

Roll No. 223112320027
Navi

Exam Code : D-24

Subject Code—62420

B.Sc. EXAMINATION

(Main/Re-appear)

(Batch 2020 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.

(Compulsory Question)

1. (a) What are Planck's quantum postulates ?
(b) Discuss Wien's displacement law.

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- (c) Define impact parameter.
- (d) Define the following :
- (i) Group velocity
 - (ii) Phase Velocity.
- (e) What do you mean by wave packet ?
- (f) Write important properties of wave function.
- (g) Explain the terms :
- (i) Pumping
 - (ii) Population Inversion.
- (h) What is stimulated emission and spontaneous emission ? $2 \times 8 = 16$

Unit I

2. (a) What are X-rays ? How are they produced ? Explain the X-ray spectra with suitable diagrams. 12
- (b) The work function of a metal is 4.8 eV. Calculate the frequency of incident radiation if the speed of photoelectrons is 200 km/s. 4

3. (a) What is Photoelectric effect ? Explain the Einstein's photoelectric equation in detail. Write its applications. 12
- (b) Calculate the radiation emitted by a black body at a temperature 430 K. Given $\sigma = 5.6 \times 10^{-8} \text{ Wm}^{-2} \text{ K}^{-4}$. 4

Unit II

4. (a) State the postulates of Bohr's theory and deduce the expression for the energy of the n th orbit of hydrogen atom. 12
- (b) Calculate the Wavelength of last member of Lyman series of Hydrogen atom. 4
5. (a) Describe Frank-Hertz experiment. What does it demonstrate ? 6
- (b) What is De-Broglie Hypothesis ? Derive formula for the De-Broglie wavelength in terms of kinetic energy and temperature. 6

- (c) Calculate the wavelength associated with an electron subjected to potential difference of 196 V. 4

Unit III

6. (a) Apply Schrödinger equation to obtain the energy eigen values and eigen functions for a free particle moving in one dimensional box of length a . 12
- (b) The wave function of a particle is given by $\psi(x) = e^{2x}$. Find the probability of finding the particle between $x = 1$ to $x = 3$. 4
7. (a) Derive Heisenberg's uncertainty principle and using it find the ground state energy of linear harmonic oscillator. 12
- (b) Normalise the wave function $\psi(x) = Ae^{ikx}$ over the region $0 \leq x \leq 2a$. 4

Unit IV

8. (a) What do you mean by laser ? Describe principle, construction and working of Ruby laser. Write its applications and limitations. 12
- (b) Calculate the coherence length of a laser beam having bandwidth 2800 Hz. 4
9. (a) What are Einstein's coefficients ? Derive a relation between them. 8
- (b) Explain the terms. 4
- (i) Monochromaticity
- (ii) Intensity of a laser beam.
- (c) What are the applications of laser in Industry ? 4