This syllabus is divided into two major sections: **Course Adminstrative Policies and Procedures** and **Course Outline**. The hyperlinks in the document should be active if you have a Web connection. You can easily print this document for offline use.

**Course Administrative Policies and Procedures**

**Course Description:** *Physics with Biomedical Applications I* is a laboratory course designed for students intending to enter fields such as medicine, pharmacy, physical therapy, dentistry, as well as biology. The course uses basic concepts of calculus such as the derivative and simple integration. **PHYS 1201** covers force and motion, torque, energy, fluids and thermal physics. Special topics include forces in joints and muscles, blood flow.

**Course Objectives:** Upon completion of this course students should be able to:

1. State and apply the fundamental laws and concepts of classical and modern physics.
2. Demonstrate an ability to solve realistic physics problems particularly relating to human applications.
3. Use the terminology of physics intelligently.
4. Demonstrate the ability to do experiments and give oral lab reports.
5. Recognize the importance of physics to medicine, dentistry, pharmacy, and other health sciences.
6. Prepare written reports that demonstrate both an understanding of physics and the ability to clearly express ideas.

**Prerequisite:** MATH 1400 *Survey of Calculus*, or MATH 1500, *Calculus I*. (Note: You are responsible for knowing if you have.) Anytime a derivative or an integral is used, students will learn how to apply the tabulated “recipe” for the solution in a particular problem situation. That is, they will learn how to determine limits, identify constants, etc. Calculus will be used primarily to strengthen student understanding of basic concepts including rates of change and exponential growth and decay. In addition to the textbook, handouts will be available on the application of calculus to the physics.

**ADA Statement:** This course is available in alternate media by request.


**Lab Manual:** Purchase the course lab manual from the bookstore.

**Personal Response System:** You will use an *iclicker™* personal response system (PRS) in this class. No other PRS will work, even one that uses radio frequency communication instead of IR. Be certain you obtain the correct PRS. If you do not obtain your course materials through the Normandale Bookstore, you are responsible for obtaining the *iclicker*. Even if you get your *iclicker* from the Normandale Bookstore, be certain they sell you the correct device. (They have a bad habit of assuming all PRS are alike-- they aren’t!) Use this ISBN number so you obtain the correct one: ISBN 0-7167-7939-0. You will associate your *iclicker’s* serial number with your name (much like you associate your cell phone serial number with a phone number). A used *iclicker* is OK.
**Calculator requirement:** Students will need a basic scientific calculator with these specialized functions and their inverses: $[\sin x]$, $[\cos x]$, $[\tan x]$, $[\log x]$, $[10^x]$, $[\ln x]$, $[e^x]$, $[1/x]$ or $[x^{-1}]$, and statistical functions. Graphing calculators not required, but may be used and are recommended. Only traditional calculators may be used on exams. You may not use the calculator function of a cell phone, PDA or similar device.


**University of Minnesota Equivalent:** PHYS 1201/1202, *Introductory Physics for Biology and Precalculus I & II*. (Note: Normandale’s PHYS 1201/1202 does not satisfy the University of Minnesota’s IT physics requirements. You must take PHYS 1121 and 1122 if you are transferring to an engineering program or planning to be a physics or astronomy major.) Consult the College of Biological Sciences Transfer Guide. PHYS 1201/1202 is the preferred course for biology majors transferring to the University of Minnesota as well as many programs in other colleges such as CFANS.

**Class Participation Points & iClickers:** You will receive class participation points by using your PRS. There are 15 possible points. If you attend class regularly and answer a clicker question, you will receive one point. If you answer correctly you will receive two points. Because there will be a minimum of 15 clicker questions asked during the semester, you could obtain at least 30 points and 15 of these points are essentially bonus points that add to your total point accumulation.

**Cooperative Learning Groups:** A substantial portion of the work this course involves working with other students. You will engage in two basic types of cooperative group activities: Laboratory and problem solving. There will be three graded-group problems. You should be aware of three important rules governing these groups. These rules are necessary to ensure effective groups: 1. If you are more than five (5) minutes late, you may not be allowed to join your group. 2. If you miss the group session immediately preceding a graded group problem, you will not be allowed to work with your group and will receive a “0” for that problem. 3. THERE WILL BE NO MAKE-UP PROBLEMS.

