PHYSICS OF TECHNOLOGY - PHYS 1800

Spring Semester 2010

Course: Designed for non-physics majors.

Goal: To help you develop a good understanding of everyday physics, i.e. the world around us.

Help- You develop an enjoyment in understanding and explaining everyday phenomena.

Not- aimed at simply accumulating a bunch of facts!

You will Discover- that learning to develop your own physical explanations will be most gratifying and will give you a much better appreciation of nature.

PHYSICS OF TECHNOLOGY - PHYS 1800

Class: Mon, Wed, Fri, 10:30-11:20 am, Room **BUS 318**

Instructor: **Mike J. Taylor**, SER Bld. 220C, Tel: 797-3919

e-mail: **mike.taylor@usu.edu**

Office Hours: Mon, Wed, Fri, 11:30am -12:30pm

Laboratory Demonstrations: Tue 1:30-2:45pm, ESLC 046

Recitation: Thur 1:30-2:45pm, Room ESLC 046

Assistant Instructor: **Jonathan Pugmire**

e-mail: **jon.pugmire@aggiemail.usu.edu**

Prerequisites: Algebra (Math 1050) and Trig (Math 1060)

PHYSICS OF TECHNOLOGY - PHYS 1800

Objectives:

This course provides a **conceptual introduction** to physics with the primary goals of gaining knowledge and intuition into every day phenomena using well-developed physical principles and to acquire basic problem solving skills.

Texts:

W. Thomas Griffith, ***The Physics of Everyday Phenomena, A Conceptual Introduction to Physics***, 3rd or later editions (McGraw Hill, 2001or later) **REQUIRED.**

E. Hecht, Physics:Algebra/Trig, 2nd Ed (Brooks/Cole Publishing, Pacific Grove, 1997). **Recommended as a study guide.**

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Where to get help:

- ***Reviewing the text*** and looking over other example problems. (Solutions to odd numbered problems are given in the back of text.)
- ***Talk with colleagues*** in your class and have them explain things to you (rather than simply solving the problem for you).
- ***Ask questions*** in the **Recitation class** (be prepared to explain where the problem arises). This will lead to a better understanding for you and a **positive discussion for the whole class**.
- ***Seek help*** from the class **Instructor** or the **Assistant Instructor** during designated office hours (or other times as available).

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Lectures (BUS 318):

- Will focus on **basic physical concepts** and their application in our every day world.
- They will **augment and follow** the textbook development but **will not** cover all the text material in detail.
- You are advised to **read the text** (as indicated in the attached syllabus breakdown) **prior** to coming to each lecture to be more familiar with the topics discussed.
- Lecture notes available on Web at: www.physics.usu.edu, then follow: Class Website, Phys 1800….
- **Disability Note:** Contact instructor and the Disability Resource Center (797-2444)

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Laboratory (ESLC 046):

- To aid your understanding of the physical concepts a **laboratory demonstration class** will be given every Tuesday (1:30 -2:45 pm).
- Numerous experiments will be performed to illustrate the principles discussed in the lectures and to help develop your understanding. (**IMPORTANT**)
- No direct credit will be given for attending these demonstration labs but the **homework and exam questions** will often draw upon these experiments and you are **strongly advised** to attend the demonstrations.
- **Note:** The **$10 fee** is used to upkeep the laboratory demonstration equipment used in this class.

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Recitation (ESLC 046):

- A recitation class will be given every Thursday (1:30-2:45 pm). They are designed to **review and reinforce** the material presented in the lectures and in the textbook and will act as a forum for developing your problem solving skills.
- Recitation classes provide an excellent opportunity for you to discuss problems with your **homework or exam preparation**.

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Homework:

- Problems based on the class and laboratory material will be given out at the **Friday class.**
- Due beginning of class on the **following Friday** (see Syllabus schedule).
- You are encouraged to discuss the homework assignment with others and to work together solving the problems.

Homework Format:

- **13 sets** of homework: each will consist of several short answer questions as well as some basic problems.
- Each homework is worth up to **20 points.** (To get full credit, you must clearly show your work.)
- Only your **top 10** homework scores will be counted in your grade. Homework must be handed in on time.

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Homework Grading:

- **No credit** will be given for **late homework**; it will be counted as one of the three scores that are dropped.
- Up to 2 additional ***Bonus Questions*** will be given out with each homework. These are more challenging (but quite doable) problems that are intended to expand your physics comprehension and problem solving skills.
- Bonus questions are **optional** and worth **10 extra points**.

