PHY 170 GENERAL PHYSICS CHEMICAL ENGINEERS
SECOND SEMESTER 2013/2014

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RECOMMENDED TEXTBOOKS

1. FUNDAMENTALS OF PHYSICS – HALIDAY AND RESNICK
2. PHYSICS FOR SCIENTISTS AND ENGINEERS WITH MODERN PHYSICS (4 TH EDITION) – GIANCOLI
3. PHYSICS FOR SCIENTISTS AND ENGINEERS WITH MODERN PHYSICS EXTENDED VERSION) – TIPLER AND MOSCA
4. ANY GENERAL PHYSICS MATERIALS FROM THE WEB WOULD BE HELPFUL

Rules for the Class:

1. No one will be allowed to join the class 15 min. after commencement.
2. Attendant sheet will be taken each time after the class with students' signatures. Attending less than 50% lectures during the entire semester automatically disqualifies you from taking the exams, according to the University rules and regulations
3. Mobile calls are not allowed during the lectures except the Lecturer.
4. Make sure you understand at least 60% of lectures and the teaching assistance would top up for you with your questions

COURSE OUTLINE

CHE 170 GENERAL PHYSICS FOR CHEMICAL ENGINEERS (3, 0, 3)

Review and Measurement: Measuring things, The International System of Units, Basic Units and definitions, derived Units.

Waves: *General properties of oscillations and waves:* Electrical oscillations; the general wave equation; Planes and spherical solutions; Phase angles; Amplitude and intensity, frequency and wavelength. Doppler effect in light and sound; Doppler broadening and red shift. *Superposition of waves:* Linear systems and principle of superposition; Superposition of two wave trains of the same frequency; Formation of standing waves; Nodes and antinodes; Superposition of many waves of equal amplitude but slightly different frequency. Amplitude-modulated waves, beats, group and phase velocity; Dispersion of waves. *Acoustic waves:* Sound reception, production, recording (The ear, Loudspeaker, Telephone and Earpiece sound recording and reproduction); Sound track pitch, musical intervals, intensity and loudness. The decibel; Calculation of decibels, intensity levels; Threshold of hearing; Loudness quality. Acoustic transducers. Ultrasonic waves (production, properties and applications). *Electromagnetic waves:* Gamma and X-radiation, UV, visible IR. Production and detection of electromagnetic waves. *Matter waves:* Blackbody radiation. Dual nature of light; Wave-particle duality of matter.

Optics: *Diffraction of light:* The double slit; Derivation of the equation of intensity; Distinction between interference and diffraction; Maxima and minima; Missing orders. The diffraction grating; Formation of spectra by grating; Overlaping orders, Resolving power of the grating. *Polarization of light:* Polarization by reflection; Representation of the vibrations in light. Polarising angle and Brewsters law.

Nuclear physics: *Nuclear reaction:* Alpha decay; Barrier penetration. Beta decay. Gamma decay. *Application of nuclear physics:* Fission; Chain reaction; Nuclear fusion; Radioactive decay; Radioactive equilibrium; Natural radioactivity and radioactive dating. *Energy deposition in media:* Energy loss; Charged particles; Units of energy loss and range; Straggling, Multiple scattering and Statistical processes. Energy loss through bremsstrahlung. Interaction of ionizing radiation (α,

β, γ, n) with matter. *Particle detection:* Ionization detectors; Ionization counters; Proportional counters; Geiger-Müller counters; Scintillation detectors; Time of flight; Cherenkov detectors; Semiconductor detectors; Calorimeter; Layered detectors. *Accelerators:* Electrostatic accelerators (Cockcroft-Watson machines, Van de Graaf accelerators); Resonance accelerators (Cyclotron; Linear accelerator); Synchronous accelerator.

Atomic physics: *Quantum Theory:* Review of quantum theory of the hydrogen atom (results only); Meaning of the quantum numbers n, i, m; Heisenberg Uncertainty principle. Angular momentum and magnetic momentum of atomic electrons. Larmor precession; Zeeman effect. *Atomic spectra:* Nature of chemical bond; Molecular vibrational and rotational spectra; Raman effect.

Magnetic properties of matter: Dia-, Para-, Ferro-, and Ferrimagnetism.

Relativistic Mechanics: Galilean transformations; Lorenz transformations.

BACKGROUND OF THE COURSE

Physics is a quantitative science that uses experimentation and measurement to advance our understanding of the world around us. Many people are afraid of physics because it relies heavily on mathematics, but don't let this deter you. Most physics concepts are expressed equally well in plain English and in equations. In fact, mathematics is simply an alternative shorthand language that allows us to easily describe and predict the behavior of the natural world. Much of this course involves learning how to translate from English to equations and back again and to use those equations to develop new information.

