HCC HOUSTON COMMUNITY COLLEGE	**HOUSTON COMMUNITY COLLEGE** **NORTHWEST COLLEGE**

COURSE SYLLABUS FOR UNIVERSITY PHYSICS I♦

Course Title: ***University Physics I***
Course Number : ***PHYS 2325***
Class Number : ***79221***
Semester : ***Spring 2012***
Time and Location: ***6:00 – 8:00 pm MW Room 201 Spring Branch Campus***

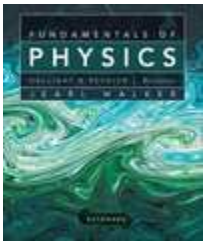
Instructor: **G. Raymond Brown, Ph.D.**
Office Hours: MW 4:00 – 6:00 pm, Faculty Workroom 613, Spring Branch Campus
E-mail: ***Use the course Eagle Online web site for all communications regarding the course.*** **In emergency only use the HCCS email g.brown@hccs.edu .**
AskOnline: http://hccs.askonline.net

Course Description:

Prerequisites: **Must placed into Math 2414 (or higher). (Note: Math 2414 is the *second* calculus course. This means you must already have the content of the Calculus I course.) Must also be placed into GUST 0341 (or higher) in reading.**
Credit: 3 (3 lecture)
A calculus-based physics course designed specifically for chemistry, physics, and engineering majors. Topics include principles of mechanics, sound, wave phenomena, kinetic theory, fluid flow, and thermal physics. Core Curriculum Course. (formerly PHYS 2425)

Required Text:

Halliday & Resnick, Jearl Walker, ***Fundamentals of Physics,*** Wiley, 9th edition, USA.



♦ *The instructor reserves the right to change/modify the syllabus, should there be any conflict with the schedule or policy of the college.*

Student Learning Objectives

Upon successful completion of this course, students should be able to:

1. Use vector analysis and calculus to solve kinematics and dynamics problems.
2. Apply Newton's laws of motion to analysis of dynamics problems.
3. Relate the concept of total work done to the change in kinetic energy of a particle.
4. Identify different forms of energy and transformation of energy.
5. Apply conservation laws (conservation of energy and linear momentum) to the analysis of dynamics of a particle or a system of particles.
6. Apply Newton's laws of motion to rotational motion.
7. Distinguish between waves and particles and analyze the properties of traveling waves and standing waves.

It is intended by design of the instructor that the testing and grading performed in the course include all of these learning objectives. They are all included in the general criterion that the successful student be able to solve at least 70% of a random selection of intermediate-difficulty problems from the textbook.

Course Learning Outcomes.

Upon successful completion of this course, students should be able to solve problems in the areas of:

1. Kinematics
   1.1. Solve one and two dimensional kinematics problems.
   1.2. Analyze motion of a free falling object, projectile motion, and a particle in circular motion.
2. Newton's Laws
   2.1. Use Newton's Laws of motion in solution of dynamics problems.
   2.2. Draw free body diagrams to enumerate forces acting on a particle.
3. Conservation laws
   3.1. Use the definition of work and the work energy theorem applied to analysis of dynamics problems.
   3.2. Use the definition of potential energy and relate it to conservative forces.
   3.3. Relate internal energy to the work done by non - conservative forces.
   3.4. Use Conservation of Energy.
   3.5. Use Conservation of momentum in the analysis of collisions.
4. Rotations
   4.1. Solve simple problems involving rotational dynamics.
   4.2. Use the conditions for equilibrium applied to solution of problems.
5. Waves
   5.1. Distinguish between traveling waves and standing waves.
   5.2. Solve problems involving traveling and standing waves.

It is intended by design of the instructor that the testing and grading performed in the course include all of these course learning outcomes. They are all included in the general criterion that the successful student be able to solve at least 70% of a random selection of intermediate-difficulty problems from the textbook.

An unstated Learning Outcome is that the successful student has learned how to learn about mathematical and scientific topics. This ability is essential to any professional career in science, engineering and mathematics.

