Name: **Enrolment No:**	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2019

Programme Name: B.Sc. (H) Chemistry & B.Sc. (H) Maths **Semester : III**
Course Name : Elements of Modern Physics **Time : 03 hrs**
Course Code : PHYS 2009 **Max. Marks : 100**
Nos. of page(s) : 02

Instructions: Your answer should be concise and to the point.

SECTION A (All questions are compulsory)

Q1	Define zero point energy for a particle in a rigid box and discuss its dependence on mass of the particle and size of the box.	**[5]**	**CO3**
Q2	Calculate the uncertainty in the velocity of an electron which is confined in a 10Å box.	**[5]**	**CO2**
Q3	An electron collides with a Hydrogen atom and excites it to a state of n = 3. How much energy was given to the Hydrogen atom in this inelastic collision?	**[5]**	**CO1**
Q4	Calculate the energy of the neutron whose de Broglie wavelength is 1Å. (mass of neutron = 1.674×10^{-27} Kg)	**[5]**	**CO1**

SECTION B (Question 8 has internal choice.)

Q5	Describe the Davisson & Germer experiment to demonstrate the wave nature of particles.	**[10]**	**CO1**
Q6	Write a note on the arguments that lead to the failure of the proton-electron model.	**[10]**	**CO4**
Q7	Sketch the N-Z graph and discuss the conclusions that can be drawn from it.	**[10]**	**CO4**
Q8	Normalize the wave-function $\varphi(x) = e^{-\lvert x \rvert} sin\alpha x$ **OR** Find the expectation value $\langle x \rangle$ of the position of a particle trapped in a one-dimensional box of width L.	**[10]**	**CO2**

SECTION-C (Question 10 has internal choices.)

Q9	(a) A piece of an ancient wooden boat shows an activity of ^{14}C of 3.9 disintegrations per minute per gm of Carbon. Estimate the age of the boat if the half-life of ^{14}C is 5568 years. Assume that the activity of fresh ^{14}C is 15.6 dpm. gm.	**[10]**	**CO4**
	(b) List out the difficulties with β–decay that led to the assumption of neutrino. Also discuss the Pauli's neutrino hypothesis.	**[10]**	**CO4**

Q10	A beam of particles with energy E is incident on a potential barrier with potential function $\left.\begin{matrix} V(x) = 0 & for\ x < 0 \\ V(x) = V_o & for\ 0 < x < a \\ V(x) = 0 & for\ x > a \end{matrix}\right\}$ Where the symbols have their usual meaning. Show that there is a finite probability of transmission even if $E < V_o$. **OR** A beam of electrons impinges on an energy step barrier of height 0.035eV. Calculate the fraction of electrons reflected and transmitted at the barrier when the energy of the electron is (i) 0.045eV (ii) 0.020eV	**[20]** **[20]**	**CO3** **CO3**

Values of some physical constants:

Planck's constant, h = 6.6 x 10^{-34} J.s
Boltzmann's constant, k = 1.38 x 10^{-23} J/K
Mass of electron, m_e = 9.1 x 10^{-31} Kg
Mass of proton, m_p = 1.67 x 10^{-27} Kg
Velocity of light, c = 3 x 10^8 m/s
Rydberg Constant, R = 1.097 x 10^7 m^{-1}
Avogadro's number = 6.023 x 10^{23}