Calculus-Based Physics I - PHY K221 - COURSE SYLLABUS

Instructor: Charles Mihalko
Room: class / lab B-208
Class/Lab Time: Mon 4:30- 9:55 pm (T1/T1A)
Tue/Thu 7:00-9:45 pm (T2/T2A)
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Course Description for Calculus-Based Physics I - PHY K221

4 CREDIT HOURS

Check the TRCC Course Descriptions for current prerequisite and corequisite information

This is a calculus-based introduction to the basic concepts of classical mechanics. Major topics will include Newton's laws, motion in n-dimensions, periodic motion, thermodynamics, energy, hydrodynamics, and an introduction to material science. The course will emphasize the theoretical aspects of physics and will help the student develop effective problem solving strategies. Laboratories will be designed to allow the student to visualize the important concepts introduced in lecture and to increase student understanding of the scientific process.

Course Topics/Content

Classroom/Lecture

- math review/measurements
- kinematics in one dimension
- kinematics in one and two dimensions
- forces: laws of motion
- forces: work and energy
- energy conservation/power
- impulse and momentum
- rotational kinematics
- rotational dynamics
- fluids
- temperature and heat
- specific heat/heat transfer
- thermodynamics
- simple harmonic motion

Lab Experiments

- measurement/graphing
- free fall
- projectiles
- force equilibrium
- Newton II
- energy conservation
- collisions
- angular acceleration
- torque
- buoyancy
- gas laws
- specific heat
- latent heat
- pendulum

Learning Outcomes

Describe and Calculate the following Physics Concepts Using the Problem Solving Method:

1. Sketch or identify graphs that represent traveling waves and determine the amplitude, wavelength, and frequency of a wave from such a graph
2. Apply the relation among wavelength, frequency, and velocity for a wave
3. Understand qualitatively the Doppler effect for sound in order to explain why there is a frequency shift in both the moving-source and moving-observer case
4. Describe reflection of a wave from the fixed or free end of a string
5. Describe qualitatively what factors determine the speed of waves on a string and the speed of sound
6. Students should understand the difference between transverse and longitudinal waves, and be able to explain qualitatively why transverse waves can exhibit polarization
7. Students should understand the inverse-square law, so they can calculate the intensity of waves at a given distance from a source of specified power and compare the intensities at different distances from the source
8. Describe possible standing sound waves in a pipe that has either open or closed ends, and determine the wavelength and frequency of such standing waves.
9. Students should understand the principle of superposition, so they can apply it to traveling waves moving in opposite directions, and describe how a standing wave may be formed by superposition
10. Describe the conditions under which the waves reaching an observation point from two or more sources will all interfere constructively, or under which the waves from two sources will interfere destructively

