Name of the Department	:	Physics
Name of Course	:	B.Sc. Prog. _CBCS_DSE
Semester	:	V- Semester
Name of the Paper	:	Elements of Modern Physics
Unique Paper Code	:	42227929
Question Paper Set Number	:	Set-B

Duration: 3 Hours Maximum Marks: 75

All questions carry equal marks. Attempt any four of the following questions.

Q1(a) What are the outcomes of Davisson and Germer experiment? How do these results directly confirm the De Broglie Hypothesis of matter waves? Show that particle velocity is equal to group velocity of a wave packet.
(b)Calculate the wavelength of thermal neutron 27°C assuming energy of a particle at absolute temperature T is of order of kT, where K is Boltzmann constant (1.38 X 10^{-23} joule/kelvin).

Q2(a) State and explain Bohr's postulate. Using them calculate (i) radius of Bohr orbit and (ii) total energy of electron in hydrogen atom in nth state. What were the short comings of Bohr's theory?
(b) If the wavelength of first line of Lyman series is 1215 A°, calculate the wavelength of second line to series.

Q3(a) Explain the two slit experiment with photons and its outcomes.
(b) Consider a particle in one dimension which is confined within the region $0 \le xx \le aa$ and whose wave function is $\psi(xx) = \sin$ [illegible] e^{iiiii}.
i) Find the potential.
ii) Calculate the probability of finding the particle in the interval $\frac{aa}{2} \le xx \le aa$
iii) Evaluate the probability current density.

Q4. A particle limited to the x-axis is described by a wave function ψ which is non-zero for 0<x<L and zero otherwise. Derive the normalized wave function and eigen value. Draw wave function and probability function graphically. Also find the probability that the particle can be found between 0.4<x<0.5.

Q5. (a) For a radioactive sample having NN_{oo} nuclei initially decays to N(t) nuclei. Derive the expression

$$\frac{N}{N_0} = \left(\frac{1}{2}\right)^n \text{ where } n = \frac{t}{T}$$

where

n is number of half life

T = half life

t = total time for n half lives.

(b) A radioactive isotope X has half- life of 3 second. At t = 0, a given sample of this isotope contains 8000 atoms. Calculate

i. Its decay constant
ii. Average life
iii. The time t_1 when 1000 atoms of the isotope X remain in the sample
iv. Activity in the sample at t = t_1 sec.

Q6. (a) Obtain the semi-empirical mass formula by taking into account the various factors which affect the binding energy per nucleon. (b) Obtain the binding energy per nucleon for $^{56}_{26}Fe$ given mass of $^{56}_{26}Fe$ is 55.934939 u.

Constants:
h= $6.6X10^{-34}$ J.s
m_e= $9.1X10^{-31}$ Kg
m_n= 939.55 MeV= 1.00866 u
m_p= 938.26 MeV = 1.00728 u