2020/TDC/ODD/SEM/
PHSH–503/099

TDC Odd Semester Exam., 2020
held in July, 2021

PHYSICS

(Honours)

(5th Semester)

Course No. : PHSH–503

(Quantum Mechanics)

Full Marks : 35
Pass Marks : 12

Time : 2 hours

The figures in the margin indicate full marks for the questions

Answer **five** questions, selecting **one** from each Unit

UNIT—I

1. *(a)* Discuss photoelectric effect as evidence of corpuscular theory of light. 5

(b) What is the work function of a metal if the threshold wavelength for it is 580 nm? 2

2. *(a)* Explain the result of Davisson-Germer experiment and discuss its significance. 4

(b) Explain complementary principle. 3

UNIT—II

3. *(a)* State Heisenberg's uncertainty principle. 2

(b) By using the uncertainty principle, show that an electron cannot exist within the nucleus. 5

4. *(a)* Obtain the radius of Bohr orbit by using the uncertainty principle. 4

(b) Use the uncertainty principle to estimate the size of the hydrogen atom from the following data : 3

$$e \quad 1\;6 \quad 10^{19}\ \text{C}$$

$$m \quad 9\;0 \quad 10^{31}\ \text{kg}$$

$$\hbar \quad 1\;05 \quad 10^{34}\ \text{J-s}$$

UNIT—III

5. *(a)* What do you mean by Schrödinger equation in time-dependent and time-independent forms? Give the physical interpretation of wave function. 3

(b) Define Hermitian operators. Show that the operators $i\frac{d}{dx}$ and $\frac{d^2}{dx^2}$ are Hermitian. 1+3=4

6. Define angular momentum operator. Show that $[L_x, L_y] \quad i\hbar L_z$. 1+6=7

UNIT—IV

7. A particle moving in an one-dimensional potential, is given by

$$V \quad 0 \text{ for } x \quad 0 \text{ and } V \quad V_0 \text{ for } x \quad 0$$

(a) Write down the Schrödinger equation for the particle and solve it.

(b) Find the reflection and transmission coefficients for the case $0 \quad E \quad V_0$, where E is the total energy of the particle. 4+3=7

8. Write down the Schrödinger equation for a free particle in one-dimensional infinite potential well and calculate its eigenvalues and normalized eigenfunctions. 7

UNIT—V

9. Write the Schrödinger equation for hydrogen atom in spherical polar coordinates and split it into the radial, polar and azimuthal parts. 7

10. Solve the radial part of the Schrödinger equation for the hydrogen atom to obtain the energy eigenvalues and eigenfunctions. 7

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