Bago University
Department of Physics
First Semester Examination, March 2019

Second Year (BSc)
(Physics Specialization)

Phys 2105
Atomic Physics
Time Allowed: (3) Hours

Answer any Six questions.

1 (a) (i) Write down the formula of electronic charge 'q_n' and factor 'k' from Millikan's oil drop experiment. (ii) Describe the value of electronic charge in e.s.u units.

(b) Derive the expression of e/m ratio for cathode rays and accepted value of e/m in SI unit.

2 (a) What is photoelectric effect? Write down Einstein's photoelectric equation. What are the two important facts about photoelectric effect? The photoelectric threshold for a metal is 3000 Å. Find the kinetic energy of an electron ejected from it by radiation of wavelength 1200 Å.

(b) The stopping potential for photoelectrons, emitted from a surface illuminated by light of wavelength 5893 Å is 0.36 volt. Calculate the maximum kinetic energy of photoelectrons, the work function of the surface and the threshold frequency.
($h = 6.625 \times 10^{-34}$ Js, $c = 3 \times 10^{8}$ ms^{-1} and $1\ eV = 1.6 \times 10^{-19}$ J)

3 (a) Define work function, threshold frequency and stopping potential. Can the photoelectric effect occur in gases and liquids as well as in solids?

(b) The photoelectric work function of potassium is 2.0 eV. If light having a wavelength of 3600 Å falls on potassium, find (i) the stopping potential (ii) the kinetic energy in electron volts of the most energetic electrons and (iii) the velocities of these electrons.

4 (a) State Heisenberg's uncertainty principle. By using uncertainty principle show that the rest mass of a photon is zero.

(b) Write down the equations of De Broglie wavelength for $\frac{v}{c} \leq 0.01$ and $\frac{v}{c} \geq 0.01$. Find the De Broglie wavelength associated with (i) a 46 g golf ball with velocity 36 ms^{-1}. (ii) an electron with a velocity 10^{7} ms^{-1}.

5 (a) State De Broglie's hypothesis. How can Bohr's quantum condition be explained by the use of De Broglie's wave particle dualism?

(b) Write down the time independent Schrodinger equation for the following: (i) 2D harmonic oscillator, (ii) He atom, (iii) Li^{++} atom.

6 (a) Find the ground state energy, first excited state energy and second excited state energy of the hydrogen atom. Also draw the energy level diagram of this atom.

(b) Compute the total energy of the electron in the n^{th} state for H atom and H – like atom.

7 (a) Write down the name of the most intense optical spectra series by using in terms of Rydberg's formula.

(b) Using vector diagrams, determine the possible values of the total angular momentum of an electron system for which (i) L = 2, S = 1 and (ii) L = 2, $S = \frac{3}{2}$.

8 (a) How many X-rays series are there? Name them. Write down the properties of X- rays. Draw the X-rays energy level diagram.

(b) Define length contraction. What is an accelerated frame? Calculate the K.E of an electron moving with a velocity of 0.98 times the velocity of light in the laboratory system.