Roll no								

NATIONAL INSTITUTE OF TECHNOLOGY GOA

Farmagudi, Ponda, Goa 403 401

Programme Name: B.Tech

Mid Semester Examination, February-2021

Course Name: Physics | **Course Code: PH100**
Date: 07.02.2021 | **Time: 9.30 AM**
Duration: 1 Hour 30 Minutes | **Max. Marks: 50**

ANSWER ALL QUESTIONS

1. Monochromatic light of frequency 6.0×10^{14} Hz is produced by a laser. The power emitted is 2.0×10^{-3} W (a)What is the energy of a photon in the light beam? (b) How many photons per second, on an average, are emitted by the source? (4M)
2. A light source of wavelength λ illuminates a metal and ejects photoelectrons with a maximum kinetic energy of 1.00 eV. A second light source with half the wavelength of the first ejects photoelectrons with a maximum kinetic energy of 4.00 eV. Determine the work function of the metal. (4M)
3. Discuss the failures of classical mechanics and how does quantum mechanics overcame these failures. (5M)
4. State and explain the Heisenberg's uncertainty principle and use it to (8M)
   (a) prove the existence of Protons, neutrons and alpha particles inside the nucleus
   (b) Find the minimum energy of a Harmonic Oscillator
   (c) Determine the size of a hydrogen atom.
5. Can a wave given by an equation $Y = A\sin(wt - kx)$ represent a particle? Explain the concept of a wave packet. How does this concept lead to Heisenberg's uncertainty principle? (4M)
6. In a Compton collision with an electron, a photon of violet light (λ = 400 nm) is backward scattered through an angle 180° . (5M)
   (a) How much energy is transferred to the electron in this collision?
   (b) Compare the result with the energy the electron would acquire in a photoelectric process with the same photon.
   (c)Could violet light eject electrons from a metal by Compton collision? Explain.
7. (a) Show that at low temperatures the Planks formula for radiated energy $E_\lambda d\lambda = \frac{8\pi hc}{\lambda^5} \times \frac{1}{e^{hc/\lambda kT} - 1} d\lambda$ reduces to the Wein's law i.e. $E_\lambda d\lambda = \frac{8\pi hc}{\lambda^5} \times e^{-hc/\lambda kT} d\lambda$
   (b) Show that at large temperatures the Planks formula for radiated energy $E_\lambda d\lambda = \frac{8\pi hc}{\lambda^5} \times \frac{1}{e^{hc/\lambda kT} - 1} d\lambda$ reduces to the Rayleigh-Jeans approximation i.e. $E_\lambda d\lambda = \frac{8\pi kT}{\lambda^4} d\lambda$ (5M)
8. Describe an experiment which proves the validity of de-Broglie hypothesis regarding wave nature of matter. (5 M)
9. How could Davison and Germer be sure that the peak obtained for 54 volts electron was a first order diffraction peak? (6 M)
10. Calculate the uncertainty in position of electron if uncertainty in its velocity is (i) 0.001% and (ii) Zero, velocity of electron is 300m/s. (4 M)

******All the best ******