## Course Change Request

<table>
<thead>
<tr>
<th>Check Appropriate Boxes:</th>
<th>Undergraduate credit ☑</th>
<th>Graduate credit ☐</th>
<th>Professional credit ☐</th>
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1. School/Division: CLAS
2. Academic Subject Code: PHYS
3. Current Course Number: N190
4. Current Credit Hours: 3.0
5. Current Title: The Natural World
6. Effective Semester/Year for changes listed below: Spring 2007
7. Instructor: I. Levine

### Type of Change Requested (Check appropriate boxes and indicate changes)

- [ ] 8. Change course number to: ________________ (must be cleared with University Registrar).
- [ ] 9. Current course title: ______________________ (optional)
  - Change to: ________________________________
  - Recommended abbreviation (optional) ____________ (Limited to 32 Characters including spaces)
- [ ] 10. Current credit hours fixed at: 3.0 or variable from: __________ to __________
  - Change to credit hours fixed at: __________ or variable from: 3.0 to 5.0
- [ ] 11. Current lecture contact hours fixed at: __________ or variable from: __________ to __________
  - Change to lecture contact hours fixed at: __________ or variable from: __________ to __________
- [ ] 12. Current non-lecture contact hours fixed at: 0.0 or variable from: __________ to __________
  - Change to non-lecture contact hours fixed at: __________ or variable from: 0.0 to 3.0
- [ ] 13. Is this course currently graded with S-F (only) grades? Yes No
  - Change to S-F (only) grading? Yes No
- [ ] 14. Does this course presently have variable title approval? Yes No
  - Is variable title approval being requested? Yes No
- [ ] 15. Is this course being discontinued? For all campuses Yes No for this campus only
- [ ] 16. Current course description: Introduces students to the methods and logic of science, and helps them understand the importance of science to the development of civilization and the contemporary world. Provides a context within which to evaluate the important scientific and technological issues of modern society. Interdisciplinary elements.
  - Change course description to (not to exceed 50 words) __________________________________________

### Justification for change (see attached)

(Use additional paper if necessary)

- [ ] 17. Are the necessary reading materials currently available in the appropriate library? Yes
- [ ] 18. A copy of every course change proposal must be submitted to departments, schools, or divisions in which there may be overlap of this course with existing courses or areas of strong concern, with instructions that they send comments directly to the originating Curriculum Committee. Please append a list of departments, schools, or divisions thus consulted.

Submitted by: [Signature]  Date: 1/19/06

Department Chairman/Division Director  Date: 1/1/06

Dean of Graduate School (when required)  Date: 1/1/06

Approved by: [Signature]  Date: 1/1/06

Assoc. Dean  Date: 1/1/06

Dean  Date: 1/1/06

Chancellor/Vice-President  Date: 1/1/06

University Registrar  Date: 1/1/06

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Re-order B 81 63030 from Central Stores
Revised March, 1977
To: CLAS Curriculum Committee
From: Jerry Hinnefeld, Chair, Dept. of Physics and Astronomy
Date: October 13, 2006
Subject: PHYS-N190 Course Change Request

Attached is a Course Change Request to modify the credit hour assignment of PHYS-N190 The Natural World from fixed at 3.0 to variable, 3.0 to 5.0.

In response to the adoption of a common set of minimal general education requirements for all baccalaureate degrees at IU South Bend, the College of Liberal Arts and Sciences undertook a revision of the general education requirements for its B.A. degrees. One of the additions adopted by CLAS was a laboratory science requirement, to be satisfied by taking either a 5-cr. combined lecture/laboratory course or a 2-cr. laboratory course coupled to a 3-cr. lecture course. Our department has concluded that the best way for us to offer courses that will satisfy this requirement is to design some offerings of PHYS-N190 The Natural World, our physics version of this Common Core course, with a formal laboratory component. Other offerings of PHYS-N190 will continue to be offered without a formal laboratory component at 3.0 cr. hrs., so in this scenario it will be necessary for PHYS-N190 to be variable-credit.

Please let me know if you have any questions.
This information and further class information can be found at mypage.iusb.edu/~ilevine

Lecture: (NS0063), Monday & Wednesday 11:30 to 12:45, Instructor: Ilan Levine Office: 347 Northside Hall, 520-5544 Hours: Tuesday 9:30-11:30 (or by appointment or just stop by my office) E-mail: ilevine@iush.edu Text: Hewitt, Paul G., "Conceptual Physics", Tenth edition, Addison-Wesley, 2005

Laboratory exercises (NS 0062): Wednesday(3757) 13:30-15:30, Wednesday(3758) 16:00-18:00

If you need adaptations or accommodations because of a disability, if you have emergency medical information to share with me, or if you need special arrangements in case the building must be evacuated, please make an appointment with me as soon as possible.

