.c. | Solve one-dimensional systems utilizing relationships involving displacement, velocity, acceleration, and time.  |
|  | 1.d. | Examine properties of a body in free fall.  |
| 2. | Apply Translational Kinematics to two-dimensional motion.  |
|  | Assessment Strategies |
|  | 2.1. | Written Product |
|  | 2.2. | Simulation |
|  | 2.3. | Drawing/Illustration |
|  | Criteria |
|  | 2.1. | you diagram two-dimensional kinematic systems correctly. |
|  | 2.2. | you utilize equations to relate measurements of time, velocity, acceleration, and displacement in two-dimensional systems. |
|  | 2.3. | you graph kinematic variables correctly. |
|  | 2.4. | you derive expressions for the displacement and velocity as functions of time for a particle moving in an xy-plane with constant acceleration.  |
|  | 2.5. | you calculate displacement and velocity as functions of time for a particle moving in an xy-plane with constant acceleration.  |
|  | 2.6. | you calculate the displacement, time, or velocity for a particle with non-constant acceleration.  |
|  | 2.7. | you calculate solutions to two-dimensional systems using kinematic equations and their derivatives. |
|  | Learning Objectives |
|  | 2.a. | Differentiate between distance, displacement, average speed, average velocity, instantaneous velocity and acceleration in two dimensions.  |
|  | 2.b. | Relate variables to a frame of reference thru proper construction of diagrams and graphs of two-dimensional systems.  |
|  | 2.c. | Derive mathematical expressions for relationships involving time, displacement, velocity, and acceleration in two dimensions.  |
|  | 2.d. | Solve two-dimensional systems utilizing relationships between displacement, velocities, acceleration, and time.  |
| 3. | Apply the concepts of work, power, and energy to dynamics applications.  |
|  | Assessment Strategies |
|  | 3.1. | Written Product |
|  | 3.2. | Simulation |
|  | 3.3. | Drawing/Illustration |
|  | Criteria |
|  | 3.1. | you identify and compare scientific work and non-scientific work examples. |
|  | 3.2. | you diagram kinetic and potential energies within multiple systems and relate them to total mechanical energy. |
|  | 3.3. | you utilize the work-energy theorem to identify work, power, and energy relationships within systems. |
|  | 3.4. | you determine the work done by a net force acting on an object by measuring the change in kinetic energy (work-energy theorem).  |
|  | 3.5. | you calculate the work done by a constant force and a variable force acting on an object.  |
|  | 3.6. | you calculate force components based on potential energy data.  |
|  | 3.7. | you calculate the area under a force versus displacement curve. |
|  | 3.8. | you differentiate between average power and instantaneous power in calculations.  |
|  | Learning Objectives |
|  | 3.a. | Compare the concept of scientific work to non-scientific work.  |
|  | 3.b. | Examine the conceptual applications for kinetic, potential, and total mechanical energies within a system.  |
|  | 3.c. | Utilize the relationships between work, energy, and power to solve mathematical problems in various mechanical systems. |
|  | 3.d. | Apply the Law of Conservation of Energy to various mechanical systems.  |
| 4. | Examine the concepts and principles of linear momentum.  |
|  | Assessment Strategies |
|  | 4.1. | Written Product |
|  | 4.2. | Simulation |
|  | 4.3. | Drawing/Illustration |
|  | Criteria |
|  | 4.1. | you diagram systems of elastic and inelastic collisions showing variables before and after. |
|  | 4.2. | you define impulse, momentum, elastic collisions, and inelastic collisions mathematically. |
|  | 4.3. | you calculate impulse for a constant force in multiple systems. |
|  | 4.4. | you calculate impulse due to a time-varying force.  |
|  | 4.5. | you find impulse by calculating the area under a force versus time graph.  |
|  | 4.6. | you determine the center of mass of a system of particles. |
|  | 4.7. | you solve for variables in linear momentum systems using the Law of Conservation of Momentum.  |
|  | Learning Objectives |
|  | 4.a. | Define impulse, momentum, elastic collision, and inelastic collision in terms of their mathematical properties.  |
|  | 4.b. | Apply relationships involving impulse and linear momentum to a system of particles.  |
|  | 4.c. | Examine the concept of center of mass as it relates to the a system of particles or a rigid body.  |
|  | 4.d. | Apply the Law of Conservation of Momentum to linear elastic and inelastic collisions.  |
| 5. | Apply the laws of rotational dynamics and equilibrium. |
|  | Assessment Strategies |
|  | 5.1. | Written Product |
|  | 5.2. | Simulation |
|  | 5.3. | Drawing/Illustration |
|  | Criteria |
|  | You will be successful when: |
|  | 5.1. | you contrast and compare the equations of motion for translational and rotational kinematics.  |
|  | 5.2. | you explain torque, moment of inertia, and the Law of Conservation of Angular Momentum verbally and mathematically.  |
|  | 5.3. | you diagram and graph rotational systems. |
|  | 5.4. | you express torque using vector cross products. |
|  | 5.5. | you calculate rotational motion components such as displacement, velocity, and acceleration using kinematic equations and their derivatives.  |
|  | 5.6. | you calculate energy, work, and power in rotational systems. |
|  | 5.7. | you calculate torque, force, or moment arm using the appropriate equations. |
|  | 5.8. | you calculate the moment of inertia for an object or system using integration for the form(s). |
|  | Learning Objectives |
|  | 5.a. | Identify the relationship between translational and rotational kinematics.  |
|  | 5.b. | Explore the concepts of angular velocity, angular acceleration, torque, moment of inertia, and conservation of angular momentum.  |
|  | 5.c. | Determine mathematically the rotational motion of a rigid body about a fixed axis. |
|  | 5.d. | Calculate the energy and work in rotational motion.  |
|  | 5.e. | Calculate torque in multiple mechanical systems.  |
| 6. | Explore the concepts of thermodynamics as they pertain to fluid systems.  |
|  | Assessment Strategies |
|  | 6.1. | Written Product |
|  | 6.2. | Simulation |
|  | 6.3. | Drawing/Illustration |
|  | Criteria |
|  | You will be successful when: |
|  | 6.1. | you diagram and graph fluid movement in multiple systems, including gas and liquid applications. |
|  | 6.2. | you explain the four Laws of Thermodynamics in relation to their impact on multiple systems.  |
|  | 6.3. | you explain or model entropy in macro and micro systems.  |
|  | 6.4. | you analyze isothermal, isobaric, and isochoric log forms of gas systems.  |
|  | 6.5. | you derive the pressure-volume and pressure-temperature relationships for adiabatic heating and cooling.  |
|  | 6.6. | you model thermodynamic processes graphically.  |
|  | 6.7. | you derive equations for thermodynamic work and apply them to systems. |
|  | 6.8. | you calculate the work done by an ideal gas. |
|  | 6.9. | you solve systems involving simple non-ideal gases.  |
|  | Learning Objectives |
|  | 6.a. | Investigate the applications of fluid dynamics in multiple systems.  |
|  | 6.b. | Identify thermodynamic systems, equations of state, and thermodynamic processes.  |
|  | 6.c. | Explain the Laws of Thermodynamics.  |
|  | 6.d. | Explain the relevance of entropy in macro and micro world settings. |
|  | 6.e. | Describe the fundamental thermodynamic processes and model their graphical representations. |
|  | 6.f. | Derive the equations for thermodynamic work done by an ideal gas during the fundamental thermodynamic processes.  |