

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

**MID SEMESTER EXAMINATION**  
**TIME: 1 Hour 30 Minutes**

**WINTER SEMESTER, 2017-2018**

**FULL MARKS: 75**

**PHY 4141: Physics I**

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.

- a) Discuss charge and matter in electrostatics. With the help of a suitable example show that electric charge is quantized. 7
- b) Distinguish electric flux and magnetic flux. Derive Coulombs law from Gauss's law. 10
- c) Protons in the cosmic rays strike the earth's upper atmosphere at a rate, averaged over the earth's surface, of  $0.15 \text{ protons/cm}^2\text{-sec}$ . What total current does the earth receive from beyond its atmosphere in the form of incident cosmic ray protons? (Earth's radius =  $6.4 \times 10^6$  meters). 8
- a) What is an electric dipole? Draw the electric field lines and the equipotential lines for an electric dipole. 7
- b) An infinite long line charge has a linear charge density  $\lambda \text{ coul/m}$ . Show that the electric field  $E$  at distance  $y$  from the line charge is given by  $E = \frac{\lambda}{2\pi\epsilon_0 y}$ , where the symbols have their usual meaning. (Do not use Gauss's law). Write down the corresponding equation for the magnetic field  $B$  produced due to a current  $i$  flowing through a wire. 10
- c) An electric dipole consists of two opposite charges of magnitude  $q = 1.0 \times 10^{-6} \text{ coul}$ . separated by  $d = 2.0 \text{ cm}$ . The dipole is placed in an external field of  $1.0 \times 10^5 \text{ nt/coul}$ . (i) Calculate the maximum torque exerted by the field on the dipole (ii) How much work must an external agent do to turn the dipole end for end from a position  $\theta = 180^\circ$  to  $\theta = 0^\circ$ ? 8
- a) Discuss Gauss's law and Coulomb's law in electrostatics. Show with an example that an excess charge put on a metallic conductor will move onto the outer surface of the conductor. 7
- b) Describe with a clear circuit diagram the phenomenon of Einstein's Photo-electric effect. Discuss photocurrent, stopping potential, threshold frequency, and the work function. 10
- c) A laser gun produces a beam of light  $2.0 \text{ mm}$  in diameter. The wavelength of the light is  $532 \text{ nm}$  ( $1 \text{ nm} = 10^{-9} \text{ meter}$ ) and the output power is  $20 \text{ mW}$  ( $1 \text{ mW} = 10^{-3} \text{ Watt}$ ). Calculate the number of photons emitted by the gun in one second. 8
- a) Write down the postulates of Special theory of relativity. What are inertial and non-inertial frames of reference? 7
- b) Derive Lorentz Transformation equations. Also write down the inverse transformation equations. 10
- c) Give a geometrical description of Michelson-Morley's experiment. Discuss how the fringe shift in this experiment is related to the existence of Ether pervading the Universe? 8