Natural Science I: How Things Work V55.0214
Fall 2006 Meyer 121

Tuesday and Thursday
9:30 – 10:45 a.m.
Instructor: Prof. Daniel Stein
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Office Hours: Monday, 3:00-4:00
Wednesday, 1:00 – 2:00

Lab Section	Day	Time
11	Tuesday	11:00 – 12:40 p.m.
12	Tuesday	1:00 – 2:40 p.m.
13	Tuesday	3:00 – 4:40 p.m.
14	Tuesday	5:00 – 6:40 p.m.
15	Wednesday	9:00 – 10:40 a.m.
16	Wednesday	11:00 – 12:40 p.m.

Course Description and Goals

Do you know how electricity is generated? How instruments create music? Why is it called a "cell phone"? What makes refrigerator magnets stick? For that matter, why is ice skating possible, and why can someone quickly remove a tablecloth without moving any dishes? All of the devices that define contemporary living are applications of basic scientific discoveries. The principles underlying these devices are fascinating as well as useful, and help to explain many of the features of the world around us. This course familiarizes you with some basic principles of physics by examining selected devices such as CD and DVD players, radio and cell phones, the basic electronic components of computers, lasers and LEDs, magnetic resonance imaging as used in medicine, and even nuclear weapons. In learning the basic physics behind these modern inventions, you will develop a deeper understanding of how the physical world works and gain a new appreciation of everyday phenomena that are ordinarily taken for granted. The course is designed for non-science students with an interest in the natural world. The basic physical ideas needed to understand how things operate are presented using some mathematics, but none beyond elementary high school-level algebra.

Course texts

1. *How Things Work, Third Edition* by Louis A. Bloomfield is bundled together with a passcode to use WileyPlus, the website for online homework, John Wiley and Sons.
2. *How Things Work Laboratory Manual.*
3. *Personal Response System Transmitter.* As this device is used for extra credit, purchase is optional.

Examination Schedule and Student Assessment

Examination 1:	15%	Thursday, October 19
Examination 2:	15%	Thursday, November 16
Laboratory:	30%	
Homework:	10%	
Final examination:	30%	December 21 at 8:00 to 9:50 a.m.

The three examinations will be in the multiple-choice format.

Laboratory Sessions

These weekly sessions are an important part of the course. You must be registered for one lab section. You will have to submit a lab report for each experiment performed. The lab report has to include answers to all questions and any data you may have collected. The lab report will be due in lab *one week* after the experiment has been performed. **The laboratory sessions will be held in Silver 203 and will begin the week of September 11.**

Attendance The lab instructor will deduct points from your lab grade for arriving late or leaving early.

Absence Policy Excused absences will only be given in the case of illness (with a doctor's note) or observation of a religious holiday. You must notify your lab instructor in advance in writing if you miss a lab due to religious reasons. All other absences will be considered unexcused and will result in a lab grade of zero. **You cannot make up a lab by attending a laboratory session that you are not registered for.**

Late Assignments Late assignments will be penalized for each day late (excluding weekends). If you wish to submit a late lab report you must do so only at your laboratory instructor's office.

Lab Instructors Each lab instructor will hold a weekly office hour where you can discuss lecture and laboratory material. Office locations and office hour schedule will be announced in lab.

Readings

Reading assignments are listed below. It is strongly recommended that you complete the readings before the material is discussed in lecture. In addition to aiding your understanding of the material, the personal response system questions, to be described below, will be based, in part, on the readings.

Homework

We are using an online system for homework supplied by the publisher of the Bloomfield textbook. Problems from the end of the chapters listed in the syllabus are assigned for homework. You will find the list of problems on the Wiley class website.

The Wiley class website address is http://edugen.wiley.com/edugen/class/cls22397/

You will need the passcode that came bundled with your book to access this website and complete the homework assignments. Due dates for each homework assignment will be found online.

There is also a Blackboard class website that we will use to send email and to post additional material where relevant.

Extra Credit: Personal Response System (PRS)

In order to promote interaction in lecture you will use your personal response system transmitter to respond to a series of questions each lecture. The results of each question are collected by a computer and displayed on a large screen for all to see. This will gauge your understanding of important topics. Also, you will receive 1/8 of a point for each question answered correctly. With 2 or 3 questions asked per lecture, and about 24 lectures where we use the system during the semester, this means that you can add a maximum of 8 or 9 points (depending on the number of questions asked over the course of the semester) to your grade for the course above that contributed by your lab grade, homework and examinations. Since this is extra credit, it cannot be made up for any reason, medical, personal or technical.

