Bachelor of Engineering Examination-2018

Department of Food Technology and Bio-Chemical Engineering

(1st year, 2nd semester)

Physics - II

*Answer any **five** questions.*

Time: **Three Hours** Full Marks: **100**

1. (a) Find the de Broglie wavelength associated with (i) a 40 gm golf ball with velocity 40 m/s. (ii) an electron with a velocity 0.2c (c is the velocity of light in vacuum). Which of these two show wave character and why?
(b) State Heisenberg's uncertainty principle. Suppose that the uncertainty in the position of a particle is equal to its de Broglie wavelength. Find the uncertainty in its velocity.
(c) The lifetime of an excited state of an atom is about 10^{-8} sec. Calculate the minimum uncertainty in the determination of the energy of the excited state.
(Plank constant h= $6.63X10^{-34}$ J.s, mass of electron = $9.1X10^{-31}$ kg) [10+7+3]

2. (a) Write down the postulates of quantum mechanics.
(b) Define eigen value and eigen function. Given an operator $\hat{\alpha} = -\frac{d^2}{dx^2}$ and two functions $f_1 = Sin\, x, f_2 = Sin\, 2x \;\; (0 < x < 2\pi)$. Show that f_1 and f_2 are eigen functions of the given operator. Find their eigen values.
(c) Deduce time independent Schrödinger's equation from time dependent Schrödinger's equation. [6+6+8]

3. (a) Consider a particle is trapped in an infinite square well given by,

$V(x) = 0$ for $0 \leq x \leq a$
$= \infty$ otherwise

Find the normalized wave function and energy eigen values. Draw the wave functions for state n=3.
(b) Calculate the expectation value of position and momentum of the above particle.
[12+8]

4. (a) Give an idea, in detail, of macrostates and microstates.
   (b) Explain the Boltzmann's distribution function with a graphical representation.
   (c) What is entropy? Write its mathematical expression. Explain equipartition theorem.

   6+6+(1+1+6)

5. (a) Explain Ampere's law and write down the region where it is applicable.
   (b) What is the correctional part of Maxwell and how did it opened a new horizon of physics?
   (c) A parallel-plate capacitor with plate area of $5cm^2$ and plate separation of 3mm has a voltage $50\sin 10^3 tV$ applied to its plates. Calculate the displacement current assuming $\varepsilon = 2\varepsilon_0$.

   (2+4)+(2+6)+6

6. (a) What will be the resultant impedance of an alternating current (A.C.) circuit containing Inductor and capacitor.
   (b) Find out the condition for the series resonant circuit.
   (c) An electric lamp marked 100V DC consumes a current of 100A. It is connected to a 200V 50cycles per sec AC mains. Calculate the impedance of the required choke.

   8+8+4

7. (a) Find out the saturation current in a DC circuit containing resistance and inductor, in series.
   (b) Show graphically the variation of current with time in above circuit.
   (c) A condenser of capacity 1μF is connected with an inductance of 10mH. Calculate the natural frequency of the circuit.

   10+5+5

8. Short notes (Any Two) 10+10
   (a) Particle trapped in a finite potential well
   (b) Time dependent Schrődinger's equation
   (c) Poynting vector.
   (d) Faraday's law of electromagnetic induction.