E 7060 (Pages : 2) Reg. No.....

Name.....

B.Sc. DEGREE (C.B.C.S.S.) EXAMINATION, APRIL 2019

Fifth Semester

Core Course—CLASSICAL AND QUANTUM MECHANICS

(Common for Model I and Model II B.Sc. Physics, B.Sc. Physics EEM and B.Sc. Physics Instrumentation)

[2013 to 2016 Admissions]

Time : Three Hours Maximum Marks : 60

Part A

Answer **all** *questions briefly.*
Each question carries 1 *mark.*

1. The minimum number of independent ———— co-ordinates is given by the number of degrees of freedom.
2. Kepler's first law identifies that the ———— between the sun and earth is constantly changing.
3. A perfectly ———— body is an ideal conception.
4. To derive the photoelectric equation Einstein applied ———— quantum theory.
5. Each observable has a definite ———— associated with it.
6. All operators of quantum mechanics have ———— functions and eigen values.
7. The solutions of the time independent Schrödinger equation are the eigen functions of the ———— operator.
8. The components of the angular momentum operator do not ———— among themselves.

(8 × 1 = 8)

Part B

Answer any **six** *questions.*
Each question carries 2 *marks.*

9. How are degrees of freedom associated with constraints ? Explain.
10. State Hamilton's principle for a conservative system.
11. What is meant by virtual work ?
12. What is Compton effect ? Explain.
13. State and explain the uncertainty principle.
14. Brief the physical interpretation of wave function.

Turn over

15. Explain the concept of expectation value.
16. What is meant by phase velocity ?
17. What are commutation relations ?
18. Point out the energy eigen values of a rigid rotator ?

(6 × 2 = 12)

Part C

Answer any **four** *questions.*
Each question carries 4 *marks.*

19. Give an account on Kepler's third law.
20. Prove that in the photoelectric effect from a metal surface, the maximum velocity of the photo-electrons is related to the stopping potential by the equation $V_{max} = 5.927 \times 10^5 \sqrt{Vo}$ where V_{max} is in m/s and Vo is in volts.
21. Bring out a conservative system with Hamilton's' principle.
22. Show that $< p_x x > - < x\, p_x > = \frac{h}{2\pi i}$.
23. Find the lowest energy of an electron confined in a cubical box of side 1 A°.
24. A particle is in motion along a line between $x = 0$ and $x = a$ with zero potential energy, and at points for which $x < 0$ and $x > a$ the potential energy is finite. The wave function for the particle in the n^{th} state is given by $y_n = A \sin \frac{n\pi x}{a}$. Find the expression for the normalized wave function.

(4 × 4 = 16)

Part D

Answer any **two** *questions.*
Each question carries 12 *marks.*

25. Distinguish between constraints and degrees of freedom. Bring out the role of generalized co-ordinates in classical mechanics with examples.
26. Discuss Planck's hypothesis to explain the spectral distribution of the intensity of radiation from a black body. Derive Planck's radiation law.
27. Obtain the time dependent Schrödinger wave equation for a particle. Separate the wave function into time dependent and time independent parts and obtain the steady state Schrödinger equation.
28. Explain the meaning of eigen values and eigen functions of an operator. Establish the time independent Schrödinger equation for a linear harmonic oscillator and obtain its energy levels.

(2 × 12 = 24)