Lecture Date	*Readings*
T Sep 5	1.1 Skating – Inertia, force, velocity, acceleration, mass, Newton's First and Second Laws of Motion.

R Sep 7	1.2 Falling Balls – section entitled "Weight and Gravity"; 1.3 Ramps - net force, Newton's third law.
T Sep 12	1.3 Ramps - energy, work, energy conservation, potential energy, ramps, mechanical advantage.
R Sep 14	3.1 Spring Scales - equilibrium, stable equilibrium, Hooke's law, oscillation, calibration, center of gravity.
T Sep 19	9.1 Clocks - time and space, natural resonance, harmonic oscillators, simple harmonic motion, frequency.
R Sep 21	9.2 Musical Instruments - sound, music, vibrations in strings, air, and surfaces, higher-order modes, harmonic and nonharmonic overtones, sympathetic vibration.
T Sep 26	9.2 Musical Instruments - standing and traveling waves, transverse and longitudinal waves, velocity, frequency, and wavelength in mechanical waves, superposition, Doppler effect.
R Sep 28	10.1 Static Electricity - electric charge, electrostatic forces, Coulomb's law, electrostatic potential energy.
T Oct 3	10.1 Static Electricity - voltage, charging by contact, electric polarization, electrical conductors and insulators.
R Oct 5	10.3 Flashlights - electric circuits, electrical resistance, voltage rises, voltage drops.
T Oct 10	11.1 Household Magnets - magnetic pole, magnetostatic forces, Coulomb's law for magnetism, magnetic fields, ferromagnetism, magnetic polarization, magnetic domains, magnetic materials.
R Oct 12	11.1 Household Magnets - magnetic flux lines, relationship between currents and magnetic fields.
T Oct 17	11.2 Electric Power Distribution - superconductivity, direct and alternating currents, induction, transformers, magnetic field energy.
R Oct 19	**Exam 1**
T Oct 24	11.2 Electric Power Distribution - relationship between changing magnetic fields and electric fields, induced emf, Lenz's law, electrical safety.
R Oct 26	11.3 Electric Generators and Motors - electromagnetic forces, energy, and work, Lorenz force.
T Oct 31	12.1 Power Adapters - quantum physics, wave-particle duality, Pauli exclusion principle, band structure, Fermi level, metals, insulators.
R Nov 2	12.1 Power Adapters - semiconductors, p-n junction, diodes, capacitors.
T Nov 7	12.2 Audio Players - analog vs. digital representations, resistors, MOSFETs, logic elements, series and parallel circuits, amplifiers.
R Nov 9	13.1 Radio - electric field energy, relationship between changing electric fields and magnetic fields, tank circuits, speed of light, wave polarization, amplitude modulation, frequency modulation, bandwidth.
T Nov 14	14.2 Discharge Lamps - color vision, primary colors of light and pigment, gas discharges, periodic chart, atomic structure and emission, radiative transitions, Planck's constant, fluorescence, radiation trapping.
R Nov 16	14.3 Lasers and LEDs - incoherent and coherent light, spontaneous and stimulated emission, population inversion, laser amplification and oscillation, diffraction, laser safety.
T Nov 21	**Exam 2**
R Nov 23	*Thanksgiving*
T Nov 28	15.2 Optical Recording and Communication - diffraction limit, plane and circular polarization, total internal reflection.
R Nov. 30	16.1 Nuclear Weapons - nuclear structure, isotopes, radioactivity, uncertainty principle, tunneling, half-life.
T Dec 5	16.1 Nuclear Weapons - alpha decay, fission, chain reaction, fusion, transmutation of elements, fallout.
R Dec 7	16.2 Medical Imaging and Radiation - X rays, gamma rays, X-ray fluorescence, Bremsstrahlung, photoelectric effect.
T Dec 12	16.2 Medical Imaging and Radiation - Compton scattering, beta decay, anitimatter, accelerators, magnetic resonance.

Weekly Schedule of Laboratories

Week of	***Weekly Lab***
September 4	*No lab*
September 11	Math Review
September 18	Kinematics
September 25	Newton's Second Law
October 2	Simple Harmonic Motion
October 9	*No lab*
October 16	Exam 1 Review
October 23	Speed of Sound
October 30	Ohm's Law
November 6	Exam 2 Review
November 13	Capacitors
November 20	*Thanksgiving Holiday (No Lab)*
November 27	Diodes and LED's
December 4	Final Examination Review