PHY 170 GENERAL PHYSICS
SECOND SEMESTER 2012/2013

Lecturer
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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

Rules:

1. No one will be allowed into the class 15 min. after commencement.
2. Attendant sheet will be taken each time after the class with students signatures (attending less than 50% during the entire semester will not be allowed)
3. Mobile calls are not allowed during the lectures except the Lecturer.

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.

MEASUREMENT AND UNITS

Physics is based on measurement. 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 me aning, 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 assining 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 out 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 SI from its French nam 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 unsed in Mechanics

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;

$$1 \text{ watt} = 1\text{W} = 1\text{kg.m}^2/\text{s}^3$$

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

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