Scope:
The object of this course is to teach you how to think, write and speak like scientists. We will study the scientific method, including the development of models and experimental techniques to test those models. With work, you should be able to understand many common phenomena (such as why hot-air balloons rise and why 100 degree steam is so much more dangerous than 100 degree water), gain some insight into the methods by which scientists study the physical world and what the limitations are to this knowledge. The ‘discovered’ nature of this course is the emphasis on designing experiments to test your models of nature using materials you might happen upon in your home (This home has a few items not found in most homes.) The capstone project for the course will be an experiment written, conducted and analyzed by student teams, as well as an oral presentation of the results of the exercise.

Topics to be covered:

Grading policies:
The division of points available for the course is: In class exams 60%, lab exercises 20%, student written lab/oral presentation 20%. Work together on homework problems and lab reports as you see fit. My advice would be to try to do as much as you can by yourself in order to learn the material. I will provide solutions to all of the homework problems.

Total grade: There will be no “grading curve”, so help each other learn! I hope that you will all learn the material and methods and earn “A’s”. I will assign letter grades based on the following percentage of cumulative scores. Score A: 87% or higher, B: less than 87%, more than 75%, C: less than 75%, more than 60%, D: less than 60%, more than 49%, F: Less than 49%.

Rules:
Exams: There will be 4 exams (three 75 minute exams and one 120 minute final). Each exam is a cumulative test (that is, you are responsible for all of the material covered since the beginning of the course.) In all of the material that you turn in, you must show your work, not simply give an answer. Also, you must show units (where appropriate.)

Comments:
1) This is a course directed to persons not majoring in physical science. That does not mean that this is simple material, and it does not mean that this is a "poetry of physics" course. The course will cover material which is both intellectually and technically challenging. An integral part of learning both the ideas and the process of science thinking is practice in quantitative problem solving. I remind you that there is a mathematics prerequisite for the course, and it is there for a reason: you will be using some very basic mathematics techniques in problem solving (see below for details.) We will review them together, but it is your responsibility to master these techniques. I urge you to ask questions as soon as you encounter ideas or techniques which you don’t understand.

2) In terms of the total grade, the HW score is worth nothing. However, solving the problems by yourself, as you are studying that material, is essential preparation for exams. We will review solutions to selected
problems during each class. Be sure to ask questions about any questions that I don’t cover that you need help with.

**Suggestions:**

1) I have assigned problems for homework to help you learn the material. These assignments should be viewed as the minimum amount of problem solving required as part of your learning. Do more problems from the book than I assign for extra mental ‘workouts’.  
2) Make sure to ask questions about things you don’t understand. This can be done in class, at my office, by phone, by e-mail, carrier pigeon, etc....
3) Do the reading assignments! I assign a chapter to be read before I cover it in class. This will make the lecture MUCH more useful than doing the reading after the lecture. Trust me on this. Do it!

**Some mathematical techniques that will be used.**

**Taking the ratio of two ratios:** At various points our calculations will require diving one ratio, say a/b by another ratio, say c/d. Viz: \( x = \frac{(a/b)}{(c/d)} \). This ratio may be calculated by resolving each component ratio separately, if we know the numbers. That is, if we know that \( a=1 \), \( b=2 \), \( c=4 \) and \( d=2 \), then \( a/b = \frac{1}{2} = 0.5 \) and \( c/d = 4/2 = 2 \) and then the ratio of these ratios is \( x = 0.5/2 = 0.25 \).

We can solve for \( x \) another way: by inverting the bottom ratio and multiplying it by the upper ratio. That is, using the rule that \( (a/b)/(c/d) = (ad)/(bc) \). This technique can be used in many cases where we can’t use the first method (for example, we may not know the separate values of b and d, but we may know the ratio \( b/d \) (example, we may not know b or d but we do know that b is twice as big as d and so the ratio \( ad/bc \) = \( a/c2 \)).

**Solving an equation for one unknown:** In many problems, we will develop an expression in which everything except for one quantity (for example, the momentum) is known. We will then solve the expression for that unknown.

