

Roll No. [REDACTED]

Exam Code : D-23

Subject Code—60460

B. Sc. EXAMINATION

(Main/Re-appear) (Batch 2019 Onwards)

(Fifth Semester)

PHYSICS

CPL-501 Paper-I

Elements of Modern Physics

Time : 3 Hours

Maximum Marks : 80

Note : Attempt *Five* questions in all, selecting *one* question from each Unit. Q. No. 1 is compulsory. All questions carry equal marks.

1. (a) What is Kirchhoff's law ?
- (b) What do you mean by a black body ?
- (c) What are Bohr's postulates ?
- (d) Calculate the wavelength associated with an electron subjected to a potential difference of 0.4 kV.

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- (e) What is wave function ? Write its physical significance ?
- (f) What are Eigen values and Eigen functions ?
- (g) Explain the terms :
 - (i) Pumping
 - (ii) Population inversion
- (h) What do you mean by spontaneous and stimulated Emission ? 2×8=16

Unit I

2. (a) Show that the change in wavelength of X-ray photon on scattering from a free electron is independent of the wavelength of incident radiation. 12
- (b) A certain spectral line has wavelength 510 nm, Calculate the frequency and energy in eV of the photon associated with it. 4
3. (a) Derive Wein's displacement law and Stefan's law from Planck's radiation law. 8

- (b) What are X-rays ? How are they produced ? Write the properties of X-rays. 8

Unit II

4. (a) Explain in detail the effect of nuclear mass on spectra. 8
- (b) What are de-Broglie waves ? Derive formula for the de-Broglie wavelength of a particle in terms of kinetic energy. 8
5. (a) Define Phase velocity and Group velocity. Obtain an expression for the Group velocity. 10
- (b) Calculate the wavelength of first and last member of Balmer series. 6

Unit III

6. Derive one dimensional time dependent and time independent Schrodinger equation for a non-relativistic free particle. 16

7. (a) State Heisenberg's uncertainty principle and derive it from a hypothetical gamma ray microscope. 12
- (b) A particle is moving in 1- d box of length 205 nm. Calculate the energy of the particle in third excited state. 4

Unit IV

8. (a) Discuss in detail the concept of directionality, monochromaticity, and intensity of laser light. 12
- (b) Discuss the applications of laser in detail. 4
9. (a) Describe principle, construction and working of Ruby laser. Write their applications and limitations. 12
- (b) Calculate the coherence length of a laser beam of bandwidth 2150 Hz. 4