Instructor guidelines and policies

Attendance: HCCS Attendance Policy is stated in the ***Spring 2009*** Student Handbook ***page 2*** as follows*: "You are expected to attend all lecture classes and labs regularly. You are also responsible for materials covered during your absences. Instructors may be willing to consult with you for make-up assignments, but it is your responsibility to contact the instructor. Class attendance is checked daily. Although it is your responsibility to drop a course for nonattendance, the instructor has the authority to*

drop you for excessive absences. You may be dropped from a course after accumulating absences in excess of 12.5 percent of the total hours of instruction (lecture and lab). For example:

• For a three credit-hour lecture class meeting three hours per week (48 hours of instruction), you can be dropped after six hours of absence.

• For a four credit-hour lecture/lab course meeting six hours per week (96 hours of instruction), you can be dropped after 12 hours of absence."

If circumstances significantly prevent you from attending classes, please inform the instructor.

Web link to this information

Assignments: Practice problems are assigned from the text for every chapter covered. Students are strongly advised to attempt all these selected problems and other problems from the text. In general, students who fail to do these assigned problems do not do well in the course. It is not possible to learn to solve problems unless you attempt to solve problems.

Support Course Material: Course resources, lecture Notes (PPT), Exams Reviews and Assignments are posted on Blackboard/Vista.

Make-up Exams: *There are no make-up exams*, therefore, make every effort to take exams on their scheduled date. If an exam is missed, the best of the upcoming exams counts as two exams. Should you miss more than one exam.

Cell phones and beepers: All cell phones and pagers should be set on "silent" or "vibrate" during class times.

Recording : No recording of any sort unless otherwise recommended by the ADA office.

Grade Determination: Three regular exams and a compulsory comprehensive final are administered during the semester. Homework assignments are made for each chapter of the textbook. Online participation: Students are expected to use the Blackboard discussion topics to raise questions about difficulties in solving problems, as in a class-wide study group. Note: The final examination is compulsory (no student is exempt) and once a student takes the final Examination, that student cannot receive a grade of "W" in the course. The final grade is based on the score out of 100% that the student accumulated from the three exams, quizzes, homework and the final exam. Below is the weighting of the categories:

Exam I	20 %
Exam II	20 %
Exam III	20 %
Final Exam	25 %
Assignments	15%
Total	100 %

Grading Scale

A = 90-100 %
B = 80-89 %
C = 70- 79 %
D = 60-69 %
F = < 60 %

NOTICE: Students who repeat a course three or more times may soon face significant tuition/fee increases at HCC and other Texas public colleges and universities. If you are considering course withdrawal because you are not earning passing grades, confer with your instructor/counselor as early as possible about your study habits, reading and writing homework, test-taking skills, attendance, course participation, and opportunities for tutoring or other assistance that might be available.

Withdrawal Policy *(Please read this carefully)*

It is the responsibility of the student to officially drop or withdraw from a course. Failure to officially withdraw may result in the student receiving an "F" in the course. A student who officially withdraws from a course before the Official Date of Record will not receive a grade and the course will not appear on the student's permanent record. A student withdrawing from a course after this period and prior to the deadline designated in the HCC calendar will receive a grade of "W". Students should take care in dropping a course, as the third or future attempt to retake a course will result in a higher rate of tuition.
Students may only drop online during the drop/add period listed in the registration calendar. After the first week of class in a regular term, students must complete a withdrawal form and meet with a counselor to complete the withdrawal process.

Course Withdrawals - First Time Freshman Students - Fall 2007 and Later
Under Section 51.907 of the Texas Education Code "an institution of higher education may not permit a student to drop more than six courses, including any course a transfer student has dropped at another institution of higher education." This statute was enacted by the State of Texas in the Spring 2007 and applies to students who enroll in a public institution of higher education as a first - time freshman in Fall 2007 or later. Any course that a student drops is counted toward the six-course limit if "(1) the student was able to drop the course without receiving a grade or incurring an academic penalty; (2) the student's transcript indicates or will indicate that the student was enrolled in the course; and (3) the student is not dropping the course in order to withdraw from the institution."
Policies and procedures for implementation of this statute are being developed and will be published as soon as they are available.
HCC students affected by this statute that have attended or plan to attend another institution of higher education should become familiar with that institution's policies on dropping courses.
Web Link to this information

Disability Support Services (DSS):

"Any student with a documented disability (e.g. physical, learning, psychiatric, vision, hearing, etc.) who needs to arrange reasonable accommodations must contact the Disability Services Office at the respective college at the beginning of each semester. Faculties authorized to provide only the accommodations requested by the Disability Support Services Office."