**Evaluation and Exams:** Individual quizzes will consist of a written problem solution and five multiple choice conceptual questions. There will be no make-up or rescheduling opportunities for any lab, quiz, or the final exam. There will be five individual quizzes and your lowest score will be dropped. If you miss an individual quiz, you will receive a “0” for that quiz, and it will become the lowest score and hence dropped. When I grade a problem, the “correct answer” is worth about 20%. Other equally important aspects of your solution include: Showing your work, using reasonable logic, drawing suitable diagrams, having the appropriate units, and, of course, following the problem-solving strategy. In short, you must demonstrate know how to get the answer.

**Important grading policy:** Any request for a reconsideration of the grading of any quiz, problem, lab or any graded assignment or test must be made within two class days of the return of the item in question or prior to the day of the final exam, whichever comes first. A class day is a day on which lecture section of the course meets. For example, if your class meets Tuesday and Thursday, and a quiz is returned on Tuesday, you must submit the request for reconsideration by Thursday before class.

**Exemption from Final Exam:** You will be excused from the Final Exam and your grade (“A”) will be based on all pre-final work if you meet the following criteria: (1) Your predicted final standing, based on all pre-final work must be 92.0% or greater. (Your predicted final grade is based on your work to date and a prediction of your performance on the final exam based on the average of your individual quizzes. This
prediction is not your pre-final percent.) (2) You must have NOT missed any individual quizzes, graded group problems, labs, or any other required, graded work.


SPECIAL SUMMER SESSION NOTE: The summer session schedule is set by Normandale Community College over a year in advance and may conflict with the schedule of other schools or your personal plans. You should only take the course if you can be here for all labs, quizzes, the final exam, and class meetings. There are only four quizzes, all four count, and there are NO makeup quizzes or labs. There may be only 11 labs instead of 12 depending on the scheduling of the summer sessions and the July 4 holiday. (The total number of points is adjusted for this.) Summer sessions sometimes begin on a Monday when only the labs meet and there is no “lecture” section. Or, you may have a lab on a Tuesday before the first lecture section. You are required to attend your first scheduled lab in order to guarantee a seat in the course for yourself and to pick up course materials. Please do not ask to reschedule any quiz, graded problem, or the final exam, because the answer will be “no”. The only exceptions allowed would be for events like your National Guard unit being suddenly activated or you have been commanded to appear before The Pope, The Queen, or The President, and you will need to bring me an autographed photograph of him or her.

Grading Breakdown:

<table>
<thead>
<tr>
<th></th>
<th>Full Semester</th>
<th>Summer Session</th>
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<tbody>
<tr>
<td>Written Assignment</td>
<td>25</td>
<td>7%</td>
</tr>
<tr>
<td>Class PRS Participation</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Points</td>
<td>4%</td>
<td>4%</td>
</tr>
<tr>
<td>Individual Quizzes</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>(4 x 20 + 4 x 5)</td>
<td>28%</td>
<td>30%</td>
</tr>
<tr>
<td>Graded Problems</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>(3 x 20)</td>
<td>17%</td>
<td>18%</td>
</tr>
<tr>
<td>Lab (12 x 5)</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Final Exam (50 multiple-</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>choice questions, 100</td>
<td>100</td>
<td>30%</td>
</tr>
<tr>
<td>points)</td>
<td>28%</td>
<td>30%</td>
</tr>
<tr>
<td>Total Points</td>
<td>360</td>
<td>335</td>
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</tbody>
</table>

Grading Scale:

