

05 March 2015 (Afternoon)

**ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)**  
**ORGANISATION OF ISLAMIC COOPERATION (OIC)**  
**Department of Computer Science and Engineering (CSE)**

**SEMESTER EXAMINATION**  
**DURATION: 1 Hour 30 Minutes**

**WINTER SEMESTER, 2014-2015**  
**FULL MARKS: 75**

**PHY4105: PHYSICS**

Programmable calculators are not allowed. Do not write anything on the question paper.  
 There are **4 (four)** questions. Answer any **3 (three)** of them.  
 Figures in the right margin indicate marks.

Discuss charge and matter in electrostatics. State and explain *Coulomb's law*. Describe Millikan's Oil drop experiment to measure the value of the elementary charge  $e$ . 10

What do you mean by the term "charge is conserved"? Show how the radioactive Uranium ( $U^{238}$ ) and Calcium ( $Ca^{44}$ ) disintegrates into different elements and particles? Is charge conservation law obeyed in this process? 5

The radius of copper nucleus is about  $5.1 \times 10^{-13}$  cm. Calculate the density of the material that makes up the nucleus (atomic weight of copper = 64 gm/mole. Ignore the mass of the electrons in comparison to the nucleus) 10

State and explain Gauss's law in electrostatics. Write down Gauss's law for gravity, magnetism and an incompressible fluid. 10

Apply Gauss's law to calculate the electric field (i) at a distance  $r$  in front of a sheet of charge of surface charge density  $\sigma$  and (ii) for points a short distance above the surface of a charged conductor of surface charge density  $\sigma$ . 5

What is an electric dipole? Define dipole moment  $P$ . Show that the electric field due to a dipole at a distance  $r$  along its perpendicular bisector is given by  $E = \frac{1}{4\pi\epsilon_0} \frac{P}{r^3}$  where the symbols have their usual meaning. 10

Discuss Galilean Transformation and Lorentz Transformation. Show that the Lorentz transformation reduces to Galilean transformation for an object moving at an speed  $v \ll c$ . 10

Describe Michelson-Morley experiment. How did Michelson and Morley convincingly proved that the speed of light in free space has the constant value  $c = 3.0 \times 10^8$  m/s, and that there is no preferred universal frame of reference? 10

A certain radio-active particle has a lifetime of  $1.0 \times 10^{-7}$  sec. when measured at rest. How far does it go before decaying if its speed is  $0.99c$  when it is created? 5

Discuss Einstein's Photo-electric effect. Draw a neat circuit diagram to elaborate the mechanism of photo- electrons being created in this experiment. Write down the relevant equations relating energy of photon and the kinetic energy of the ejected electron. 10

Ultra-violet light of wavelength 350 nm ( $1 \text{ nm} = 10^{-9} \text{ m}$ ) and intensity  $1.00 \text{ W/m}^2$  is directed at a potassium surface. (i) Find the maximum kinetic energy of the photo-electrons (ii) If 0.50 percent of the incident photons produce photo-electrons, how many are emitted per second if the potassium surface has an area of  $1.00 \text{ cm}^2$ ? 10

Draw the curves for (i) Photo-electron current and Retarding potential when the frequency remains constant (ii) Photo-electron current and Retarding potential when light intensity remains constant (iii) Maximum Photo- electron Energy (eV) and Frequency (Hz) for Cesium, Sodium and Calcium. 5