Homework is worth 20% of your final grade.

Homework is **key** to doing well in the class. A large fraction of the exam questions will be based on the homework and laboratory problems.

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Final grade is based on homework and four exams.

In-Class Exams (20% each):

- **3 in-class** exams scheduled during recitation time on Thursdays (see Syllabus). Each exam will be **closed-book.**
- Exams based on topics covered in class, homework and laboratory demonstrations.
- Each exam will consist of multiple choice questions, short answer questions and some basic numerical problems.
- A list of **relevant formulas** will be provided.

Final Exam (20%):

The final exam is **not cumulative** and will follow the format of the previous three in-class exams

Make-Up Exams:

These will **not** be given unless there are **compelling** reasons or illness.

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Text: provides a clear explanation of each physics topic in words with **limited use of math** and formulas.

Divided into **six** units:

1. **Motion**: Newton's laws, linear & circular motion, energy.
2. **Fluids and Heat**: behavior of fluids, heat flow, engines.
3. **Electricity and Magnetism**: electrostatics, magnetic fields, generators, motors.
4. **Waves and Optics**: properties of waves, light, lenses, telescopes.
5. **Atomic and Nuclear**: atoms, radioactivity, nuclear reactions.
6. **Relativity**: Einstein's theories, cosmology.

This course will focus on the **first 4 units** (Chapters 2-17) which concern major ideas in **Classical Physics**.

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Each chapter is divided into several separate sections and concludes with a **well-developed summary** of the most important points.

Each chapter contains:

Conceptual questions- aimed at developing basic concepts of the phenomena.

Numerical questions- aimed at developing skills in problem solving using basic algebraic math.

"Home" experiments- many of these will be performed in the laboratory demonstrations. (There is no better way of learning than by doing experiments.)

PHYSICS OF TECHNOLOGY Spring 2010 Syllabus

Date	Day	Lecture	Chapter	Homework Due
Jan 11	M	Class Admin: Intro.Physics Phenomena	1	-
13	W	Units, Scalars, Vectors,	1 & App. B, C	
15	F*	Speed and Velocity	2	
Jan 18	**M**	***Martin Luther King Day***	***No Class***	
20	W	Acceleration	2	
22	F*	Free Falling Objects	3	1
Jan 25	M	Projectile Motion	3	
27	W	Newton's Laws	4	
29	F*	Mass and Weight	4	2
Feb 1	M	Motion with Friction	4	
3	W	**Review**	1-4	
4	**Th**	**EXAM 1**	-	
5	F*	Circular Motion	5	3
Feb 8	M	Planetary Motion	5	
10	W	Gravity and Orbits	5	
12	F*	Energy	6	4
Feb 15	**M**	***Presidents Day***	***No Class***	
16	**Tu**	Harmonic Motion **(Monday class)**	6	
17	W	Momentum	7	
	F*	Impulse and Collisions	7	5
Feb 22	M	Rotational Motion	-	
24	W	Angular Momentum	8	
26	F	Catch up Day	8	6
Mar 1	M	Static Fluids, Pressure	9	
3	W	**Review**	5-8	
4	**Th**	**EXAM 2**		
5	F*	Flotation	9	-

* = Homework Handout

PHYSICS OF TECHNOLOGY Spring 2010 Syllabus

Date	Day	Lecture	Chapter	Homework Due
Mar 8	M	Fluids in Motion	9	7
10	W	Temperature and Heat	10	
12	F*	First Law of Thermodynamics	10	
Mar 15-19	**M-F**	***Spring Break***	***No Classes***	
Mar 22	M	Heat flow and Greenhouse Effect	10	8
24	W	Climate Change	-	
26	F*	Heat Engines	11	
Mar 29	M	Power and Refrigeration	11	9
31	W	Electric Charge	12	
Apr 2	F*	Electric Fields	12	
Apr 5	M	Electric Potential and Lightning	12	10
7	W	**Review**	9-12	
8	**Th**	**EXAM 3**	-	
9	F*	Magnetic Force	14	
Apr 12	M	Electromagnets	14	11
14	W	Motors and Generators	14	
16	F*	Making Waves	15	
Apr 19	M	Sound Waves	15	12
21	W	E-M Waves, Light and Color	16	
23	F*	Mirrors and Reflections	17	
Apr 26	M	Refraction and Lenses	17	No test week
28	W	Telescopes and Microscopes	17	13
30	F	**Review**	14-17	
May 7	**F**	**FINAL EXAM: 09:30-11:20am**	**BUS 318**	

* = Homework Handout

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Grades:

A 92.5% and above

A- 90.0% and above

B+ 87.5% and above

B 82.5% and above

B- 80.0% and above

C+ 77.5% and above

C 72.5% and above

C- 70.0% and above

D+ 67.5% and above

D 60.0% and above

F below 60.0 %

What is Physics?