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Grade</th>
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<tbody>
<tr>
<td>85-100</td>
<td>A</td>
</tr>
<tr>
<td>70-84</td>
<td>B</td>
</tr>
<tr>
<td>55-69</td>
<td>C</td>
</tr>
<tr>
<td>50-54</td>
<td>D</td>
</tr>
<tr>
<td>&lt;50</td>
<td>F</td>
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Policy on Incompletes: Generally I will assign an “I” grade when a student has extenuating circumstances that cause him or her to miss significant portions of the course. The “I” is an alternative to a “W” when the student has demonstrated a mastery of the material and only will miss a part of the course. An agreement between me and the student is made as to the nature of the work to be made up and when it will be completed. I use the “I” very rarely and only upon extensive consultation with the student well in advance of
the end of the semester. Extenuating circumstances include jury duty, military duty, and extraordinary family situations. Example 1: A student is in the National Guard and her unit is called to active duty for a brief deployment. In the tenth week of the semester she notifies me that she will miss the last quiz and final exam in the course. To date, all her work has been satisfactory. She agrees to take the last quiz and final exam upon her return. Her request is granted. Example 2: A student has missed several labs and two quizzes. His performance on the other quizzes in the course does not demonstrate an understanding of the material. The day before the final exam, he emails me requesting an “I” so he can better prepare for the final exam and not harm his GPA. His request is denied due to the untimely request and current standing in the course.

**Laboratory:** We will undertake lab experiments each week. Your group will give an oral summary of your work. Each lab is worth 5 points: 1 point for attendance (as determined by your presence for the pre-lab “clicker” question), 1 point for being prepared (determined by your answers to pre-lab “clicker” question), and 3 points for demonstrating an understanding of what you have done. It is important that you do not miss a laboratory session. THERE WILL BE NO MAKE-UP LABS and you cannot successfully complete the course without doing the laboratory work.

**Policy on Missing Labs:**

<table>
<thead>
<tr>
<th>Missing Labs</th>
<th>Points for That Lab</th>
</tr>
</thead>
<tbody>
<tr>
<td>Miss one lab</td>
<td>0 points for that lab</td>
</tr>
<tr>
<td>Miss a second lab</td>
<td>-5 points for that lab</td>
</tr>
<tr>
<td>Miss a third lab</td>
<td>-10 points for that lab</td>
</tr>
<tr>
<td>Miss a fourth lab</td>
<td>Final grade will be “F”</td>
</tr>
</tbody>
</table>

**Problem Assignments:** Problems will be assigned from each chapter. These will not be graded. Answers will be on D2L. You are, of course, urged to work additional problems. It is important to do these problems because we may do some in class and variations on them may appear on quizzes.

**Note regarding electronic devices:** Cell phones and pagers must be turned off during class. Only traditional calculators may be used on exams. You may not use the calculator function of a cell phone, PDA, iPod or similar device.

**How to Get the Most Out of This Class:** Don’t miss class! Read the book. Don’t get behind in your reading. (Unlike other disciplines, it is IMPOSSIBLE to cram for a physics exam the night before and count on a passing grade.) Start by reading the chapter Summary, then the text. Work on the Problems, and Questions at the end of each chapter with other students. Finally, be sure to see me for help. My office hours will be posted on my office door. If you need to see me outside of the those times, please arrange an appointment with me in person, via phone or via email. Don’t wait until it is too late if you are having difficulties.

**From the Normandale Community College Catalog:** “Normandale Community College believes that every person’s education is the product of his/her own intellectual efforts. Each student who enrolls and remains at Normandale, therefore, understands that to submit [individual] work which is not their own violates the purpose of the college and of his/her presence here. No intellectual community can maintain its integrity or be faithful to its members if violations of its central purpose are tolerated. In case such violations do occur, the instructor has the prerogative to take appropriate action.”
The learning outcomes and consequently the key concepts, textbook readings, and suggested problems are all subject to change. Preface each learning outcome with the phrase, “Upon successful completion of this course, you should be able to...”

**INTRODUCTION**

**Key Concepts:** The Nature of Science, Physics and its Relation to Other Fields, Models, Theories and Laws, Measurement and Uncertainty; Significant Figures, Units and the SI System, Converting Units, Dimensional Analysis.