**Example** 3 + 3p = 5 (p - 1). We want to solve for p:

\[
\begin{align*}
3 + 3p &= 5p - 5 \quad \text{(just multiplied through by 5 on the right side of the equation)} \\
3 + 5 &= 5p - 3p \quad \text{(added 5 to both sides of the equation and subtracted 3p from both sides.)} \\
8 &= 2p \\
4 &= p \quad \text{(divided both sides by 2), and we have found p.}
\end{align*}
\]

**Powers and scientific notation:** These are used to represent very large and very small numbers and are presented in detail in the lecture and lab. Also, look at the last page of the text which shows tables of values of powers of 10.

**Word problems:** You will need to work on your skill at translating a question with words into a set of mathematical symbols which you can then manipulate. This is a skill which requires practice, so don’t get frustrated if you have trouble with this at first, but you must work on it.

**Symbols:** Remember that mathematical symbols only have the meaning that you put into them for that problem. The symbol “p” could stand for the amount of momentum in one problem, but in a different problem the symbol “p” could stand for another quantity, such as pressure. You must use symbols and expressions intelligently!

**Geometry:** We will use some basic results (such as the relation between the radius and circumference of a circle \( C = 2\pi r \)), but they will be explicitly discussed the first time that I use them.

**Notation:** \( \sqrt{\text{something}} \) is notation meaning the square root of something.

**If you have trouble with any of these, you need to see me or go to the math tutoring room. We will be using these manipulations all the time in the course.**

Inspirational (?) note: Physics is a human activity that anyone can do. You do it all the time subconsciously when you walk, drive, throw a ball, etc. Studying it formally is less familiar, but you can do it. I will be your guide through this study. **If you keep working at it, you will get it!**
L1 Jan 9, Lecture: Course outline, Math techniques

L2 Due 11 Jan, read chapter 1 and continue to practice math.
Lab # 1. Measurement and error estimation practice

Problems: compute the following
a) Solve the following equation for p:
   \( p = \frac{(1/4)(4/16)}{ } \)

b) Solve this equation for x: \( x + 1 = 2x - 2 \).
c) Solve this equation for y: \( ay^2 = d \), where \( a = \frac{1}{2} \) and \( d = 1 \).
d) Solve this equation for z: \( 2z - 3 = z + 1 \)
e) Solve the following equation for x: \( x^2 - 4 = 0 \)
f) \( 10^4 \times 10^2 = \)
g) \( 10^4 \times 10^3 = \)
h) \( 10^7/10^8 = \)
i) The radius of a sphere is 1m. What is its volume?
j) This same sphere is now hollowed out. The spherical hole inside has a radius of 0.5m. What is the volume of the hole, and what is the volume of solid material left? (hint: draw a picture!)

Exercise: A friend tells you that the Hubble space telescope used to study light from distant stars is put in space so that it will be closer to the stars it is meant to study. How do you show him that he is wrong? (The nearest star is about 4.3 light-years away, or about 2.5\( \times \)10\( ^{13} \)miles away. Hubble orbits the earth at a distance of ~ 200 hundred of miles above the surface of the Earth.)

L3 Due 18 Jan. read chapter 2
Lab # 2. Velocity and Acceleration

Exercise 1: Your little sister tells you that she has discovered something amazing. “The moon grows bigger as it sets!” Is this a scientific hypothesis? Are you able to design a test of this hypothesis? (If so, describe it.)
Exercise 2: How long is a day in seconds?
Exercise 3: How long is a year in minutes?
Exercise 4) The average distance between the Earth and the Sun is 1.5\( \times \)10\( ^{11} \)m. How much is this in km? miles? cm?

L4 Due 23 Jan, read chapter 3

Question: Does an object need to be at rest to be in equilibrium? Is an object at rest necessarily in equilibrium?
Problem: Using the information in the below diagram, calculate the net force on the block.
If you look at the block 10 seconds later, in which direction will the block move?

\[ F1 \]
\[ \text{North} \]
\[ \text{South} \]
\[ F2 \]
\[ F3 \]
\[ \text{F1 = 2N, South} \]
\[ \text{F2 = 4N, North} \]
\[ \text{F3 = 3N, North} \]

Question: When a ball is tossed straight up, it momentarily comes to a stop at the top of its path. Is it in equilibrium at this brief moment or not?
L5 Due 25 Jan, read chapter 4.
Lab #3. Free Fall

From chapter 3: Rev questions 1,3,5,7,11,13,20 exercises 15,19 and 36. Problems 3, 6 and 9
problem: A car drives down a straight track in the north direction. Photogates along the track measure the speed to be a constant 50 mph. What is the acceleration of the car?
A physics professor next bends the track into a circle and the photogates still record the car as going 50 mph. Has the acceleration changed from the straight-track case?

