5. (a) Explain the principles of X-ray diffraction in the context of crystallography. How does Bragg's Law describe the relationship between the incident angle of X-rays, the interplanar spacing of crystal lattice planes, and the resulting diffraction pattern? (10)

   (b) A crystal with a lattice spacing of 0.2 nm is illuminated with X-rays of wavelength 0.1 nm. If the first-order diffraction peak is observed at an angle of 30 degrees, calculate the interplanar spacing. (8)

6. (a) Write down the assumptions and draw backs of Liquid drop model. Derive the Semi empirical binding-energy formula. (10)

   (b) Explain the plot of binding energy per nucleon with the stability of nuclear chart. Explain why even-even nuclei are more stable. (8)

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 5129 **J**

Unique Paper Code : 2224001203

Name of the Paper : Modern Physics

Name of the Course : **B.Sc. Hons. - (Physics)_NEP: UGCF-2022**

Semester : II / IV / VI (GE Paper)

Duration : 3 Hours Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. **All** Questions carry equal marks.
3. Q. No. **1** is compulsory.
4. Answer any **four** of the remaining five questions.
5. Use of non-programmable scientific calculators are allowed.

P.T.O.

1. Attempt **any six** questions out of **seven**.

   (a) Calculate the de Broglie wavelength of an electron moving with a speed of 2×10^6m/s.

   Given: mass of the electron $m = 9.11 \times 10^{-31}$kg. and $h = 6.626 \times 10^{-34}$Joule – second.

   (b) Write and explain postulates of Bohr model.

   (c) What are the continuity and boundary conditions that must be satisfied for a wave function to be physically acceptable?

   (d) What are quantum dots and their significances?.

   (e) What are the conditions necessary for stimulated emission to occur?

   (f) Calculate the radioactive constant for an element whose half-life period is 20 years.

   (g) What is the mass number A of a nucleus whose radius R is 2.5 F? (6×3=18)

2. (a) What are the factors affecting the photoelectric current and kinetic energy of emitted electrons? Explain the effect of intensity and frequency of incident light separately, using Einstein's photoelectric equation. (10)

   (b) A laser beam emits energy at a rate of 1 mW using light of wavelength 500 nm. How many photons are emitted per second?

   Given: $h = 6.626 \times 10^{-34}$Joule – second. (8)

3. (a) Give an explanation of the spectrum of hydrogen on the basis of Bohr model. Express Rydberg constant in terms of fundamental constants. Draw the energy level diagram of hydrogen, indicating the energies of the first few states in eV. (10)

   (b) Explain and working principle of Heisenberg's Gamma-ray Microscope. (8)

4. (a) Calculate the three lowest energy levels (in eV) for an electron inside a one-dimensional infinite potential well of width 2A°. Also determine the corresponding normalized eigen functions. Given: mass of electron $m = 9.11 \times 10^{-31}$kg. $h = 1.05 \times 10^{-34}$ Js. (10)

   (b) Show that the eigen values of the time-independent Schrodinger equation $E\psi = H\psi$ are real. (8)