- "Study of the basic nature of matter and the interactions that govern its behavior."

- For as long as we can imagine philosophers (people) have studied physics (natural science) - why and how things behave:
  - What are stars and why do they move?
  - Why doesn't the moon fall to the Earth like an apple does?
  - Why is the sky blue?
  - What makes the ice so slippery?
- Physics is the modern term and for several centuries it was known as "Natural Philosophy".

Physical Principles and Theories

- Physical principles and theories are used to explain fundamental interactions in:

Life sciences:?

Living organisms
– Biology
– Zoology
– Health

Physical sciences:?

Physics
Chemistry
Geology
Astronomy
Oceanography
Meteorology (weather)

- Physics is the most quantitative of the sciencies and uses measurements and mathematics to develop and test its theories.

Role of Mathematics in Physics:

- Math is used as a **tool** in physics helping to make more concise statements than are possible using words alone.
- Math provides an **accurate** and **convenient** way of summarizing a physical law for investigating its properties.
- Math is a "**universal**" language and is not limited by national, ethnic or social boundaries.

Example: The distance traveled by a truck is equal to its average speed of motion multiplied by the time the journey takes.

or $D = S \times t$

where D = distance
S = average speed
t = journey time

or $S = ? \times t$

where S = distance
$?$ = average speed
t = journey time

Same formula - different symbols!

What are the major subfields in Physics?

- ***Classical Physics*** *(pre 20th century)*
  - Mechanics ? forces, motion
  - Thermodynamics ? heat, temperature
  - Electricity and magnetism ? charge, currents
  - Optics ? light, lenses, telescopes
- ***Modern Physics*** *(20th century)*
  - Atomic and nuclear ? radioactivity, atomic power
  - Quantum mechanics
  - Particle physics

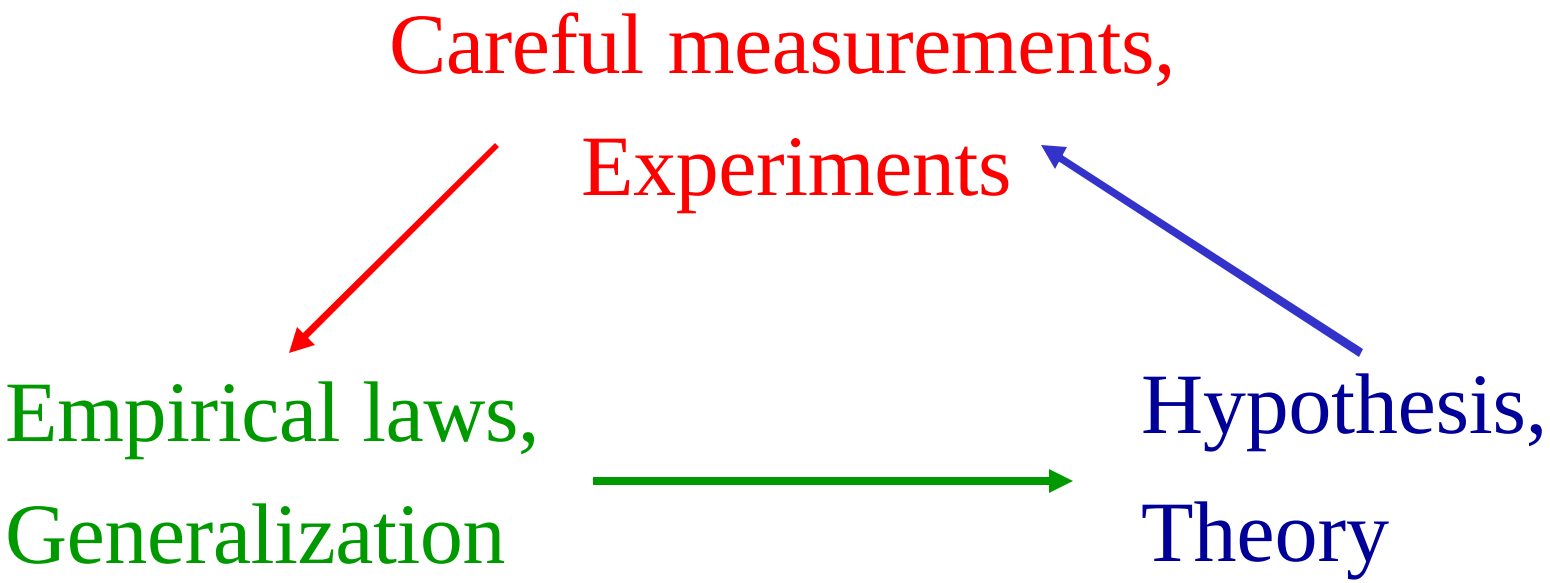
  } ? basic structure matter
  - Condensed matter ? solids and liquids, computer, laser
  - Relativity, Cosmology ? universe, life!

