THE OPEN UNIVERSITY OF SRI LANKA

DEPARTMENT OF PHYSICS

B.SC. DEGREE PROGRAMME – 2014/2015

LEVEL 03

PHYSICS FOR BIOLOGY STUDENTS – PCU 1271/PSU 1244

FINAL EXAMINATION

Time allowed: Three hours (3 hrs.)

Date: 28th October 2015 **Time: 1.30 pm – 4.30 pm**

Answer SIX (06) questions only.

(1) (a) State Kepler' laws of planetary motion. Assuming that the planets revolve in approximately circular orbits around the Sun, deduce Kepler's third law from Newton's law of gravitation.

(b) Use the following data to calculate

(i) the mass of the Sun

(ii) the acceleration due to gravity at the surface of the Sun. Mean radius of the Earth's orbit = $1.5\times10^{11}\,m$
Period of revolution of the Earth around the Sun = 365 days .
Radius of the Sun = $7\times10^{8}\,m$
Gravitational constant $G = 6.67\times10^{-11}\,m^3s^2kg^{-1}$

(2) (a) State the Faraday's laws of electromagnetic induction and the Lenz law.

(b) Two long straight parallel wires are separated by a distance $2a$. If the wires are carrying equal currents in opposite direction, what is the flux density in the plane of the wire at a point?
(i) midway between them
(ii) at a distance "a" above the upper wire.
Find the force between two wires.

(c) A rectangular coil of dimension $0.3m\times0.4m$, consisting of 200 turns rotates about an axis parallel to its long side, making 3000 revolutions per minute in a magnetic field of 0.08 tesla. What are the instantaneous values of induced e.m.f. when the plane of the coil makes on angle.

(i) 0^o (ii) 50^o (iii) 90^o with the field direction.

(3). (a) Explain the difference between reactance and impedance.

(b) Derive an expression for the impedance of a LR circuit connected to an a.c. Power supply. Obtain an expression for the phase relationship between the current and voltage.

(c) A coil of negligible resistance and inductance 0.02 H is in series with a wire of zero inductance and resistance *12 Ω*. An e.m.f. of *130 V, 40 Hz* is applied across the above series circuit.

Calculate,
(i) the current in the circuit.
(ii) the potential difference across the resistor.
(iii) the potential difference across the inductor
(iv) the angle of lag. (Phase difference)

(4) (a) State Hooke's law.

(b) Draw a labeled graph of tensile stress against tensile strain for a metal wire upto the breaking point. Show on your graph the region in which Hooke's law is obeyed.

(c) A steel wire of length 4.7 *m* and cross-section $3.0\times10^{-5}m^2$ is stretched by the same amount as a copper wire of length 3.5 *m* and cross-section $4.0\times10^{-5}m^2$ under a given load. What is the ratio of Young's modulus of steel to that of copper?

(5) (a) State Bernoulli's theorem. State the conditions under which it may be applied.

(b) What is meant by streamline and turbulent flow?.

(c) Water is flowing through a tube having one end at the ground floor and the other end at the first floor which is at a height of 5 *m*. The diameter of the end at the ground floor is 4 mm and that of the end at the first floor is 2 mm. Find the velocity and the pressure at the first floor if the corresponding values at the ground floor are $1.0ms^{-1}$ and $2\times10^5Nm^{-2}$ respectively.

(6) (a) Write the characteristics of simple harmonic motion.

(b) Drive an expression for the period of oscillation of a simple pendulum.

(c) A 50 g mass vibrates in simple harmonic motion at the end of a light spring. The amplitude of the motion is 12 cm and the period is 1.7 seconds. Find

(i) the frequency
(ii) the spring constant
(iii) the maximum speed of the mass
(iv) the maximum acceleration of the mass
(v) the speed when the displacement x is 6 cm.
(vi) the acceleration when x = 6 cm

(7) (a) Describe an experimental method to find the focal length of concave mirrors.

(b) A small object is placed at right angles to the axis of a concave mirror so as to form:

(i) a real image
(ii) a virtual image, twice as long as the object.

If the radius of curvature of the mirror is R what is the distance between the two images?

(c) A pole 4 m long is laid along the principal axis of a convex mirror of focal length 1 m. The end of the pole nearer the mirror is 2 m from it. Find the length of the image of the pole.

(8) (a) Distinguish between adiabatic and isothermal changes.

(b) A quantity of $O_2(\gamma = 1.4)$ is compressed to occupy a volume of 3 liters at 10 atmospheric pressure and 27°C. If it is allowed to expand adiabatically to one atmosphere pressure find the new volume and temperature.

(c) Calculate the root mean square velocities of the gases given below.

(i) H_2 gas at 0°C
(ii) H_2 gas at 50°C
(iii) O_2 gas at 0°C

Molecular weight of $H_2 = 0.002$kg
Molecular weight of $O_2 = 0.032$kg

The gas constant $R = 8.31$ J mole^{-1}K^{-1}