

Bago University
Department of Physics
First Semester Examination, March 2019

Fourth Year (BSc)
(Physics Specialization)

Phys 4105
Quantum Mechanics
Time Allowed: (3) Hours

Answer any Six questions.

- 1 (a) What are black body and black body radiation? Describe Planck's theory of the blackbody radiation.
(b) A photoelectric surface has a work function of 4.0eV. What is the maximum velocity of the photoelectrons emitted by the surface when light of frequency 3.0×10^{15} Hz falls on it?
 - 2 (a) Define (i) Einstein's photon concept, (ii) work function and (iii) threshold frequency.
(b) The wavelengths of some of radiations emitted by mercury (Hg) are 4358Å, 5460Å and 5780Å. Find the frequency and the energy of each photon.
 - 3 (a) Derive the energy of electron in the hydrogen atom by Bohr's theory.
(b) Find the threshold frequency and threshold wavelength of the radiation which falls on the surface of Zinc whose work function is 3.6eV.
 - 4 (a) In Compton scattering process, after an elastic collision between a photon and a free electron, increase in wavelength of the scattered X-ray. Why?
(b) Why electron cannot be present in the nucleus? Explain using uncertainty principle.
 - 5 (a) How can be explained Bohr's quantum condition by using the De Broglie's matter wave?
(b) A particle of mass m moves in one dimension between $x = a$ and $x = b$, in which region the wave function of the particle is $\psi(x) = A/x$, where A is normalization constant.
(i) Calculate A . (ii) Find the expectation value of x .
 - 6 (a) State (i) Eigen functions, (ii) Eigen values and (iii) Linear momentum operator.
(b) Prove the commutator relations
 - (i) $[\hat{A} \hat{B}, \hat{C}] = \hat{A} [\hat{B}, \hat{C}] + [\hat{A}, \hat{C}] \hat{B}$
 - (ii) $[\hat{A}, [\hat{B}, \hat{C}]] + [\hat{B}, [\hat{C}, \hat{A}]] + [\hat{C}, [\hat{A}, \hat{B}]] = 0$
 - 7 (a) What are the Hermitian operators and linear momentum operator?
(b) Express the uncertainty relations and commutator relations for the angular momentum operators. Write down the possible values of n , l and m .
 - 8 (a) Derive time independent Schrodinger equation for a wave packet motion in one dimension.
(b) Prove that the Eigen values of a Hermitian operator are real.
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