



DOON UNIVERSITY, DEHRADUN
Mid Semester Examination, Fourth Semester, 2017-18
Department of Physics, School of Physical Sciences

Generic Elective

Course: PHG-252: Modern Physics (Elective)

Time Allowed: 2 Hours

Maximum Marks: 30

Instructions:

- 1) All questions are compulsory. Read the questions carefully and attempt each part.
- 2) Number the questions and their sub parts properly.
- 3) Explain the symbols used wherever applicable.

SECTION: A

Marks: 6 x 1 = 6

- 1) What is a wavefunction and what is its significance ?
- 2) Write the energy operator.
- 3) What is the ultraviolet catastrophe ?
- 4) Which experiment confirmed de Broglie's hypothesis about matter waves
- 5) Write the Planck's radiation formula.
- 6) What is Pair Production.

SECTION: B

Marks: 4 x 3 = 12

- 7) What is an eigenfunction, prove that the expectation value is the eigenvalue of an eigenfunction.
- 8) Deduce the time independent Schrodinger equation.
- 9) Briefly, explain the hydrogen spectrum and explain all the series and their formula to calculate wave number.
- 10) Assume that a certain 660 Hz tuning fork can be considered as a harmonic oscillator whose vibrational energy is 0.04 J. Calculate the total number of quantas constituting the total vibrational energy. Calculate the energy quanta of an atomic oscillator that emits and absorbs orange light whose frequency is 5.00×10^{14} Hz.
(1.5 + 1.5)

Or

X-rays of wavelength 10.0 pm are scattered from a target. (a) Find the wavelength of the x-rays scattered through 45° . (b) Find the maximum wavelength present in the scattered x-rays.

(1.5 + 1.5)

SECTION: C

Marks: 2 x 6 = 12

- 11) Explain the Compton effect in detail and derive the expression for shift in the wavelength observed in Compton effect.
- 12) Explain Photoelectric effect and its observations. Discuss the observations in respect to classical physics and then explain using Einstein's quantum theory of light.
(3 + 3)