

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination
Course Number: PHY 4121
Course Title: Engineering Physics I

Winter Semester: A.Y. 2022 - 2023
Full Marks: 150
Time: 3 hours

Please answer according to the order of the questions. There are 6 (six) questions. Answer all 6 (six) questions. The symbols have their usual meanings. Programmable calculators are not allowed. Marks of each question and corresponding CO and PO are written in the brackets at right side.

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1. a) Define drift velocity. Explain why the current/electricity is so fast despite the drift velocity is very slow. (5)
(CO1)
(PO1)
 - b) Find out the expression of drift velocity of free electrons when the current flows through a conducting wire of cross-sectional area A hence show that the current density in the wire can be expressed by Ohm's law, i.e. $J = \frac{ne^2\tau}{m}E$, where the symbols have their usual meanings. (10+5)
(CO2)
(PO2)
 - c) A wire connected in a circuit has a current of I A through it. If the diameter of the wire is just doubled (without changing the material of the wire), determine the factor by which the drift speed of electrons will be changed? (05)
(CO3)
(PO2)
 2. a) Define magnetic domain and write the characteristics difference between the different types of magnetic materials. (05)
(CO1)
(PO1)
 - b) State and explain Curie-Weiss law for magnetism and show the magnetic susceptibility curves for both ferro- and anti-ferromagnetic materials at above and below the critical temperature. (15)
(CO2)
(PO2)
 - c) Explain what is hysteresis for magnetization? Explain way of calculating the work done per cycle of magnetization using the hysteresis loop. (05)
(CO3)
(PO2)
 3. a) Define interference and write the conditions necessary for the interference of light. (5)
(CO1)
(PO1)
 - b) Describe Young's double slit interference experiment and find the expressions for the bright and dark fringes to occur. (15)
(CO2)
(PO2)
 - c) Green light of wavelength 5100 \AA from a narrow slit is incident on a double slit. If the overall separation of 10 bright fringes on a screen 200 cm away is 2 cm, find the slit separation. (05)
(CO3)
(PO2)
 4. a) Write the difference between interference and diffraction of light. (5)
(CO1)
(PO1)
 - b) Show that the intensity distribution of light due to a single slit diffraction is given by, $I \approx A^2 = A_0^2 \frac{(\sin\beta)^2}{\beta^2}$, hence find and plot the intensities of secondary maxima with respect to the principal maximum. The symbols in the equation have their usual meaning. (15)
(CO2)
(PO2)
 - c) In an experiment with single slit diffraction of 532 nm light the angular width of the central maxima is observed to be $\pi/3$. Calculate the width of the slit. (05)
(CO3)
(PO2)

5. a) State and explain the Brewster's law for polarization by reflection. (5)
(CO1)
(PO1)
- b) Show that if an unpolarized light of intensity I_0 is incident on a polarizer, the intensity of light transmitted through the polarizer will be $\frac{1}{2} I_0$. Discuss it in terms of Malus's law. (15)
(CO2)
(PO2)
- c) The critical angle of incidence for total reflection in case of water is 48° . What is its polarization angle? Calculate the angle of refraction corresponding to the polarization angle. (05)
(CO3)
(PO2)
6. a) State and explain the quantum theory of light. (5)
(CO1)
(PO1)
- b) Describe the photoelectric effect phenomenon and derive the expression of Einstein's photoelectric equation. Explain why metals are important to observe the photoelectric effect? (15)
(CO2)
(PO2)
- c) The work function of Calcium is 2.7 eV . When an EM radiation of frequency $8 \times 10^{14} \text{ Hz}$ is applied to Calcium, determine the kinetic energy of the photoelectrons leaving the Calcium? (05)
(CO3)
(PO2)