# B. E. FOOD TECHNOLOGY AND BIO-CHEMICAL ENGINEERING
## SUPPLEMENTARY EXAM-2019

(1st year, 2nd semester)

Physics - II

Answer any *five* questions.

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

1. (a) What do you understand by matter wave? What was de-Broglie's hypothesis regarding matter waves?

(b) A proton has a speed of $2.3 \times 10^4$ m/s. Determine its de-Broglie wavelength.
(Plank constant h= $6.63 \times 10^{-34}$ J.s, mass of proton = $1.67 \times 10^{-27}$ kg)

(c) State and explain Heisenberg's uncertainty principle. Diameter of hydrogen atom is $10.6 \times 10^{-11}$ m .Use the uncertainty principle to estimate the uncertainty in momentum of an electron in hydrogen atom.

[8+4+8]

2. Consider a particle trapped in a box where potential is given by,

$\quad$ V(x) = 0 $\qquad\qquad$ for $0 \le x \le L$

$\qquad$ = infinite $\qquad$ otherwise

(a) $\quad$ Find the wave function and energy eigen values.

(b) $\quad$ Normalise the wave function.

(c) $\quad$ Draw the wave function for the ground and first excited states.

[(7+7)+2+4]

3(a) Define and explain the terms: microstates, macrostate and thermodynamic probability.

(b) Discuss the concept of phase space.

(c ) Write down the formula for Boltzmann's entropy and explain each term.

(d) What do you mean by equipartition of energy?

[9+3+5+3]

4.(a) Find the expressions for the growth and the decay of charge on a capacitor connected in series with a resistor. Plot the variation of capacitor charge with time during charging and discharging.

(b) What do you mean by the time constant of the circuit?

(c) What is the steady state voltage across the capacitor at the time of charging?

[(12+3)+3+2]

[ Turn over

5. (a) A voltage $V_0 Sin\omega t$ is applied to a series LCR circuit. Derive an expression for the instantaneous current in the circuit.

(b) What is series resonance in AC? What are the resonant frequency, bandwith and Q factor of this circuit? [12+8]

6. (a) What is Ampere's circuital law?

(b) Show how this law can be applied to find the magnetic field due to an indefinitely long straight conductor carrying a steady current. Plot the variation of magnetic field with distance from the conductor.

(d) A long straight wire of radius $R$ carrying a current $I$ of uniform current density. Find the magnetic field inside the conductor.

[4+(9+3)+4]

7. (a) Write down and explain four Maxwell's equations in electromagnetism.

(b) Derive the electromagnetic wave equations from Maxwell's equation in free space.

[10+10]

8. Short notes (Any Two) [10+10]

   (a) Laws of electromagnetic induction

   (b) Postulates of quantum mechanics

   (c) Growth and decay of current in LR circuit

   (d) Boltzmann's distribution