

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

MID SEMESTER EXAMINATION

WINTER SEMESTER, 2017-2018

TIME: 1 Hour 30 Minutes

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.

1. 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 protons/cm²-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 x 10⁶ meters). 8
2. 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 λ 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 $q = 1.0 \times 10^{-6}$ coul. separated by $d = 2.0$ cm. The dipole is placed in an external field of 1.0×10^5 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
3. 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 mm in diameter. The wavelength of the light is 532 nm (1 nm = 10⁻⁹ meter) and the output power is 20 mW (1 mW = 10⁻³ Watt). Calculate the number of photons emitted by the gun in one second. 8
4. 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