Name:

Enrolment No:

End-Semester Examination, December 2023

Program Name: B.Sc (H) Chemistry, Mathematics & Geology
Semester : III
Course Name : Elements of Modern Physics **Time : 3 hrs.**
Course Code : PHYS 2009G **Max. Marks: 100**
Nos. of page(s): 02

Instructions:

- All questions are compulsory.
- Scientific calculators can be used for calculations.

Section A **4 marks x 5 = 20 Marks**

S. No.		Marks	COs
Q 1	Find the maximum frequency, and minimum wavelength of X-rays produced by 30 keV.	**4**	**CO1**
Q 2	For a non-dispersive medium, prove that the phase velocity is equal to the group velocity i.e. $v_g = v_p$.	**4**	**CO2**
Q 3	Calculate the de-Broglie wavelength associated with a proton moving with a velocity equal to $\frac{1}{20}$ th of the velocity of light.	**4**	**CO1**
Q 4	Calculate the uncertainty in the velocity of an electron that is confined in a 10A° box.	**4**	**CO3**
Q 5	Derive the Energy-Time Uncertainty Principle from Position-Momentum Uncertainty	**4**	**CO2**
	Section B **10 Marks x 4 =40 Marks**		
Q 6	An X-ray photon is found to have its wavelength doubled on being scattered through 90° Find the wavelength and energy of the incident photon.	**10**	**CO1**
Q 7	Write the physical significance of wave function ψ. Deduce Schrodinger time-dependent wave equation.	**10**	**CO3**
Q 8	Write the Rutherford's atomic model. Explain the two drawbacks of Rutherford's atomic model. Calculate the Energy as per Bohr model	**10**	**CO2**

Q. 9	An X-ray beam of wavelength $0.97Å$ is obtained in the third order after reflection at 60° from the crystal plane. Another beam is obtained in the first order after reflection at 30° from the same crystal plane. Calculate the wavelength of the second X-ray beam. **OR** Write the Bragg's law with its physical significance. How this law can be useful in Determination of the crystal structure.		**CO5**
	Section C **20 Marks x 2= 40 Marks**		
Q 10	Explain Bethe-Weizacker Semi-empirical Mass Formula (SEMF). Derive a formula for the atomic number of the most stable isotope isobar of a given A and use it to find the most stable isobar of A = 25.		**CO4**
Q 11	Explain the law of radioactive decay. Discuss the half-life. According to measurements by Rutherford and Geiger, one gram of radium emits 3.7×10^{10} alpha particles in one second. Estimate the half-life of radium. **OR** What is Bragg's law for diffraction of X-rays by crystal? Derive it. The glancing angles of reflection for K_a, X-rays from palladium are 5.4° from (100) planes 7.6° from (110) planes and 9.4 from (111) planes. From the above data, find the cubic lattice structure of the palladium crystal.		**CO5**

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