Sexual Harassment

This is described in students' policies page 30 as follows:
"HCC shall provide an educational, employment, and business environment free of sexual harassment. Sexual harassment is a form of sex discrimination that is not tolerated by HCC.

Any student who feels that he or she is the victim of sexual harassment has the right to seek redress of the grievance. HCC provides procedures for reviewing and resolving such complaints through its Grievance Policy.

Substantiated accusations may result in disciplinary action against the offender, up to and including termination of the employee or suspension of the student. In addition, complainants who make accusations of sexual harassment in bad faith may be subject to equivalent disciplinary action." Web link to this info

Honor Code: You are expected to adhere to the honor system.
Academic Dishonesty: Any form of cheating on a test or exam, plagiarism on assignments, etc. will not be tolerated. Any suspected incidents of plagiarism and/or cheating (academic dishonesty) will be dealt with severely in accord with the College's guidelines.

Important Dates

Classes begin/system	Jan 17, 2012
Last date to Drop/Add/Swap	Jan 18, 2012
Official day of record	Jan 30, 2012
Spring Break	Mar 12 through Mar 18, 2012
Last date for administrative and student withdrawals	Mar 29, 2012
Spring Holiday	Apr 6-8, 2012
Veteran's Advanced-Pay Application Deadline for Summer Session	Apr 13, 2012
Deadline for Spring Federal Student Loans	Apr 16, 2012
Instruction Ends	May 6, 2012
Final Examination	May 9, 2012, 6:00 – 8:00 pm
Grades Due	May 14, 2012
Grades Available to Students	May 18, 2012

Tentative outline for University Physics I-PHYS 2325 (Spring 2012)
N.B.: This outline is subject to change as the semester progresses

Week # & Date	Activities	Objectives and Assignments
1	Chapter 1	Textbook Part 1, Ch 1: Units and Measurements
WED 01/18	Course introduction and discussion of the syllabus. Connection of mathematics to real stuff (measured real quantities) is through ***units***.	Homework assignments are always in purple, and the numbers are *Problem* numbers at the end of each chapter. Ch 1: 1, 6, 8, 10, 14, 18, 22, 24, 26, 30. Become accustomed to calculation of real values stated in units.
2	Chapters 2 & 3	Ch 2: 1D motion. Ch 3: Vector quantities.
MON 01/23	Study 1D motion under constant acceleration.	Ch 2: 8, 11, 17, 22, 34, 36, 39, 40, 52, 58. Note that the kinematic equations in use here are completely determined by the definitions of velocity and acceleration, plus the condition that the acceleration is constant.

