E 2938   (Pages : 2)   Reg. No...............................

Name....................................

B.Sc. DEGREE (C.B.C.S.S.) EXAMINATION, APRIL 2022

Fifth Semester

Core Course—CLASSICAL AND QUANTUM MECHANICS

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

[2013 to 2016 Admissions]

Time : Three Hours   Maximum Marks : 60

Part A

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

1. Angular ——————— is an axial vector.

2. A ——————— co-ordinate is one that does not explicitly appear in the Lagrangian.

3. A body which ——————— all radiations incident upon it is called a black body.

4. Photoelectric ——————— is directly proportional to the intensity of the incident light.

5. The uncertainty principle holds good even when the ——————— values are zero.

6. Matter waves are called ——————— waves.

7. The ——————— of a harmonic oscillator is quantized.

8. An operator for which no ——————— exists is called singular.

$(8 \times 1 = 8)$

Part B (Short Answer Questions)

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

9. What are constraints ? Explain.

10. Obtain the principle of virtual work.

11. Write down de Broglie hypothesis.

12. Define wave function.

13. What is an operator ?

14. Explain orthogonality of wave function.

15. How eigen value is different from eigen vector ?

Turn over

16. What is meant group velocity ?

17. Give the physical concept of zero point energy.

18. What are commutation relations ?

$(6 \times 2 = 12)$

Part C

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

19. State and illustrate principle of least action.

20. Obtain Lagrange's equation from Hamilton's principle.

21. Determine the de Broglie wavelength of a 46 g. golf ball with a velocity of 30 m/s.

22. The speed of an electron is measured to be 5×10^{-1} m/s to an accuracy of 0.03 %. Find the uncertainty in determining the position of this electron.

23. Show that α and α^2 represents the eigen values of same state.

24. Find the zero point energy in electron volts of a pendulum whose period is one second.

$(4 \times 4 = 16)$

Part D

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

25. Discuss Kepler's laws of planetary motion with Mathematical support.

26. Explain photoelectric effect. Give an account of Einstein's explanation of photoelectric effect on the basis of quantum theory.

27. Obtain Schrodinger time dependent wave equation in three dimensions. Show that the energy levels of a harmonic oscillator are equally spaced.

28. Starting from the canonical commutation relations for position and momentum operators derive the commutation relation for the components of angular momentum.

$(2 \times 12 = 24)$