PHY 209
Space and Time in Elementary Physics

Syracuse University Summer Session II 1995

Meetings: MTWTh 10:00-11:45 am, 104 Physics Bldg.

Instructor: Rob Salgado
office: 263-3 Physics Bldg, Syracuse NY 13244
voice: (315)-443-3881, fax: (315)-443-9103
email: `salgado@suhep.phy.syr.edu`
WWW: `http://altair.syr.edu:2024/ROB/`

Office hours: drop by any time or call me (I usually stay until 2am) or make an appointment or catch me logged-on at night (as `rbsalgad@hydra` or as `salgado@ace`) or send me email (`salgado@suhep` is easy to remember, and it is the best way to reach me)

Prerequisites: High-school Algebra, Trigonometry, and Geometry.

Corequisites: Precalculus (MAT 194).

Motivation: Galileo once said "The book of Nature is written in the mathematical language." Physics is not math, and math is not physics. It is important to distinguish between the two. Mathematics is but a very useful tool that helps us describe the physics. When one comes upon a physical situation, one first appeals to one's **physical intuition** to model the problem, then uses **mathematics** to *formulate* the situation (i.e., to write down a set of equations) and then to *calculate* (i.e., to solve the equations to obtain a set of numbers). Hoping that one has actually described the physical situation, one appeals again to one's **physical intuition** to interpret the results.

Objective: This course is intended to prepare you for the (PHY 211/212) General Physics sequence by helping you develop both your physical intuition and your mathematical intuition.

Method: This is not a lecture course. This is a "hands-on" project-oriented course which will introduce you to some of the basic concepts of physics and to some of the mathematical tools that are useful in studying them. In the General Physics sequence, one usually follows "the history of physics" trail to introduce the various physical concepts. A basic knowledge of mathematics is usually assumed, and more advanced mathematical techniques are introduced as needed. Here, we will follow "the history of mathematics" trail to introduce the various physical concepts. **The goal is to highlight the connections between mathematics and its application in physics by re-introducing the mathematical concepts with physical models.** Hopefully, this will enhance your mathematical intuition with physical analogies, which in turn will enhance your physical intuition with mathematical analogies. There will be an emphasis on methodically formulating and solving physics problems.

Textbook: There is **no textbook** for this course. On a daily basis, I will distribute a handout which contains the lesson for the day and the assignment due on the next day. (More details are below.) I will provide materials that are not readily available.

Electronic Materials: At times, you will be expected to perform some calculations. You may find the need to use a **calculator**. I strongly request that you obtain a **Sunix computer account**. Some of our activities may make use of the Internet and the World Wide Web.

On-line information: This and all future handouts will be accessible through the following World Wide Web site:

`http://altair.syr.edu:2024/PHY209/`

New information for this course (as well as information that may be helpful for your future courses) is continually being added. Please check it regularly. This is a good way to get comfortable with this new medium for information. (A web page for PHY211 is being constructed for the fall semester.)

Homework: The assignment will usually be a combination of reading the lesson, performing some task (possibly in the classroom, or in the quad, or at home), explaining what you've learned, and then applying it to a new situation. You are encouraged to work together on the tasks and discuss the write-ups, but it should not deteriorate into one student doing all of the work for another. The assignment is due by the start of the next class, when we will be discussing the assignment. This discussion is an essential part of the course. Thus, latecomers will be penalized by one point off their score and no-shows will receive no credit for the assignment. Late assignments will not be accepted.

Grades: Your grade is determined by the quality of the daily assignments you submit. Each assignment is graded on a 4-point scale:

4 for "mastery of the topic"

3 for "a very good effort"

2 for "a good effort"

1 for "a fair effort"

0 for "zero effort".

Each assignment also contains a challenging question worth 1 bonus point for a correct answer. There are approximately 25 class days. So, approximately 100 points will earn a perfect score. There is **no final exam**. This class is not graded on a curve.
A=90+, B=80+, C=70+, D=60+, F<60.

Schedule Note: Although this class is scheduled to meet Monday through Thursday, the University has declared Friday, June 7 and Friday, July 14 to be class days to make-up for days lost to holidays.

Topics to be covered: (very rough outline)

- *WEEK 1*

  Euclidean and non-Euclidean geometry *What is π?*
  - *How do we know the earth is not flat?*

  Introduction to the Internet and the World Wide Web

- *WEEK 2*

  Euclidean geometry: lengths, areas, volumes, angles *Basic measurements. Basic units of the metric system.*

  Cartesian geometry and graphing functions *Basic graphing of simple functions and taking data from physical situations.*
  - *Introduction to kinematics: linear motion with the Sonic Ranger. Galilean gravity.*

  Equation Solving *Algebraic and geometric interpretations.*
  - *Mathematically formulating the physical problem. Colliding trains.*

  The Triangle *Exploiting scaling symmetry (proportions). The Pythagorean Theorem.*
  - *How tall is that building? How big is the moon? Introduction to geometrical optics (the law of reflection).*

  Welcome to the Carrier Dome
  - *A measurement of the speed of sound.*

- *WEEK 3*

  Trigonometry and the Circular functions *What does sine, cosine, and tangent mean?*
  - *More geometrical optics (the law of refraction).*

  The Vector *What is a vector? Basic algebraic operations and geometrical interpretations.*
  - *Introduction to the Newton Laws of Motion. How far will this water balloon travel?*

  An Application of vectors
  - *The inclined plane.*

- *WEEK 4*

  More applications of vectors
  - *Statics and Stable Configurations. Center of Mass. Free-body diagrams. The hanging sign.*

  Large Numbers, Scientific Notation, and Significant Figures *The Powers of Ten (video).*
  - *Some constants of nature (e.g. the speed of light, the Avogadro number, the Gravitation constant).*

  Periodic Functions
  - *Introduction to rotational and oscillatory motion. The oscilloscope.*

  The Exponential function *What is e? Growth and decay.*
  - *How far does a basketball bounce back up? The capacitor.*

- *WEEK 5*

  Differential Calculus *What is differential calculus about?*
  - *Linear and projectile motion revisited. Introduction to energy. Newtonian Gravity.*

  Making approximations *Intuitive introduction to series expansions.*
  - *Some order-of-magnitude problems.*

  Integral Calculus *What is integral calculus about?*
  - *Linear and projectile motion re-revisited.*

- *WEEK 6*

  Solving more-challenging problems we can now tackle
  - *How far is the horizon? How far does the moon fall each second? Why is there no air on the moon? How high can a mountain stand?*