Week # & Date	Activities	Objectives and Assignments
WED 01/25	In Ch 3, we study the mathematics of directed quantities (vectors), to sum and multiply vector quantities.	Ch 3: 12, 13, 20, 22, 29, 30, 42, 51, 61, 64. Summing vectors is usually needed in any problem involving motion. The dot product calculates projections and energies. The cross product calculates rotations and areas.
3	Chapter 4	Motion in 2D and 3D.
MON 01/30	Study of the kinematic equations at constant acceleration, and the special case of projectile motion.	Ch 4: 10, 16, 18, 32, 38, 46, 48, 63, 66, 71, 76, 78. Notice that the *form* of the kinematic equations at constant acceleration is just the same as in 1D motion. Note also that the dot product is needed for the velocity squared equation.
WED 02/01	Study of circular motion, especially uniform circular motion. Galilean relativity describes relative motions.	Why are the kinematic equations for circular motion so very different than those for constant acceleration? This emphasizes that the *direction* of motion is more important to understanding than is the magnitude of displacements, velocities and accelerations.
4	Chapter 5	Force and motion, part 1.
MON 02/06	Test 1	Test 1 includes chapters 1 through 4 of the textbook.
WED 02/08	Introduction to Newton's laws of motion. Newton's 2nd law determines the kinematic equations that apply to a physical object.	Ch 5: 8, 10, 16, 32, 37, 38, 44, 48, 52, 54. The form of Newton's 2nd law that we use here, $\vec{F}_{net} = m\vec{a}$, applies only to a single object of constant mass m. What if more than one object in a system moves?
5	Chapters 6 & 7	Ch 6: Frictional forces and circular motion. Ch. 7: Work and kinetic energy.
MON 02/13	Models of contact friction and fluid friction are developed and used with N's 2nd law. N's 2nd law is applied to uniform circular motion (UCM).	Ch 6: 10, 14, 18, 20, 24, 30, 39, 45, 50, 54. Friction forces on moving objects always act in the direction opposite to the velocity, for examples, $\hat{D} = \hat{\mathcal{F}}_\mu = (-\hat{v})$, for the fluid drag force and the kinetic surface friction force, respectively.
WED 02/15	Work is the seminal form of energy. For the work done by a force to move a particle, the formula is $\mathcal{W} \equiv \int_{\vec{r}_i}^{\vec{r}_f} \vec{F} \cdot d\vec{r}$.	Ch 7: 6, 11, 14, 20, 24, 30, 38, 40, 42, 48. Use of the definition of work determines all other types of energy. For example, kinetic energy is defined by the work done by the net force acting on an object.
6	Chapters 8 & 9	Ch 8: Conservation of energy. Ch 9: Linear momentum.
MON 02/20	The energy equation states the sum of all energies involved in a closed system. Nature tells us that such a sum is ***constant***. This is the content of conservation of energy.	Ch 8: 6, 16, 20, 26, 30, 32, 40, 53, 57, 58. Any conservative force $\vec{F}_{cons}$ has a potential energy U defined by $\Delta U = U_f - U_i = -\mathcal{W} = -\int_{\vec{r}_i}^{\vec{r}_f} \vec{F}_{cons} \cdot d\vec{r}$. All potential energies are defined in this way. So the meaning of the path integral definition of work is extremely important to understand.
WED 02/22	Momentum, defined by $\vec{p} = m\vec{v}$, is another conserved quantity in nature. So we say that momentum is conserved.	Ch 9: 6, 7, 14, 16, 22, 33, 44, 52, 68, 74. The total momentum of a system of N particles is $\vec{p} = \sum_{n=1}^{N} m_n \vec{v}_n$. Conservation of $\vec{p}$ is equivalent to N's 3rd law. For collisions of particles in a system, the total $\vec{p}$ before and after the collision must be the same: $\vec{p}_B = \vec{p}_A$. For *elastic collisions*, the kinetic energy also is unchanged: $K_B = K_A$.