11. Determine locations of interference maxima or minima for two sources or determine the frequencies or wavelengths that can lead to constructive or destructive interference at a certain point
12. Determine, for an object moving in a plane whose velocity vector undergoes a specified change over a specified time interval, the average force that acted on the object
13. Draw a well-labeled, free-body diagram showing all real forces that act on the object
14. Calculate, for an object moving in one dimension, the velocity change that results when a constant force F acts over a specified time interval
15. Determine, for an object moving in a plane whose velocity vector undergoes a specified change over a specified time interval, the average force that acted on the object
16. Write down the vector equation that results from applying Newton's Second Law to the object, and take components of this equation along appropriate axes.
17. Students should be able to analyze situations in which an object moves with specified acceleration under the influence of one or more forces so they can determine the magnitude and direction of the net force, or of one of the forces that makes up the net force, such as motion up or down with constant acceleration
18. Write down the relationship between the normal and frictional forces on a surface
19. Find the terminal velocity of an object moving vertically under the influence of a retarding force dependent on velocity.
20. Use Newton's Second Law to write a differential equation for the velocity of the object as a function of time.
21. Students should understand Newton's Third Law so that, for a given system, they can identify the force pairs and the objects on which they act, and state the magnitude and direction of each force.
22. Students should be able to apply Newton's Third Law in analyzing the force of contact between two objects that accelerate together along a horizontal or vertical line, or between two surfaces that slide across one another
23. Students should know that the tension is constant in a light string that passes over a massless pulley and should be able to use this fact in analyzing the motion of a system of two objects joined by a string
24. Students should be able to solve problems in which application of Newton's laws leads to two or three simultaneous linear equations involving unknown forces or accelerations
25. Use integration to calculate the work performed by a force F(x) on an object that undergoes a specified displacement in one dimension
26. Use the scalar product operation to calculate the work performed by a specified constant force F on an object that undergoes a displacement in a plane
27. Calculate the change in kinetic energy or speed that results from performing a specified amount of work on an object.
28. State alternative definitions of "conservative force" and explain why these definitions are equivalent
29. State the general relation between force and potential energy, and explain why potential energy can be associated only with conservative forces
30. Calculate a potential energy function associated with a specified one-dimensional force F(x).
31. Write an expression for the force exerted by an ideal spring and for the potential energy of a stretched or compressed spring
32. Apply conservation of energy in analyzing the motion of objects that move under the influence of other non-constant one-dimensional forces
33. Calculate the power required to maintain the motion of an object with constant acceleration (e.g., to move an object along a level surface, to raise an object at a constant rate, or to overcome friction for an object that is moving at a constant speed
34. Students should be able to understand and apply the relation between center-of-mass velocity and linear momentum, and between center-of-mass acceleration and net external force for a system of particles
35. Students should be able to define center of gravity and to use this concept to express the gravitational potential energy of a rigid object in terms of the position of its center of mass.
36. Calculate the area under a force versus time graph and relate it to the change in momentum of an object.
37. Explain how linear momentum conservation follows as a consequence of Newton's Third Law for an isolated system
38. Identify situations in which linear momentum, or a component of the linear momentum vector, is conserved
39. Apply linear momentum conservation to one-dimensional elastic and inelastic collisions and two-dimensional completely inelastic collisions
40. Calculate the torque on a rigid object due to gravity
41. Students should understand the analogy between translational and rotational kinematics so they can write and apply relations among the angular acceleration, angular velocity, and angular displacement of an object that rotates about a fixed axis with constant angular acceleration.

42. Determine the angular acceleration with which a rigid object is accelerated about a fixed axis when subjected to a specified external torque or force.
43. Write down, justify, and apply the relation between linear and angular velocity, or between linear and angular acceleration, for an object of circular cross-section that rolls without slipping along a fixed plane, and determine the velocity and acceleration of an arbitrary point on such an object
44. Derive the expression for the period of a simple pendulum
45. Determine the strength of the gravitational field at a specified point outside a spherically symmetrical mass
46. Apply angular momentum conservation and energy conservation to relate the speeds of an object at the two extremes of an elliptical orbit
47. Apply Archimedes' principle to determine buoyant forces and densities of solids and liquids.
48. Students should understand the "mechanical equivalent of heat" so they can determine how much heat can be produced by the performance of a specified quantity of mechanical work.
49. State the connection between temperature and mean translational kinetic energy, and apply it to determine the mean speed of gas molecules as a function of their mass and the temperature of the gas.
50. Explain qualitatively how the model explains the pressure of a gas in terms of collisions with the container walls, and explain how the model predicts that, for fixed volume, pressure must be proportional to temperature
51. Relate the heat absorbed by a gas, the work performed by the gas, and the internal energy change of the gas for any of the processes above
52. Relate the heats exchanged at each thermal reservoir in a Carnot cycle to the temperatures of the reservoirs

Required Texts/Supplies:

Physics for Scientists & Engineers, ed. 4; Giancoli; Pearson

Expectations, Attendance, Grading, Due Dates, and Academic Honesty:

