BRIEF DESCRIPTIONS OF THE EXPERIMENTS

Modules PHY/230 and 230 Experimental Physics I and II

E17 JOHNSON NOISE

All systems maintained at a temperature above absolute zero show random motions arising from their thermal kinetic energy. The term **noise** is generally used to describe this form of random motion. The electrical version of this form of noise will be known to anybody who has listened to the background sound coming from the loudspeaker of a record player or Hi-Fi system - more obvious when no record is playing. This experiment investigates the electrical noise generated in a resistor. The dependence on bandwidth and temperature is measured and this allows a determination of Boltzmann's constant *k* to be made.

E20 HALL EFFECT in DOPED GeAs A FUNCTION OF MAGNETIC FIELD AND CURRENT (development experiment)

The Hall effect provides a sensitive method of measuring the density of conduction electrons or holes in a semiconductor. The current carriers are deflected by a magnetic field and produce a transverse voltage which is measured with a potentiometer. The experiment illustrates the interaction between electric and magnetic effects, which arises when charged particles are in motion.

G1 MEASUREMENT OF g USING KATER'S PENDULUM

The experiment begins with an investigation of the properties of a compound pendulum. The main part of the experiment involves the use of the compound pendulum proposed by Kater to make a high precision determination of g using electronic timing. The experiment demands patience and manual skill and the data analysis requires careful assessment of uncertainties to ensure that the apparatus has been used to the limit of its accuracy.

G2 ANGSTROM'S BAR

This experiment demonstrates the heat flow properties of a metal rod. A travelling wave of temperature oscillations is propagated up the rod by a device which alternatively heats and cools its lower end. This wave is recorded directly into an interfaced PC and a value the thermal diffusivity of the material of the rod can be obtained when the velocity and attenuation of the wave have been determined in the analysis.

G4 MEASUREMENT OF THE MAGNETIC SUSCEPTIBILITY OF A LIQUID USING QUINCKE'S METHOD.

The magnetic susceptibility of a paramagnetic liquid is measured from the magnetic force on the liquid contained in a U-tube, which is determined by a displacement method. The applied magnetic field is first calibrated as a function of the current in the electromagnet. The experiment is repeated for different concentrations or different species of the magnetic ions The results are interpreted in terms of the electronic configuration of metallic ions and the magnetic energy levels of the paramagnetic state.

G5 SPEED OF SOUND IN AIR AND GASES

The speed of sound is measured in air and in a series of unknown gases. The apparatus consists of a source and receiver in a transparent tube, which can be filled with the gases using a manifold system. The apparatus is only about one metre long so the timing involved is on the

millisecond scale. A digital storage oscilloscope is used to display the sound pulses which must be analysed so as to identify the unknown gases with reference to the accepted values of the speed of sound.

G9 THE LATENT HEAT OF VAPORISATION OF LIQUID NITROGEN.

This experiment in thermodynamics concerns a first order phase change described by the Clausius-Clapeyron equation. The reduction in temperature of a liquid (in this case liquid nitrogen), is investigated as the pressure over its surface is reduced. The accent of the experiment is on a skilful use of the vacuum equipment together with an assessment of whether equilibrium conditions have been achieved. The experiment demonstrates a phenomenon which is exploited in low temperature physics and which is used here to determine a value for the latent heat of vaporisation of liquid nitrogen.

G10 THE LINEAR AIR TRACK (working as two pairs)

The cars or sliders and their attached springs on the linear air track form a macroscopic version of the atoms in a 1-dimensional crystalline lattice. The experiment concerns the excitations in this lattice and the equipment is in fact, the mechanical analogue of the electrical circuit in experiment E7. A monatomic and a binary (sodium chloride) lattice can both be created and the dispersion relations (ω *versus* k) will be measured. The theory is presented in the same notation as in Hook & Hall.

L2 LIGHT SCATTERING

A beam of light passing through a medium in which small particles are suspended it is attenuated because some of the intensity of the beam is scattered away from the beam direction. This phenomena is studied in this experiment and the wavelength dependence of the scattering cross-section of the particles is deduced, by measurements with four different lasers. The results are compared with theoretical predictions of "Rayleigh" and geometrical scattering. The experiment is available in both the Physics and Astronomy courses.

L3 FRAUNHOFER DIFFRACTION

A laser is used as a coherent source and the Fraunhofer diffraction patterns of single and multiple slits are determined by driving a detector (which is interfaced to a PC) through the diffraction patterns. The experimental diffraction patterns should be compared with the calculated ones and the convolution of the patterns for the multiple slits investigated.

N1 γ-RAY SPECTROSCOPY

In this experiment a NaI detector which is interfaced to a PC is calibrated for the measurement of γ-ray energies. The spectra are measured from a range of γ-ray sources and must be interpreted in terms of the Photo Electric Effect, the Compton Effect and Pair Production. The aim is to be able to identify elements from the measured features in their γ-ray spectra.

N2 α-PARTICLE SPECTROSCOPY (experiment being upgraded)

In this experiment a silicon solid state detector which is interfaced to a PC is calibrated for the measurement of α-particle energies. The spectra are measured from a range of α-particle sources under vacuum conditions to avoid absorption of the α-particle beams. These spectra must be interpreted and the nature of the nuclear transitions identified.