Week # & Date	Activities	Objectives and Assignments
7	Chapters 10 & 11	Ch 10: Rotation. Ch 11: Rolling, torque and angular momentum.
MON 02/27	The physics of rigid body rotations have innumerable engineering applications; for example, almost every mechanical device with moving parts involves rotations.	Ch 10: 6, 16, 28, 30, 40, 51, 54, 56, 64, 66. Angular quantities ($\theta = \frac{s}{r}, \omega = \frac{d\theta}{dt}, \alpha = \frac{d\omega}{dt}$) are much easier to use in rotational motion than are linear quantities ($s, v = \frac{ds}{dt}, a = \frac{dv}{dt}$) because they have constant values everywhere on the rotating object, while the linear quantities vary.
WED 02/29	We examine the particulars of rolling motion. We study the application of Newton's laws, energies, and momentum to rotational motion.	Ch 11: 7, 12, 24, 30, 35, 41, 54, 59, 62, 66. Rotations are inherently 3D, and are most simply described by the vector cross product. Thus the rotational analog of force $\vec{F}$ is torque $\vec{\tau} = \vec{r} \times \vec{F}$, where $\vec{r}$ is the displacement from the pivot point to the point of action of the force.
8	Chapter 11	Ch 11 continued.
MON 03/05	Test 2	Test 2 includes material through Chapter 10 of the textbook.
WED 03/07	Note the value of using both the dot product of vectors and the cross product.	The main complication of rotations, as compared to translations, is that the rotational analog of mass is the moment of inertia, which depends on the mass distribution and the axis of rotation.
BREAK	Spring Break	March 12 through March 18, 2012
9	Chapters 12 & 13	Ch 12: Equilibrium and elasticity. Ch 13: Gravitation.
MON 03/19	Mechanical equilibrium is central to civil engineering. Both equilibrium and properties of materials, like elasticity, are important to mechanical and civil engineering.	Ch 12: 10, 14, 20, 22, 28, 32, 37, 45, 46, 49. Equilibrium of an object is determined by two conditions: the net force is zero, and the net torque is zero. The elasticity of a material is characterized by elastic moduli, for which $modulus = \frac{stress}{strain}$. Stress refers to external stimuli, and strain to the material response to the stress.
WED 03/21	Gravitation is a basic force of nature, first described in a precise mathematical way by Newton.	Ch 13: 10, 12, 14, 23, 27, 40, 54, 56, 60, 66. Gravitation is a condition of space created by the presence of a mass, called the gravitational field. All of the basic forces of nature have this property of extending through a region of space, and are therefore called field forces.
10	Chapter 14	Last day for "W" grade is 03/29. Ch 14: Fluids
MON 03/26	The basic concepts involved here are N's 2nd law and conservation of energy, momentum and mass, all applied to fluids.	Ch 14: 7, 12, 20, 26, 29, 38, 44, 54, 65, 71. The basic concepts applied here lead to relationships called Pascal's principle, Archimedes' principle, the equation of continuity and Bernoulli's principle.
WED 03/28	Continuation of Ch 14.	The relationships can solve many problems in plumbing, hydraulics, and mechanical engineering.
11	Chapter 15	Ch 15: Oscillations
MON 04/02	First we study simple harmonic motion (SHM), and determine the equation of motion, with applications.	Ch 15: 14, 18, 22, 34, 36, 39, 47, 52, 60, 63. SHM is ubiquitous in nature and in designed machines. All practicing engineers need an excellent understanding of this motion and extensions of it.

Week # & Date	Activities	Objectives and Assignments
WED 04/04	Next we add damping and simple forcing to the basic SHM.	Much mechanical and electrical design is concerned with resonance. Sometimes resonant behavior is desirable and sought, in other situations it must be avoided.
12	Chapters 16 & 17	Ch 16: Waves, part 1. Ch 17: Waves, part 2.
MON 04/09	Wave motion in simplest form combines SHM with translation of the motion (not necessarily translation of the material).	Ch 16: 6, 10, 22, 27, 30, 33, 38, 40, 52, 56. We limit attention in this chapter to 1D waves, which obey the wave equation $\frac{\partial^2 y}{\partial x^2} = \frac{1}{v^2}\frac{\partial^2 y}{\partial t^2}$. This is solved in general by the form $y = h[z]$, where h is a function of the combination $z = kx \pm \omega t$, and the wave velocity is $v = \frac{\omega}{k}$.
WED 04/11	We study some basic features of sound waves, such as interference, beats, the Doppler effect and shock waves.	Ch 17: 6, 14, 18, 22, 36, 50, 54, 59, 64, 70. The complexity of sound waves is the basis of the rich information that can be conveyed in this medium, ranging from a simple bang to a beautiful piece of music.
13	Chapter 18	Ch 18: Temperature, heat, and the first law of thermodynamics.
MON 04/16	Test 3	Test 3 includes material through Chapter 17 of the textbook.
WED 04/18	We define temperature scales, and see that temperature determines the direction of heat flow. Then conservation of energy gives the 1st law.	Ch 18: 6, 16, 21, 32, 35, 38, 50, 56, 60, 64. Most thermal effects are material-dependent, so we need to develop the concepts of specific heat and latent heats. We also discuss methods by which energy can be transported in systems.
14	Chapters 18 & 19	Ch 19: The kinetic theory of gases.
MON 04/23	Ch 18 continued.	Special case applications of the 1st law.
WED 04/25	We develop the form of the ideal gas law, and then look at the microscopic foundations of the gas law, leading to the kinetic theory of gases.	Ch 19: 8, 14, 17, 24, 27, 32, 38, 46, 52, 60. Specific heats at constant volume and constant pressure are distinguished. Analysis of paths in the pV diagram lay the foundation for the study of heat engines.
15	Chapter 20	Ch 20: Entropy and the 2nd law of thermodynamics.
MON 04/30	The concept of entropy provides a physical understanding of irreversible processes, and the operation of heat engines.	Ch 20: 8, 12, 18, 26, 28, 31, 34, 35, 43, 46. The 2nd law of thermodynamics states that real physical processes always cause increases in entropy. This is basically a statistical result, and is a new concept, not previously encountered in our study of mechanics.
WED 05/02	Class meeting devoted to review for the final examination.	Review for final exam. A review occurs when students bring forward difficulties in understanding course content. It is not a synopsis of the course by the instructor, or a preview of test questions.
16	Finals Week	
WED 05/09	Final Exam, 6:00 to 8:00 pm.	The final exam is a comprehensive test over all content addressed in the course. Content covered after Test 3 has increased weight in the final exam.