This course lets you know a bit of Physics but master of no specialized area. Your imagination about our world and univers would be explored never before you have thought through imagination and experimentation. Your mind would be stretched to appreciate the progress of science and the weakness of mankind. Relax and enjoy the lectures.

MODE OF ASSESSMENT

The course would be assessed based on the following

1. Exercise and Home Work 15%
2. Mid semester examination 20%
3. Final Examination 60%
4. Class attendance 5% (If students attends lectures less 90% of total lectures, he does not get this score)

NB: Class attendance would be taken at every lecture. It is the Class Representative to furnish the Teaching Assistance this list with every student signature.

MEASUREMENT AND UNITS

Physics is based on measurement, in other wards the fundamental building blocks of Physics is measurement. Essentially, measurement assigns a numerical value to some aspect of an object. For example, if we want to compare the height of two people, we can have them stand side by side and we can easily see who is taller. What if the two people don't happened to be in the same place, but we still want to compare their heights? We can use some object, compare the height of the first person to that object, then compare the height of the second person to that object- this is measurement. This will only work, of course if we use the same object to measure both people, i.e., we need to standardize the measurement in some way.

We start by learning how to measure the physical quantities in terms of which the laws of physics are expressed. Among these quantities are *length, time, mass, temperature, pressure*, and *electrical resistance*. We use many of these words in everyday speech. You might say, for example, « I will go to any length to help you as long as you do not pressure me ».
In physics, words like *length* and *pressure* have precise meaning, which we must not confuse with their everyday meaning. In above example, the scientific meanings of length and pressure have nothing to do with their meanings in quoted sentence. As Robert Oppenheimer has written « Often the very fact that words of science are the same as those of our common life and tongue can be more misleading than enlightening »

We define a physical quantity, such as length, by setting up a *standard* and assigning a unit- the meter to it. We are free to define the standard in any way that we want. The important thing is to do so in such a way that scientist around the world will agree that our definition is both sensible and practical.

The International System of Units

In 1971, the 14th General Conference on Weights and Measures picked seven quantities as base units, forming the basis of the International Systems of Units, abbreviated S.I from its French name and popularly known simply as the *metric system*

The SI base unit, particularly those of length, mass, and time are all on a « human scale » If bacteria have a unit system, they no doubt use smaller base units.

SI base units used in Science

Quantity	Name	Symbol
Length	meter	m
Mass	kilogram	kg
Time	second	s
Amount of substance	mole	mol

Many SI derived units are defined in terms of these base units. For example, the SI unit for power, called the *watt* (abbr. W), is defined in terms of the base units for mass, length and time. Thus;

$$1 \text{ watt} = 1\text{W} = 1\text{kgm}^2/\text{s}^3$$

To express the very large and the very small numbers we often run into in physics, we use the so called scientific notation. For example :

$$3{,}560{,}000{,}000 \text{ m} = 3.56 \times 10^9 \text{ m}$$

and

$$0.000\ 000\ 492 = 4.92 \times 10^{-7} \text{ s.}$$

To distiguish large and small numbers, scientistist deveice notation as in the table below.

Power	Prefix	Abbreviation
10^{-18}	atto	a
10^{-15}	femto	f
10^{-12}	pico	p
10^{-9}	nano	n
10^{-6}	micro	µ
10^{-3}	milli	m
10^{-2}	centi	c
10^{1}	deka	da
10^{3}	kilo	k
10^{6}	mega	M
10^{9}	giga	G
10^{12}	tera	T
10^{15}	peta	P
10^{18}	exa	E
10^{21}		
10^{24}		

Complete the last two columns by yourself !

When scientist makes measurement, there is always some uncertainty. Consider a ruler. The result of a measurement : e.g. 8.8 ±0.1 cm. The percentage uncertainty is given by

$$\frac{0.1}{8.8} \times 100\% \approx 1\%$$

The smallest measureable unit of the measuring device is what is used to determine the uncertainty or the percentage uncertainty. We are often times talk about accuracy and precision.

Accuracy vs. Precision

- Precision - how well can I repeat a measurement with a given apparatus?
- Accuracy - how close is my measurement result to the actual value?
- Uncertainty includes both accuracy and precision

Fundamental unit for length is called the *meter* and is defined as the distance traveled by light in a vacuum during a time interval of 1/299 792 458 second. Fundamental unit of mass is called the *kilogram* and is defined as the mass of a specific platinum-iridium alloy cylinder kept at the International Bureau of Weights and Measures in France.
Fundamental unit of time is called the *second* and is defined as 9 192 631 700 times the period of oscillation of radiation from the cesium atom.

Lecture notes at the following link

http://lore.com/GENERAL-PHYSICS.1/library