

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

SEMESTER FINAL EXAMINATION

WINTER SEMESTER, 2016-2017

DURATION: 3 Hours

FULL MARKS: 150

Phy 4141: Physics

Programmable calculators are not allowed. Do not write anything on the question paper.

There are **8 (eight)** questions. Answer any **6 (six)** of them.

Figures in the right margin indicate marks.

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| ✓ 1. | a) State Gauss's law in electrostatics. Define electric flux and flux density. Write down Gauss's law for magnetism, for gravitation, and for an incompressible fluid. | 7 |
| | b) A cylindrical surface is immersed in a uniform electric field E parallel to the cylinder's axis. Show that the total flux through the cylinder is zero. | 10 |
| | c) The distance r between the electron and proton in hydrogen atom is about 5.3×10^{-11} meter. Calculate the magnitude of electrical force and the gravitational force between these two particles. ($G = 6.7 \times 10^{-11} \text{ nt-m}^2/\text{kg}^2$, $\epsilon_0 = 8.85 \times 10^{-12} \text{ coul}^2/\text{nt-m}^2$) | 8 |
| ✓ 2. | a) Define electric field E . Obtain an expression for the electric field E at a distance y from an infinitely long line charge of linear charge density λ . | 7 |
| | b) What is an electric dipole and the dipole moment? Find the electric field E due to a dipole at a distance r along the perpendicular bisector of the dipole. Plot E for a point charge and the dipole moment p as a function of r . | 10 |
| | c) Calculate the magnitude of the electric field strength E such that an electron placed in the field, would experience an electric force equal to its weight? | 8 |
| ✓ 3. | a) Discuss Ohm's law. Define resistivity and current density. Write down Ohm's law in its microscopic form. What do you mean by temperature coefficient of resistivity? | 7 |
| | b) In a metallic conductor the electrons drift opposite to the applied external electric field E . Show that the drift velocity of the electrons in the conductor is given by $v_d = j/ne$, where the symbols have their usual meaning. | 10 |
| | c) An aluminum wire of diameter 10 mm is welded end to end to a copper wire of diameter 5 mm. The composite wire carries a steady current of 10 amp. What is the current density in each wire? What happens at the junction as the current flows through the composite wire? | 8 |
| ✓ 4. | a) Define capacitance of a capacitor. What are dielectric materials? Write down Gauss's law when a dielectric material is inserted between the plates of a capacitor. | 7 |
| | b) What are free charge and induced charge? Derive an expression to show that the induced surface charge is always less in magnitude than the free charge. | 10 |
| | c) A parallel plate capacitor has plates with area A and separation d . A battery charges the plates to a potential difference V_0 . The battery is then disconnected, and a dielectric slab of thickness d is introduced between the plates. Calculate the stored energy both before and after the slab is introduced and account for any difference. | 8 |

- ✓ 5. a) Classify different types of magnetic materials. Draw the magnetic field versus magnetization curves for a diamagnet, a paramagnet, and a ferromagnet. 7
- b) Discuss the effect of magnetic field on an electron moving through the magnetic field with a velocity v . What is Hall effect? Discuss how this effect is applied to determine the nature of charge carriers in a semiconductor? 10
- c) Write short notes on the followings: 8
- Magnetic domain
 - Saturation and Remanent magnetization
 - Soft and hard magnetic materials
 - Internal molecular field in a magnetic material
6. a) Write down the Lorentz transformation equations and also their inverse forms. Discuss why a moving clock ticks slower than the one at rest? 7
- b) Discuss Einstein's theory of general relativity relating light and the gravity. What is gravitational lensing? How was this effect detected for a Quasar? 10
- c) Write short notes on the followings: 8
- Gravitational Red shift
 - Precession of the perihelion of Mercury's orbit around the sun
 - Quasar
 - Graviton
7. a) Define polarization of light. Discuss with the help of a diagram the mechanism of polarization of light using polarizing sheets. 7
- b) Discuss polarization by double refraction. Describe how a beam of unpolarized light falling on a calcite crystal is split into two beams which are polarized at right angles to each other? What are o-ray and e-ray? 10
- c) Two polarizing sheets have their polarizing directions parallel so that the intensity I_m of the transmitted light is a maximum. Through what angle must either sheet be turned if the intensity is to drop by one-half? 8
- ✓ 8. a) Discuss the phenomena of interference of light. Write down the conditions for constructive and destructive interference. 7
- b) Describe Newton's ring experiment. Discuss how are the rings formed? What are the conditions for intensity minimum and maximum? 10
- c) To reduce reflection using the mechanism of interference, a lens is coated with a thin film of transparent substance like magnesium fluoride (MgF_2 , refractive index $n = 1.38$). How thick a coating is needed to produce a minimum reflection at the center of the visible spectrum? ($\lambda = 5500 \text{ \AA}$) 8