L6 Due 30 Jan, read chapter 5. student lab proposals due.
In chapter 4, Review question 1,2,5,8,13,16 project 3, exercises 1,7,9,22,27 and problems 2,3,4.

Question 1) The following problem requires use of what you have learned from chapters 1-4. A 40 Kg boy accelerates from rest to a speed of 1m/sec in 3 seconds. A) What is the average acceleration of the boy? B) What is the average force on the boy? C) How far has he traveled at T=3 seconds?

Question 2) You exert a net force F on a mass m, and the acceleration is a. What is the acceleration of that object if you double the force? What is the acceleration if you double the mass of the object? What would the acceleration be if you instead halved the mass of the object?

L7 Due 1 Feb, Exam I, Chapters 1-4

L8 Due 6 Feb, read chapter 6 & 7
read chapter 6
Lab #4: Newton's law's of motion
In chapter 5, Rev q 1, 6,10,11,17, 22. One step calculations: 1,2 Exercises 5,19,43, and 49. Problems 1,2, 3 and 4.

In chapter 6, Rev questions 1,2,9,11,12,16. 18 Exercises 1,8,10,12,18,24,28,48,50. Problems 1,8, and 9.

L9 Due 8 Feb, read chapter 8
Lab #5: Momentum and Energy
In chapter 7, Rev q. 3,4, 8,15,20. One step calculations 2,5,9,10 Exercises 1,2,11,14,19,28, 36. Problems 4, 8, 10.

Question: From a rooftop, one ball is dropped from rest while another identical ball is thrown downward. Which of the following are the same for both balls? (a) Change of KE in the first second of fall. (b) Change of PE in the first second of fall. (c) Change of KE in the first meter of fall. (d) Change of PE in the first meter of fall.

L10 Due 13 Feb, review reading and questions from chapters 1-8
In chapter 8, Review q 1, 2, 6, 9,10,13, 14,18,20,24,28, 31 One step calculations 1,3 Exercises 2, 3, 18, 25, 36, 47, 59 Problems 1,3.

Why does rifling a barrel (which causes the bullet to spin around its long axis) make the weapon more accurate?

L11 15 Feb, Exam II, chapters 1-8. normal class time and location.
No Labs this day

L12 Due 20 Feb read chapter 9. Draft of student lab due.

L13 Due 22 Feb, read chapter 10
Lab #6: Projectile motion and scattering.
In chapter 9, Rev q1, 3,4,5, 8,9,12,14,15, 16, 17, 22, 26,29 one step calculation 5 Exercises: 2, 14, 25, 43, 48, and 54. Probs: 1&4.
1) What is the gravitational force between the Earth and Sun?

2) Assume you are of mass 100kg, and you are suddenly placed at rest at a height of about $3.6 \times 10^7$ m above the surface of the earth. What is the force that the earth exerts on you? What force do you exert on the earth? What is your acceleration? Now, this is roughly the same height that they place geostationary communication satellites. If they are subject to a force and hence an acceleration, speculate on why they don’t fall to the earth, the way that you will.

SPRING VACATION! (Time to contemplate what we have discussed thus far. ☺)

L14 Due March 6, Read Chapter 11
In chapter 10 Rev q 1, 2, 3, 4, 5, 9, 11, 14, 17, 19, 21, 25. Exercises: 5, 13, 14, 15, 25, 27, 49 and problems 1, 3, and 5.

L15 Due 8 March, read chapter 12
In chapter 11, Rev q 1, 3, 6, 8, 10, 13, 15, 18, 20, 24, 28 Exercises: 1, 2, 3, 4, 12, 20, 23, 42 and problems 2, 5 and 6.

L16 Due 13 March, read chapter 13
In chapter 12: Rev q 2, 3, 4, 5, 8, 9, 10, 14, 19, 26 Exercises 5, 11, 12, 13, 15, 21, 31, 47 and problems 1, 2, 3, 9 and 10
Question: Which will rust faster, a piece of iron or the same amount of iron in “steel wool”?

L17 Due 15 March, read chapter 14
Lab #7: density Review status of student written labs
In chapter 13: Rev q 1, 2, 3, 4, 5, 6, 7, 8, 9, 13, 16, 18, 20, 21, 23, 24, 25. Exercises 2, 6, 8, 14, 23, 26, 34, 42, 47, 55, 59 and problems 1, 5 6 and 10

Question: What is a fluid?