**Learning Objectives:**
1. Recognize and use the SI base units and unit prefixes.
2. Convert from one unit system to another.
3. Use dimensional analysis to check your work.
4. Use scientific notation in your work.
5. Estimate physical parameters to check the consistency of answers.
6. Use a sensible number of significant figures.

**Textbook:** 1.1 to 1.5, 1.10

**Problems:** 1:1,3,8,9,17,21,29,57,64.

**Link:** [U.S.N.O. Time](#)

**DESCRIBING MOTION: KINEMATICS IN ONE DIMENSION**

**Key Concepts:** Average Velocity, Instantaneous Velocity, Acceleration, Motion with Constant Acceleration, Falling Objects, Graphical Analysis of Linear Motion.

**Learning Objectives:**
1. Define the relationship between position, velocity, and acceleration of an object in motion, both as averages over finite time intervals and as instantaneous quantities.
2. Explain how the derivative relates to the slope of a position-time or velocity-time graph.
3. Calculate velocity from a position function or acceleration from a velocity function by taking a derivative.
4. From a graph of position, velocity, or acceleration as a function of time, be able to determine the other two graphs.
5. Derive the kinematics equations for constant acceleration situations.
6. Solve one-dimensional motion problems when there is constant acceleration or constant velocity.
7. Define free fall and solve free fall problems.
8. Construct a graph of experimental free fall data.
9. Determine “g” from a graph of experimental free fall data.

**Textbook:** 2.1 to 2.7

**Problems:** 2:3,5,7,17,21,30,39,40,41,56
VECTORS
Key Concepts: Vectors and Scalars, Addition of Vectors—Graphical Methods, Subtraction of Vectors, and Multiplication of a Vector by a Scalar, Adding Vectors by Components, unit vectors.
Learning Objectives:
1. Resolve 2-D vectors into components.
2. Add and subtract vector components and find resultant vectors both graphically and with numerical components.
3. Use unit vector notation.
4. Multiply a vector by a scalar.
Textbook: 1.6 to 1.9, 3.1 to 3.2
Problems: 1:41,45,50; 3:2,5

NEWTON’S LAWS OF MOTION
Learning Objectives:
1. State, explain, and give examples of Newton’s first, second and third laws.
2. List the four fundamental forces of nature.
3. Use Newton’s second law to translate a free-body diagram into a mathematical representation.
4. Explain what is meant by “weight” and draw a vector representing it.
5. Explain normal force and draw a vector representing it.
7. Recognize the difference between constant velocity and constant acceleration situations.
8. Find the net force acting on objects, their resulting accelerations and use this in problem solving.
9. Solve problems involving static and kinetic friction, tension forces, and gravitational forces.
10. Give examples of injuries to humans caused by high accelerations.
Textbook: 4.1 to 4.7; 5.1, 5.4, and 5.5
Problems: 4:5,7,13,23,53; 5:4,8,25,31

CIRCULAR MOTION
Key Concepts: Circular Kinematics, angular velocity, rotation, revolution, centripetal acceleration.
Learning Objectives:
1. State the similarities and differences between linear and rotational motion.
2. Use the proper units for circular motion.
3. Use rotational motion kinematics concepts to solve basic problems.
4. Apply Newton’s law to circular motion situations that include frictional, normal and tension forces.
Textbook: 3.4 and 3.5; 5.2, 10.1 to 10.4
Problems: 3:23,26; 5:16,19,51,54; 10:1,2,9

WORK AND ENERGY
Learning Objectives:
1. Define work and energy.
2. Find the scalar (dot) product of a force vector and a displacement vector.
3. State the units of work and energy.
4. Solve problems involving work done by forces such as gravity and elastic (spring) forces.
5. Define kinetic energy and state its units.
6. Define and use the work-energy theorem to solve problems.
7. Define power and state the units associated with power.
8. Define gravitational potential energy and use the concept in problem solving.
9. Define elastic potential energy and use the concept in problem solving.
10. Define mechanical energy and use the concept in problem solving.
11. Distinguish between conservative and non-conservative forces and use the concepts in problem solving.
12. State the principle of conservation of mechanical energy and be able to apply it to solve problems.
13. Find the work done by a varying force by integrating.
14. Give an example of the conservation of energy in biology.

