Instructor: Mark F. Masters, Ph.D.
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Phone: 260-481-6153
Email masters@ipfw.edu
WWW: http://users.ipfw.edu/masters/
Office Hours: M 9:00 – 11:00, R 1:30-2:30
I maintain an open door policy, but I reserve the right to close my door when I am busy. I also accept appointments. If you make an appointment with me, please attempt to be there. I will always be happy to see you.

Supplies necessary for class:
1. Investigation Kit (from bookstore eventually)
2. Pen and/or pencil
3. Ruler
4. Paper
5. A folder or loose leaf notebook in which to keep your class notes, handouts and worksheets which you will always bring to class with you.
6. An open mind
7. Observational skills
8. Thinking cap
9. Work Ethic

Course Outcomes: By the end of this course you will have developed an understanding of how science functions, an understanding of light and its interaction with matter such that you can explain the phenomena of color. You should also develop an appreciation for some basics of vision.

General Education: Physics 127 is a general education course. As such it has the following learning objectives. Students who have completed the General Education requirements at IPFW are expected:

- To be familiar with the important modes of human thought that are the foundations of science, philosophy, art and social behavior. We will discuss the nature of science in depth at the beginning of the semester and you will be applying a scientific methodology throughout the semester.

- To possess effective foundation skills:
  o Read, write, and speak with comprehension, clarity, and precision.
  o Identify substantive knowledge and disciplinary methods.
  o Develop information literacy skills.
  o Reason quantitatively (as means of gaining and creating knowledge and drawing reliable conclusions)

  Homework will require writing. You will be communicating in on-line discussions within your group and also in overall class discussions. You will have to do research and you will be expected to use quantitative reasoning on the homework and exams.
• To demonstrate the ability to think critically and to solve problems using the foundation skills
  o Evaluate their ideas and the ideas of others based upon disciplined reasoning.
  o Understand the traditions that have formed one’s own and other cultures.
  o Be able to articulate their ideas in appropriate media.
  
  *All of the homework will involve critical thinking and problem solving. You will have to
  put your observations and conclusions into text during the discussions.*

**Course Goals:** There are five, important goals for this course. The first goal is to develop an understanding of the science. The second goal is to learn about physical nature of light, how light interacts with matter and our perception of light and space. The third goal is an investigation of optics. The fourth goal will be to actually create both still and animated images on the computer that make use of your physical understanding. You will be expected to apply your knowledge and understanding to simulating and modeling physical systems. The fifth (and perhaps the most important) goal is to have fun.

**About the course:** This is a unique course in which we examine light and vision through the use of computer graphics. There are several reasons for this: First, computer generated images can be remarkably realistic and the software used to produce such images utilizes an idealized model for the interaction of light with matter and of light itself. Using the software, we can investigate the behavior of light in this idealized world. We can find flaws in the software if we understand real world behavior and therefore determine ways to overcome these flaws. Second, it is important to recognize ourselves as observers and the limitations of our visual system.

It is important to recognize that we (as humans) intuitively have a “visual” understanding of what of how objects appear and how they move. This means that if something “looks” wrong, it is jarring on our eyes. However, most people do not have a cognitive understanding of the behavior of light so that they do not have the ability to express what they believe is wrong. Our goal in this class is to understand the behavior of light.

**Class and my expectations of you:** This class will be taught using a method which may be unfamiliar to you. The class will be run as more of a discussion with perhaps mini-lectures about certain topics. In order for you to truly understand something, you must work with the ideas involved; you must wrestle with the ideas. There will probably be frustration. There will be questions and YOU, as a class, must attempt to determine the answers by thinking about what you already know, what you have observed and what you will learn. If you are wrong – does it matter? NO not in class (of course being wrong on exams is a different matter). Typically, I will NOT give you direct answers to your questions. This then requires that you talk with your partners and that you DISCUSS and PARTICIPATE in class constructively. It is YOUR class and you must make it work. It is apparent to me that students who actively participate and think about the processes perform better in class overall. To assist in discussions I will give you “tutorials” which guide you in the appropriate direction.

What is participation? Participation means that you apply what you have learned, what you know to situations presented to you in class. You think about questions at hand. You write about your ideas on the discussion board. If a classmate states something that you disagree with, or do not understand, question them politely and explain what you think is wrong with what they are saying. Or if you would like a classmate to explain their reasoning, then politely ask them to do so. Participation is NOT simply asking some random question of ME. Participation is not simply waiting to be called on to answer some question – generally with an “I don’t know.” However, this means that you must be actively involved in class. You cannot
wait till the end of the semester to do the classwork. You must be involved throughout the entire semester. You must participate in the discussions regularly throughout the week for each and every week of the class.