Problem: A salvage ship is able to raise a chunk of steel from the ocean floor to the water surface, but cannot raise it above the water. Using the fact that the density of steel is four times the density of water, decide whether 1, 2 or 3 more ships are necessary to lift the steel out of the water.

L18 Due 20 March, read chapter 15
In chapter 14 Rev q 1, 2, 4, 5, 9, 10, 13, 17, 20, 22. Exercises: 1, 9, 10, 11, 14, 15, 18, 21, 39, 40, 54, 58 Problems: 1, 6 and 8.

L19 Due 22 March, read chapter 16
Lab #8: Heat capacity. Review status of student written labs
In chapter 15 Rev q 1, 2, 5, 6, 7, 11, 15, 18, 21, 29. Exercises: 1, 2, 4, 7, 14, 25, 27, 28, 38, 46, 53, 58 Problems: 1, 2, 8, & 9

Question: Will a grandfather pendulum clock run faster or slower on a hot day? Explain.

Note: 27 March is the last day that it is possible to withdraw from a course.

L20 Due 27 March: Read chapter 17. In chapter 16 Rev q 1, 3, 7, 12, 14, 18, 19, 20, 23, 28, 30. Exercises 1, 3, 6, 20, 22, 35, 48. Problems 1, 2, 3, 4
NOTE: For problem 3, assume that the mass of the nail is $5 \times 10^{-3}$ kg.
Question: Distinguish between a conductor and an insulator.

L21 Due 29 March, Exam III, chapters 1-16, normal class time and location
No labs this day.

**L22 Due 3 April** read chapter 18  
In chapter 17 Rev q 1,3, 7,8, 9,10, 11,13,15,19, 22,25. Exercises 2, 15,21, 29, 33, 40, 44,49, 56 Problems 1,3 & 6.

Question: We say that evaporation is a cooling process (a) What cools? We say that condensation is a warming process. (b) What warms?

**L23 Due 5 April**, read chapter 19  
**Student written experiments to be conducted this week.**  
In chapter 18 Rev q 3, 5,6,7, 9,12,16, 17,21, 26, 27 Exercises 2, 5, 7,14, 19, 25, 26, 37, 49 and problems 1,2,3, 8

**L24 Due 10 April**, read chapter 20  
In chapter 19, Rev q 1, 3, 6, 15, 16,22, 24, Exercises 1,2, 8,16,18,21,31,35, problems 1,3,6  
Refer to figure 19.10: Why do S-waves (transverse waves) travel only through solids, while P-waves (longitudinal) travel through both solid and liquid?

**L25 Due 12 April** read chapter 22  
**Lab # 9: Electrostatics+ Review status of student written labs**  
In chapter 20, Rev q 2, 4,5, 7,9, 12, 14,18,20,22,27 exercises 2,4,6,9,17, 21,24,,26,31, 46 and problems 1,4

**L26 Due 17 April**, read chapter 23  
**Analysis of student labs complete and draft of report due.**  
In chapter 22: Rev q 1,2,7,10, 11,14,16,19, 25,30. Exercises 1, 5, 14, 15, 24, 32,42, 32, 42, 43, 51 and Problems 5, 6  
In terms of attraction and repulsion, how do negative particles affect negative particles? How do negatives affect positives?

**L27 Due 19 April**, read chapter 24  
**Lab #10: Electromagnetism**  
In chapter 23: Rev q 3, 4,9, 11, 12,15, 17,24,29,32, 33,34,36,37,38,40. One step calculation 1, Exercises 5, 10, 15,22, 25, 28, 32,46, 39 problems 1, 4, 5, 9.

**L28 Due 24 April**, read chapter 25  
In chapter 24: Rev q 2, 5,7,9,11,14, 15, 17, 19,21,22, Exercises 2, 9, 19, 31, 33, 42, 46 and 47.

What is a likely cause of the Earth’s magnetic field?

**L29 Due 26 April**, Prepare for review of chapters 1-25 (excluding chapter 21)  
In chapter 25: Rev q 1, 2, 6, 11,19,25. Exercises 3,8,9,12,18,23,38, 47. Problems 1, 4  
**Oral presentation of student labs.**

**Final Exam Monday, 1 May, normal class room & time (2 hour exam!)**

**Grades available by 3 May.**