CORK INSTITUTE OF TECHNOLOGY
INSTITIUID TEICNEOLAIOCHTA CHORCAI

Semester 2 Examinations 2007/08

Module Title: PHYSICS

Module Code: PHYS 6012

School: SCIENCE

Programme Title:
Bachelor of Science in applied Physics & Instrumentation – Year 1
Higher Certificate in Science in Industrial Measurement & Control – Year 1
Bachelor of Science Applied Biosciences - Year 1
Bachelor of Science Biomedical Science - Year 1

Programme Code: SPHYS_7_Y1
SIMCT_6_Y1
SBIOS_7_Y1
SBMSC_7_Y1

External Examiner(s): Dr N. McMillan
Internal Examiner(s): Mr S. Cotter
Ms C. Devaney
Dr A. O'Connor

Instructions: Answer any **four** questions. All questions carry equal marks.

Duration: 2 Hours

Sitting: Summer 2008

Requirements for this examination: Log tables.

1 (a) A car is travelling at 80 kph. The driver brakes, and the car decelerates at a constant rate, coming to rest in 12 seconds. Calculate (i) the deceleration (ii) the stopping distance. [10 marks]

(b) A man of mass 80 kg jumps at a speed of 5 m/s into a stationary boat of mass 300 kg. At what speed will the boat move off? What is their combined kinetic energy? [9 marks]

(c) What is meant by (i) potential energy (ii) coefficient of friction? [6 marks]

2 (a) Outline the conditions necessary to observe interference for light. Why must they be satisfied more exactly for light than for sound? Show that, for Young's slits of separation d, the condition for constructive interference is that

$$d \sin\theta = m\lambda \quad (m = 0, 1, 2, ...)$$ [13 marks]

(b) For a diffraction grating with 600 lines/mm, find the angular separation of the cadmium violet and red lines in *second* order. (Cd violet = 442 nm; Cd red = 644 nm.) [6 marks]

(c) Sketch the diffraction pattern from a single slit and a circular aperture. Explain the relevance of this for the resolution of an optical instrument. [6 marks]

3 (a) Discuss the factors affecting the stability of the nucleus. [13 marks]

(b) What is meant by the (i) *half-life* (ii) *activity* of a radioactive substance? Radium-226 (Ra^{226}) decays with a half-life of 1600 years. Calculate the activity in becquerels of 3.5 mg of it. What would be the activity after 3000 years? ($N_A = 6 \times 10^{23}$ mol^{-1}). [12 marks]

4 (a) Sketch the magnetic field surrounding a long straight conductor. What factors influence the magnetic flux density at a distance r from the conductor? State the relationship between magnetic flux and magnetic flux density and give the SI unit for each. [8 marks]

(b) Explain how a transformer works, referring to Faraday's law of induction in your answer. [7 marks]

(c) A step-up transformer has 25 turns on the primary coil and 750 turns on the secondary coil. If the transformer is to produce a (secondary) output voltage of 4800 V with a current of 12 mA, what input current and voltage are required? State what assumption you have made in your calculations. [10 marks]

5 (a) Obtain an expression for the pressure at a depth h in a fluid. [8 marks]

(b) A pipe of diameter 12 cm is required to deliver fluid of density 1400 $\mathrm{kg/m^3}$ at a volume flow-rate of 200 λ/s. What pressure must be supplied by a pump to achieve this? [8 marks]

(c) Give an account of surface tension and give two examples of its effects. [9 marks]

6 ***Answer part (a) and THREE other parts.***

(a) Explain the operation of a Geiger counter. [7 marks]

(b) A force of 1800 N uniformly accelerates a car of mass 1650 kg from rest for 6 seconds. What is the final speed reached? [6 marks]

(c) A satellite is orbiting at a height of 80 km above the surface of the earth. If it has a camera of aperture 50 mm, what is the smallest detail it can resolve on the earth's surface? (Take the wavelength of light to be 550 nm.) [6 marks]

(d) An emf of 6 V is induced in a circular coil when the magnetic flux density is increased from zero to 0.2 T in 1.5 s. If the coil has diameter 12 cm, how many turns are there in the coil? [6 marks]

(e) Write brief notes on (i) laminar and turbulent flow (ii) viscosity. [6 marks]