How are scientific explanations/laws developed?

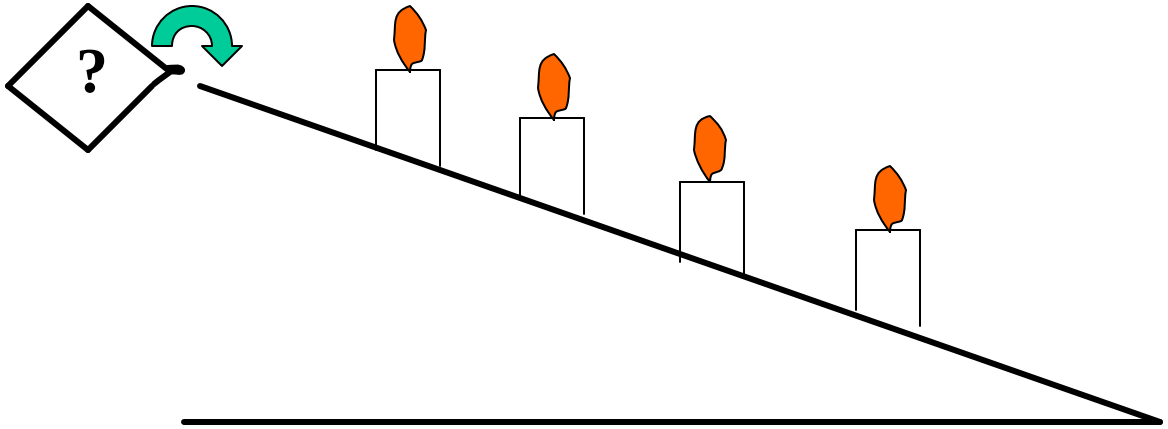
1. Careful observations reveal an unknown natural phenomena…(try to find answers - read books, search web…)
2. Gather facts and measurements about phenomena, study other people's ideas and try to develop "empirical laws" based on your results.
3. Invent a "hypothesis" to explain your observations and empirical laws.
4. Develop experiments to test your hypothesis. (Controlled experiments in laboratory preferably.)
5. Publish results in scientific literature. (critical review…)
6. Further experiments (by other researchers) **help establish new theory.**

Scientific Method:

Leads to ***new discoveries*** ? how scientific progress is made!



Solving the Mystery



Observations:

1. Candles stayed lit until beaker tipped.
2. When apparently empty beaker tipped, the candles went out one by one, top one first.

Measurements:

1. Measure time separation between each candle going out.
2. Lower angle of trough to see if all candles go out or not.
3. Tip beaker again to see if candles always go out.

Possible hypotheses:

1. Lights extinguished as colorless liquid from beaker flows past each candle one by one.

   (Qu: Do you see any liquid at the bottom of trough?)

2. Lights extinguished as air tipped out of beaker rushes past candles one by one.

   (Qu: Did you notice flames flicker in wind?)

3. Lights die out due to very cold air rolling out of beaker.

   (You could measure the temperature of the beaker; but how could cold air alone put out the flames?)

4. Lights out due to unknown colorless gas flowing past candles and snuffing them out one by one.

   (Qu: What makes candles burn?)

Final Hypothesis:

A cold , heavy, **colorless gas** that does **not burn** flowed out of the beaker and extinguished the flames one by one as it displaced the air that is rich in oxygen around them.

Answer = Carbon Dioxide (CO_2)

("Dry ice" freezes at -78.5° C or -109° F)

Next Class

Wed 10:30 am in this room.

Look at Appendices A,B,C