**It is incredibly important that you participate in the on-line activities and discussions promptly. You cannot procrastinate without frustrating your classmates. Your grade will depend upon the quality of your participation.**

I use this approach because I believe that if I tell you an answer you will not understand the reasoning behind that answer. It is ultimately a fact. However, if you have to work out the reasoning, you are more likely to understand the thinking behind the fact, the process of determining ideas and reasoning. This will serve you well beyond this class, but it is something YOU must learn.

There will be homework assignments. I expect them to be completed on time, thoughtfully, clearly and concisely. I expect your best effort. You should realize that the traditional expectation of homework load is two or three hours of homework for every hour of class. That means that for this class you are expected to spend between six and nine hours on your homework. Schedule it as such. DO NOT leave your homework to just before class; you will ultimately fail if you persist in this approach. Come to see me or contact me about questions as soon as possible. My level of sympathy for someone with questions diminishes the closer it is to the due date. Furthermore, if you make an appointment to see me, then you had better show up on time.

The traditional method for an artist to learn about light and motion is by means of a lost skill known as **Observation**. One of the most important skills in science is Observation. In class we will be honing your Observation skills. You need to look at the world around you and ask yourself **WHAT** is going on, **WHY** is this happening and **HOW** would I describe this observation so that others could understand it? **HOW** would I replicate this process in the computer graphics software?

Observations: You will be expected to make careful and accurate observations. But observations do not simply end at just looking and writing down what you see. They require you to think about what you have seen and what those observations mean and imply. They require you to write down your own questions about what you have seen and then attempt to find an answer.

Just because this is a general education, 100 level, course do not think that you can “blow off” the work or that this course will be easy. I expect you to work and learn in class. The purpose of any class is for you to learn. You are paying for this class to learn and you will, but that means you have to do the work. I cannot force understanding on you. You must achieve that on your own.

One of the difficulties with using “technology” in the classroom is the learning curve required of the students to become familiar with the “technology.” The only way to learn the technology is to use it. As such there will be homework that will require that you perform using the software and this will have to be done in the labs. Some class time will be devoted to this, but more will have to be devoted outside of class by you.
Please note. This is first and foremost a Physics class. We will concentrate on Physics. While there are creative aspects to the class, the real issue is that of applying the physics. This will be what I am looking for from you. I also want you to try to be creative. People who make a honest effort will often succeed with good results. The key is to try!

How to take notes for this class:
Keep all of your completed activities. These will form the body of your notes. Annotate these as you correct the activities.

To summarize, to succeed in this class you will have to:
• Actively and constructively participate
• Complete the homework assignments on a timely basis, thoughtfully and thoroughly. This means starting them when they are assigned and not procrastinating. DO NOT start doing the homework five minutes before it is due. This is important. The homework will require thought and your grade will depend upon your thoughts and efforts on the homework.
• Think
• Observe
• Think some more.

An outline and timeline of the topics will be covered:
I. What is Science?
II. Light and Color
   A. What is light? What is color?
   B. The interaction of light with objects
   C. Images and Shadows
   D. Optics: reflection and refraction, ray tracing
   E. Vision

Tests: These have to be figured out.

Homework: Homework assignments will include observations, small papers, problems and graphics assignments as assigned in class. Written answers are to be in complete sentences. The answers will NEVER be single word/number

Projects: There will be two main projects, related, assigned in class. Through these projects you will be expected to clearly demonstrate the physical principles learned in class.

Grading:
Class participation 10%
Homework assignments 15%
Projects/labs 30%
3 Exams 45%

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15-week breakdown of material

- Week 1-2 Introductions, Explanations, Science and Scientific Method
- Week 3 - 8 Light (what is light), the models of light (ray, particle and wave), color (what is color), (the nature of light, additive light mixing, subtractive light mixing, the interaction of light with matter, the formation of shadows).
- Week 9 - 11 Reflection and refraction. Discussions about reflections from plane and curved mirrors, the effects of refraction and how lenses work. Observations of real mirrors and lenses will be performed. Homework will include examining images through reflection from mirrors, and imaging through lenses, and “building” mirrors and lenses.
- Week 12-15 Vision

15 Week breakdown of laboratory activities

- Week 1 The game of science
- Week 2-4 Introduction to Modeling (Creating a model, adding bones).
- Week 5 Simple Animation
- Week 6 Modeling surfaces and lights
- Week 7 Light sources experiment and simulation: Additive
- Week 8 Light sources experiment and simulation: Subtractive
- Week 9 Reflection experiment and simulation
- Week 10 Refraction experiment and simulation
- Week 11-12 Vision and 3d images
- Week 13-15 Final project