PROBLEM SOLVING IN PHYSICS

Physics is a lot like driving or swimming - you have to learn by doing it. You could read a book on driving and memorize every word in it, but when you are behind the wheel the first

time you have a hard time to coordinate what you memorize in practice. After some training you will find that driving is the most easiest thing to do. Similarly, you can read your text book and/or your note book carefully, memorize every equation and formula in it but when you finish you still have not learnt physics. To learn physics you have to go beyond passive reading; you have to interact with physics and experience it by doing (solving) problems.

Below we present a brief summary of problem solving in physics. The suggestions should help to develop a systematic approach in problem solving.
It should be underlined that at the outset that there is no recipe for solving problems in physics --- it is a creative activity. In fact the opportunity to be creative is one of the attractions in physics. The following suggestions, then are not intended as a rigid set of steps that must be followed like steps in computer programming. Rather, they provide a general guideline that experienced problem solvers find to be effective.

- ☑ **Read the problem carefully** Before you can solve a problem you need to know exactly what information it gives and what it asks you to determine. This is an essential first step in problem solving.
- ☑ **Sketch the system** You may think that this is not very important. It is important and well worth doing. A sketch helps you to acquire a physical feeling for the system. It also provides an opportunity to label those quantities that are known and those that are not determined.
- ☑ **Visualize the physical process.**
- ☑ **Plan** This may be the most difficult, but at the same time the most creative, part of the problem -solving process. From your sketch and visualization, try to identify the physical process at work in the system. Then develop a strategy -a game plan - for solving the problem.
- ☑ **Identify appropriate equations** Once a plan/strategy has been developed, find the appropriate equations to carry it out.
- ☑ **Solve the equations** Use basic algebra to solve the equations identified in the previous step. Work with symbols like *x* and *y* for the most part, substituting numerical values ***only after*** obtaining the symbolic solution to the problem. This is most important. Obtaining a symbolic solution is the only way to learn what the problem has to teach you, and the only way you can be confident that you have attained the correct solution.
- ☑ **Check your answers** Once you have an answer, check to see that it makes sense: (i) Does it have the right dimension (units)? If you determine a force the units must not be in seconds. (ii) Is the numerical value reasonable? 10/100 cannot be 1000.
- ☑ **Explore limits/special cases**
- ☑ Finally, it is tempting to look for shortcuts when doing a problem -- to look for a formula that seems to fit and some numbers to plug into it. It may seem harder to think ahead, to be systematic as you solve the problem, and then to think back over what you have done at the end of the problem. The extra effort is worth it, however, because by doing these things you will develop powerful problem - solving skills that can be applied to unexpected problems you encounter on exams -- and in life in general!!