Name of the Department:	**Department of Physics and Astrophysics**
Name of Course:	**B.Sc. Prog. _CBCS_DSE**
Semester:	**V- Semester**
Name of the Paper:	**Elements of Modern Physics**
Unique Paper Code:	**42227529/ (New Course)**
Question Paper Set Number:	**5**

Duration: 3 Hours **Maximum Marks:75**

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

Q1.(a) Explain de-Broglie hypothesis. Give an experiment in its support and show how does it verify the de-Broglie hypothesis. (3,5,3.5)

(b) The work function of a metal A is twice the work function of the metal B. How will be their threshold frequency be related? (4)

(c) Calculate the fractional change in the wavelength of an X-ray of wavelength 0.400 Å , which undergoes a 90^o Compton scattering from an electron. (3.25)

Q2. (a) Distinguish between:

(i) Emission spectrum and absorption spectrum.

(ii) line spectra and continuous spectra (4)

(b) "All electron can circle the nucleus only if its orbit contains the integral number of de Broglie wavelength". Prove mathematically how this statement combines particle and wave character of electron in a stationary orbit. (8)

(c) The ionization energy of H-like atom is 4 Rydberg. What is the wavelength of radiation emitted when the electron jumps from the first excited state to ground state ? (6.75)

Q3. (a) Deduce the Uncertainty relation between energy and time by considering the motion of wave packet. Explain its physical significance. (7)

(b) The average period that elapses between the excitation of an atom and the time it emits radiation is 10^{-8} sec. Find the uncertainty in energy emitted and the uncertainty in frequency of light emitted. (5.75)

(c) Prove that for rotational motion of a particle the uncertainty principle can be given as

$\Delta L.\Delta\varphi \geq h/2\Pi$ where, ΔL is uncertainty in angular momentum of the particle and $\Delta\varphi$ is uncertainty in its angular position. (6)

Q4. (a) What are the Postulates of quantum Mechanics? Illustrate their use by an example. (8)

(b) Explain with diagram 2-Slit interference Pattern with electron and photon. (3,3)

(c) An electron has a speed of 600 m/s with an accuracy of 0.05%. Calculate the minimum uncertainty in the location of the electron. (4.75)

Q5. (a) Define one dimensional potential box. Also explain zero-point energy for the particle in one dimensional box. (6)

(b) Calculate the three lowest energy levels (in eV) for an electron inside a one-dimensional infinite potential well of width 2Å. Also determine the corresponding normalized eigenfunctions and eigenvalues. (12.75)

Q6. (a) What do you mean by continuous β-spectrum? What is discrete β-spectrum and end point energy? The half-life of $_{11}{}^{24}$Na is 14 hours. How long does it take for 93.75 % of a sample of this isotope to decay? (12.75)

(b) What do you understand by mass deficit? Calculate the energy of γ-rays in the β-decay of ^{28}Al. (Given: E_{max}=2.86 MeV.) (6)