Attendance *- I will take attendance at each class meeting. Because many of the ideas for out-of-class work will be discussed in detail during class, it is to your advantage to attend regularly. One or two missed classes will not impact your work negatively as long as you make up the work, but excessive absences (more than three) will most likely impact your work negatively.*

General / Due Dates:

1. *Come to class prepared to learn. We will have fun too!*
2. *Come to class prepared as if you will teach the class!*
3. *Work the sample problems in the book as you read & study the material. We will be doing a lot of math work in class, for homework, & assessments. Have paper, pencils & calculator.*
4. *Take notes as you study. Write down your questions. Try to find the answers via Internet search. Bring the questions to class. Chances are, that we all will learn from the questions.*
5. *All written work is due on the assigned date. Late work will automatically have ten percent deducted from the grade. Work over one week late will not be accepted and a grade of zero will be assigned. If you have any questions or concerns about getting your work in on time, please contact me before the due date.*
6. *Actively participate in class!*

Methods of Evaluation*:*

- *Sectional Exams (Two exams)*
- *Quizzes / Assignments (Weekly)*
- *Participation / Attendance (Weekly)*
- *Laboratory (Weekly Lab Reports & Participation)*

The final course grade will be computed according to the following formula:

Section Exams (Two exams)	*25%*
Quiz / Assignments / Class Participation	*50%*
Lab / Participation	*25%*
Final Grade	*100%*

Grading Scale:

Letter	Percent	Letter	Percent
A	94-100	C	73-76
A-	90-93	C-	70-72
B+	87-89	D+	67-69
B	83-86	D	63-66
B-	80-82	D-	60-62
C+	77-79	F	<60

Class/Lecture (75% of grade):

- Weekly "Exit Tickets" will be completed after the end of class. They are due Midnight the day after class. Your responses are important to help assess the understanding of the topic and what questions you might still have. You will be asked to document 3 important things we discussed in class, 2 questions you still have, and one connection to share. The lowest score will be dropped in computing your grade. Spend no more than five minutes on this assignment. Exit Tickets will be turned in via email/Blackboard. (5% of grade)
- Quizzes / Assignments will be given after every class and will be due before the beginning of the following class. The lowest score will be dropped in computing your grade. This work will be open book/open notes. (45% of grade)
- Two take-home Exams will be given during the semester and will be scheduled at least one week in advance. If you must be absent from an exam, consult with me BEFORE the exam is given. These exams will be open book/open notes. (25% of grade)

Lab (Reports & Participation) (25% of grade)

- Each student will turn in a lab report after each lab. The lab report will be due before the beginning of the following lab. The lowest score will be dropped in computing your grade.
- Lab reports will be neatly typed or handwritten with college level grammar and spelling. Each report should include the following sections:
    - Introduction/Objective: The purpose of the experiment, the physical phenomenon observed and the concept or numerical constant to be verified. (10%)
    - Procedure: A description of the methods and materials for the lab experiment describing the equipment and set up used to observe and investigate the objective and how the data was collected and recorded. Describe the dependent and independent variables where applicable. (20%)
    - Results: Display the data collected and the results obtained expressed as a neatly organized table of data, the mathematical models used and the calculations derived from the data, graphs of results with clearly labeled axes. Calculations used in the experiment should be included in a clear and organized manner with the proper units. (30%)
    - Discussions/Conclusions: An explanation and interpretation of the results and how they compare to the stated objective. Patterns and trends should be identified and related to supporting or refuting your hypothesis. Possible sources of errors should be discussed and the percent error from the accepted values should be indicated when appropriate. Questions related to the experiment should be included and answered as completely as possible. **This section will have the strongest determination for your grade. (40%)**

Please remember that it is your responsibility to keep up with assignments and paper due dates as outlined by the syllabus and calendar. Contact me if you miss a class to get any handouts from the session you did not attend. If a class is cancelled for some reason, expect to do the work and turn in any papers associated with the cancelled class in the following session.

