Course Number and Title: PHY 281 Physics I with Calculus

Campus Location:
Georgetown, Dover, Stanton, Wilmington

Effective Date:
2021-51

Prerequisite:
MAT 281

Co-Requisites:
None

Course Credits and Hours:
4.00 credits
3.00 lecture hours/week
3.00 lab hours/week

Course Description:
This calculus-based physics course includes the study of vectors, kinematics, dynamics, energy, momentum, gravitation, rotational motion and dynamics, equilibrium, oscillations, and mechanical properties of matter.

Required Text(s):
Obtain current textbook information by viewing the campus bookstore - https://www.dtcc.edu/bookstores online or visit a campus bookstore. Check your course schedule for the course number and section.

Additional Materials:
The Mathematics/Physics Department recommends the use of a TI-84 Graphic Calculator. Calculators with QWERTY keyboards are inappropriate for this course and will not be permitted in test situations.

Schedule Type:
Classroom Course

Disclaimer:
None

Core Course Performance Objectives (CCPOs):

1. Analyze motion in one, two, and three dimensions. (CCC 2, 6)
2. Investigate the laws of motion. (CCC 2, 6)
3. Analyze motion using work-energy and conservation of energy principles. (CCC 2, 6)
4. Develop strategies for analyzing elastic and inelastic collisions. (CCC 2, 6)
5. Analyze circular and rotational motion. (CCC 2, 6)
6. Apply principles of simple harmonic and periodic motion. (CCC 2, 6)
7. Investigate physics principles using experimental techniques. (CCC 1, 2, 3, 6)

See Core Curriculum Competencies and Program Graduate Competencies at the end of the syllabus. CCPOs are linked to every competency they develop.

Measurable Performance Objectives (MPOs):
Upon completion of this course, the student will:

1. Analyze motion in one, two, and three dimensions.
    1. Convert physics units in both engineering (English) and scientific (SI) system of units.
    2. Employ the principles of uncertainty, significant figures, and error propagation.
    3. Using both algebraic and graphical methods, solve for unknown variables of motion in constant velocity motion.
    4. Using both algebraic and graphical methods, solve for unknown variables of motion in linear accelerated motion (including free-fall).
    5. Interpret and create motion diagrams and graphs from information provided.
    6. Perform vector algebra calculations, including scalar and vector products.
    7. Calculate the resultant vectors in both unit-vector and magnitude-direction forms.
    8. Apply both differential and integral calculus to calculate motion variables.
    9. Distinguish between the vertical and horizontal motion of objects launched at different angles.
    10. Calculate unknown variables of motion in projectile motion for objects launched at different angles.
    11. Determine the relative velocity of moving objects in different reference frames.
2. Investigate the laws of motion.
    1. Explain the motion of objects using Newton's laws of motion.
    2. Differentiate between mechanical contact and long-range forces.
    3. Calculate the values of all mechanical contact and long-range forces from information provided.
    4. Construct free body diagrams and motion diagrams from information provided.
    5. Solve Newton's second law problems involving single and interacting objects.
    6. Determine the unknown force(s) acting on objects in equilibrium and accelerated motion.
3. Analyze motion using work-energy and conservation of energy principles.
    1. Calculate work, kinetic energy, gravitational potential energy, and elastic potential energy using both algebra and calculus.
    2. Explain and determine the motion of objects using the work-energy theorem.
    3. Distinguish between conservative and non-conservative forces.
    4. Apply the conservation of energy in both conservative and non-conservative forms to solve for motion variables.
    5. Calculate power and compare the effects of power, force, and work.
4. Develop strategies for analyzing elastic and inelastic collisions.
    1. Analyze motion and collisions using momentum and impulse principles.
    2. Calculate momentum and impulse.
    3. Apply the impulse-momentum theorem to study interaction between two objects.
    4. Apply conservation of momentum in both qualitative and quantitative situations.
    5. Analyze one- and two-dimensional elastic and inelastic collisions using conservation laws.
    6. Determine the motion of systems using the center-of-mass approach.
5. Analyze circular and rotational motion.
    1. Calculate the rotational equivalent of displacement, velocity, and acceleration in uniform rotational motion.
    2. Apply Newton's second law with the concept of centripetal force to analyze uniform circular motion.
    3. Calculate the gravitational force between objects using Newton's law of gravitation, and explain the orbits of celestial objects.
    4. Determine the period and speed of satellites around different central bodies.
    5. Calculate torque and employ the equilibrium conditions to solve static problems with extended objects.
    6. Investigate strength of solids using Young's, shear and bulk moduli.
    7. Calculate the moment of inertia, net torque, and angular acceleration of rotating objects.
    8. Determine unknown motion variables in rotational dynamics.
    9. Apply the law of conservation of angular momentum in both qualitative and quantitative situations.
6. Apply principles of simple harmonic and periodic motion.
    1. Define simple harmonic motion (SHM) in terms of Newton's second law.
    2. Use force and energy concepts to solve for unknown motion variables in SHM.
    3. In terms of angular frequency and phase, use the reference circle and solve for position, velocity, and acceleration.
    4. Determine frequency, period, and amplitude for mass on spring and simple pendulum.
    5. Investigate the SHM of a physical and determine the period and frequency of different rigid bodies.
    6. Analyze the motion of a damped oscillator
7. Investigate physics principles using experimental techniques.
    1. Develop an understanding of the inherent uncertainty in measuring devices.
    2. Analyze linear motion by constructing and analyzing motion graphs.
    3. Predict the range of a projectile based on initial velocity, vertical height, and launch angle.
    4. Verify that Newton's second law of motion is valid using at least two experimental situations, one for equilibrium and another for accelerated motion.
    5. Determine centripetal force of an object in uniform circular motion.
    6. Compare and contrast elastic and inelastic collisions by determining momentum and energy transfer in colliding carts.
    7. Verify the law of conservation of energy for an object undergoing linear motion in conservative force.
    8. Verify energy conservation for rolling bodies of different shapes down a ramp.
    9. Examine an object in static equilibrium using forces and torques.
    10. Determine the spring constant of a spring by static and dynamic experiments.
    11. Analyze the motion of a simple pendulum, and determine its damping coefficient.

Evaluation Criteria/Policies:
The grade will be determined using the Delaware Tech grading system:

90	–	100	=	A
80	–	89	=	B
70	–	79	=	C
0	–	69	=	F

Students should refer to the Student Handbook - https://www.dtcc.edu/handbook for information on the Academic Standing Policy, the Academic Integrity Policy, Student Rights and Responsibilities, and other policies relevant to their academic progress.

Final Course Grade:
Calculated using the following weighted average

Evaluation Measure	Percentage of final grade
3 – 4 Unit Tests* (summative, equally weighted)	50%
Final Exam** (summative)	15%
Labs (formative)	20%
Other – Homework, Quiz, Projects (formative)	15%
TOTAL	100%

Core Curriculum Competencies (CCCs are the competencies every graduate will develop):

1. Apply clear and effective communication skills.
2. Use critical thinking to solve problems.
3. Collaborate to achieve a common goal.
4. Demonstrate professional and ethical conduct.
5. Use information literacy for effective vocational and/or academic research.
6. Apply quantitative reasoning and/or scientific inquiry to solve practical problems.

Program Graduate Competencies (PGCs are the competencies every graduate will develop specific to his or her major):
None

Disabilities Support Statement:
The College is committed to providing reasonable accommodations for students with disabilities. Students are encouraged to schedule an appointment with the campus Disabilities Support Counselor to request an accommodation needed due to a disability. A listing of campus Disabilities Support Counselors and contact information can be found at the disabilities services - https://www.dtcc.edu/disabilitysupport web page or visit the campus Advising Center.