

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF NATURAL SCIENCES

Semester Final Examination

Course Number: Phy 4121

Course Title: Engineering Physics I

Winter Semester: 2023 - 2024

Full Marks: 120

Time: 2 Hours

Please answer according to the order of the questions. There are 4 (Four) questions. Answer all 4 (Four) 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.

1. a) Describe the working principle of a full-wave bridge rectifier and how it converts AC into DC. (6)
(CO1)
(PO1)
 - b) Find an expression for the contact potential (built-in potential) of a p-n junction under equilibrium conditions, (18)
(CO2)
(PO2)
- $$V_i = \frac{e}{2\epsilon} w_0^2 \left(\frac{N_A N_D}{N_A + N_D} \right)$$
- where symbols have their usual meanings.
- c) A silicon diode ($n=1$) has a reverse saturation current $I_s=2$ mA and is forward-biased at $V_D=0.6$ V. Calculate the diode current at $T=300$ K. (06)
(CO3)
(PO3)
2. a) State the differences between soft and hard magnetic materials based on their properties and characteristics. Also, provide examples of their applications in various fields. (06)
(CO1)
(PO1)
 - b) Formulate Langevin's equation for the magnetic susceptibility of core electrons in diamagnetic materials. (18)
(CO2)
(PO2)
 - c) Using electron configuration, illustrate why magnesium is diamagnetic while phosphorus is paramagnetic. (06)
(CO3)
(PO2)
3. a) Define polarization of light. State and describe the Brewster's law for polarization of light by reflection. (6)
(CO1)
(PO1)
 - b) Demonstrate that if an unpolarized light of intensity I_0 is incident on a polarizer, the intensity of light transmitted through the polarizer will be $(1/2)I_0$. Discuss it in terms of Malus's law. (18)
(CO2)
(PO2)
 - c) The critical angle of incidence for total reflection in case of water is 48° . Calculate the polarization angle. Calculate the angle of refraction corresponding to the polarization angle. (06)
(CO3)
(PO2)
4. a) State and describe the quantum theory of light. (6)
(CO1)
(PO1)
 - b) Explain the photoelectric effect phenomenon and derive the expression of Einstein's photoelectric equation. Why metals are important to observe the photoelectric effect? (18)
(CO2)
(PO2)
 - c) Ultraviolet light of wavelength 350 nm and intensity 1.00 W/m² is directed at a potassium surface. (a) Calculate the maximum KE of the photoelectrons. (b) If 0.50 percent of the incident photons produce photoelectrons, how many are emitted per second if the potassium surface has an area of 1.00 cm²? (The work function of potassium is 2.2 eV) (06)
(CO3)
(PO3)