Revisions to Syllabus:

The information contained in the syllabus is subject to revision at my discretion. I will inform the class of any changes that are made. If you miss a class, check with a classmate upon your return to verify that you have the most up-to-date information.

Campus and Class Policies:

Academic Integrity - Academic integrity is essential to a useful education. Failure to act with academic integrity severely limits a person's ability to succeed in the classroom and beyond. Furthermore, academic dishonesty erodes the legitimacy of every degree awarded by the College. In this class and in the course of your academic career, present only your own best work; clearly document the sources of the material you use from others; and act at all times with honor.

Students with disabilities- Students with learning disabilities should contact the Learning Specialist, Matt Liscum, at 860-215-9265 or via email at mliscum@trcc.commnet.edu as soon as possible to ensure timely accommodations. Students with physical disabilities should contact Elizabeth Willcox at 860-215-9289 or via email at ewillcox@trcc.commnet.edu to facilitate accommodations. All testing accommodations MUST be discussed with the instructor in a timely manner, that is, at least one to two class meetings prior to any scheduled test for which accommodations are needed.

Title IX of the Education Amendments of 1972 (Title IX) - prohibits discrimination based on sex in education programs and activities in federally funded schools at all levels. If any part of a school district or college receives any Federal funds for any purpose, all of the operations of the district or college are covered by Title IX. Title IX protects students, employees, applicants for admission and employment, and other persons from all forms of sex discrimination, including discrimination based on gender identity or failure to conform to stereotypical notions of masculinity or femininity. All students (as well as other persons) at recipient institutions are protected by Title IX – regardless of their sex, sexual orientation, gender identity, part-or full-time status, disability, race, or national origin- in all aspects of a recipient's educational programs and activities." If any student experiences sexual misconduct or harassment, and/or racial or ethnic discrimination on Three Rivers Community College Campus, or fears for their safety from a threat while on campus, please contact Vicki Baker, the Diversity Officer and Title IX Coordinator: 860-215-9208 (vbaker@trcc.commnet.edu)

Statement of Policy for Public Act No. 14-11: An Act Concerning Sexual Assault, Stalking and Intimate Partner Violence on Campus: "The Board of Regents for Higher Education (BOR) in conjunction with the Connecticut State Colleges and Universities (CSCU) is committed to insuring that each member of every BOR governed college and university community has the opportunity to participate fully in the process of education free from acts of sexual misconduct, intimate partner violence and stalking. It is the intent of the BOR and each of its colleges or universities to provide safety, privacy and support to victims of sexual misconduct and intimate partner violence."

Academic Dishonesty - Academic integrity is essential in all aspects of college coursework and learning. I have zero tolerance for academic dishonesty. It is expected that YOU complete all your assigned ALEKS work. Communication or collaboration of ANY sort is ABSOLUTEY PROHIBITED during any exam. Academic Misconduct is punishable in a number of ways, including a score of a zero on the assignment where the cheating took place, a grade of an F in the course and/or possible censure on your permanent record. All cases of academic dishonesty will be referred to the Academic Dean. Do not let yourself come under the suspicion of academic dishonesty.)

Withdrawal policy- A student who finds it necessary to discontinue a course once class has met must provide written notice to the registrar. Withdrawal forms are available at the Registrar's office. No punitive "W" grades are assigned to any withdrawal requested before the unrestricted withdrawal deadline for the semester. Withdrawal requests received after this deadline must bear the signature of the instructor. No withdrawals are permitted after the last class preceding the final exam. Students who do not obtain an official withdrawal, but simply stop attending classes, run the risk of receiving an "F" grade for the course.

Classroom Behavior- This is a college course for committed students, and I expect you to maintain proper decorum in the classroom. Treat your fellow students with maturity and respect at all times. Extend the same attitude towards your instructor. **Immature behaviors will simply not be tolerated; if I am forced to address a behavior issue more than once, you will be asked to leave and not return to class.**

Online learning portfolio - All students are required to maintain an online learning portfolio in Digication that uses the college template.