**Textbook:** 6.1 to 6.8, 7.1 to 7.8
**Problems:** 6:1,7,11,14,25,28,35,38,39,43,44,57; 7:3,4,13,14,22,35,45

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**LINEAR & ANGULAR MOMENTUM**

**Key Concepts:** Momentum and Its Relation to Force, Conservation of Momentum, Momentum-Impulse, Seat Belts and Air Bags, Center of Mass for the Human Body.

**Learning Objectives:**
1. State what is meant by “impulse.”
2. Distinguish between external and internal forces.
3. Show that if the net external force is zero, Newton’s second law results in conservation of momentum.
4. Solve problems by employing conservation of momentum and the momentum-impulse theorem.
5. Integrate a force that acts over a time interval to find the impulse and the change in momentum.
6. Define center of mass and calculate a center of mass.
7. Define “angular momentum.”
8. Apply the conservation of angular momentum principle to human motion.

**Textbook:** 8.1 and 8.2; 8.5 and 8.6, 10.5, 10.8, 10.9, and 10.11
**Problems:** 8:2,3,7,34,39,49; 10:21,23,44,48

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**TORQUE & STATIC EQUILIBRIUM**


**Learning Objectives:**
1. Recognize the difference between torque and force.
2. Define “rotational inertia”.
3. Define torque and calculate the magnitude and direction of a torque.
4. Solve stable equilibrium problems in which the net torque is zero.
5. Describe how the human body generates torques.
6. Calculate forces in muscles and joints including the elbow, neck, jaw, shoulder and foot.
7. Describe the physical parameters for stress, strain, and fracture in humans. (optional)

**Textbook:** 10.6 and 10.7
**Problems:** 10:26,27,70,71
FLUIDS
Key Concepts: Density and Specific Gravity, Pressure in Fluids, Atmospheric Pressure and Gauge Pressure, Pascal’s Principle, Buoyancy and Archimedes’ Principle, Fluids in Motion; Flow Rate and the Equation of Continuity, Bernoulli’s Equation, Applications of Bernoulli’s Principle, Viscosity, Poiseuille’s Equation, Blood Flow in the body, Surface Tension, The heart as a pump.
Learning Objectives:
1. Define and calculate a density.
2. Define buoyant force.
3. Define hydrostatic pressure and derive the equation for pressure.
4. Find the total force due to a column of fluid by integrating.
5. State Pascal’s Principle.
7. Define surface tension and state an example from biology or medicine.
8. Explain how the conservation of mass principle leads to the continuity equation.
9. Explain how the conservation of energy principle leads to the Bernoulli equation.
10. Solve problem using the continuity principles and Bernoulli’s equation.
11. Explain viscosity.
12. Relate the principles of static and dynamic fluids to the human cardiovascular system and solve problems using these concepts.
13. Describe the various physical principles involved in improving human cardiac functioning.
Textbook: 15.1 to 15.8
Problems: 15:8,15,16,26,29,30,36,39,45,58

THERMAL ENERGY
Learning Objectives:
1. Define temperature.
2. Distinguish between temperature and heat.
3. Solve problems using the equation of state for an ideal gas.
4. Define temperature based on a gas’s average molecular kinetic energy.
5. Solve problems using the kinetic theory of gases.
6. Explain the concepts of vapor pressure, partial pressure and diffusion and solve problems related to these concepts.
7. Explain the role of partial pressure in human respiration.
8. Explain the three mechanism of heat transfer: Radiation, convection, and conduction.
10. Describe how the human body radiates thermal energy and cools the body.
11. State how climate change is affecting humans, plants, and animals. (optional)
Textbook: 16.1, 16.2, 16.4 to 16.7; 17.10 and 17.11
Problems: 16:3,17,23,35,41,46,62; 17:52,53,57

FINAL EXAM
18 July 2011