

PHYSICS 257L
ADVANCED PHYSICS LABORATORY
(0.6 ; 3 credits)

Textbook: Laboratory manual
Constructed by the Instructor

Contents:

One weekly 30-minutes lecture on instrumentation, noise and signal processing and two 3-hour lab sessions.

Six to eight experiments selected from the following list:

1. Transient and steady states of a simple harmonic oscillator

The forced vibrations of an electrically driven tuning fork are studied on an oscilloscope and a computer. The response of the oscillator to driving force is collected and analyzed by means of a computer.

2. Coupled oscillators and periodic structures

A study is made of the exchange of energy and normal modes of two coupled electric (LC) oscillators. The response to a pulse and a periodic driver is examined.

The propagation and reflection of energy, characteristic impedance, attenuation, dispersion and cut-off frequency of a transmission line is studied.

3. Bridge circuits

The transfer functions of the Wien bridge and Twin-T networks is studied. The effect of placing the Twin-T filter in the feed-back network of an amplifier is examined.

4. Determination of the speed of sound in a liquid, using the diffraction of light

The method of Debye and Sears for the measurement of the grating spacing in a liquid, caused by the ultrasonic vibrations of a quartz crystal, is used to deduce the speed of sound in heptane.

5. Prism spectrometer

Adjustment, autocollimation, measurement of the angles of a prism, refractive index measurements of a prism and of ethanol are performed on a prism spectrometer.

6. The Franck-Hertz experiment

Determination of the excitation potential of mercury is performed using a Franck-Hertz tube and a graphic recorder that plots the plate current vs the accelerating potential.

7. Planck's constant

Determination of h by the photoelectric effect. Data on the amplified photo current and retarding potential are acquired by a P.C. that plots I vs V for the lines of Mercury, which are separated by means of a prism.

8. Measurement of the Curie temperature of Monel metal

A monel metal bar is used as a core of a transformer. The monel bar is cooled by immersion in liquid air and the magnetization is measured as the temperature rises through the Curie point. The data are acquired by means of a PC.

9. Determination of the magnetic susceptibility of a solution of manganese chloride

The magnetic field of an electromagnet is calibrated using a gaussmeter. The change of level of the solution in a Quincke tube, placed between the poles of the magnet, is measured by means of a cathetometer to determine the susceptibility of a manganese chloride solution and hence that of the solute.

10. Measurement of the acceleration of gravity

Two photocells are used to measure the time-of-flight of a falling steel ball using a crystal oscillator and a counter. Statistical analysis of the data is used to investigate the precision and accuracy of the results.

11. Measurement of the velocity of light

The method of Foucault and Michelson which measures the time of flight of a light beam reflected from rotating mirror is used to obtain the speed of light in air.

12. Millikan's oil drop experiment

Measurement of the force on a charged oil drop is used to measure the charge of the electron.

13. Hall Effect

The Hall effect is investigated in p- and n-type Germanium as a function of temperature. Data on the Hall effect, crystal resistance and temperature are acquired by means of a PC and analyzed.

14. Optics

Quantitative study of single slit, double slit and edge diffraction patterns.

14. Nuclear Magnetic Resonance:

Calibration of a Gaussmeter using NMR of a water sample. The use of NMR to measure the gyromagnetic ratio of fluorine and deuterium. Study of the effect of a paramagnetic salt on proton relaxation in water.

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