Nagarjuna Degree College 38/36, Ramagondanahalli, Yelahanka Hobli. Bengaluru - 560 064.

Reg. No.

V Semester B.Sc. (CBCS) Degree Examination, March/April - 2022

PHYSICS

Statistical Physics, Quantum mechanics - I

Atmospheric Physics & Nano Materials

(CBCS Scheme Freshers and Repeaters 2018-19 & Onwards)

Paper : V

Maximum Marks: 70

Time : 3 Hours

Instructions to Candidates:

- Answer any Five questions from each part. 1.
- Use Non programmable scientific calculators are permitted. 2.

PART-A

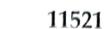
Answer any five questions. Each question carries Eight marks. $(5 \times 8 = 40)$ 1. What are fermions and bosons? a. Derive an expression for the distribution function of particles obeying Fermi - Dirac b. statistics. (2+6)2. What is Phase Space? a. b. Distinguish between Maxwell - Boltzmann statistics, Bose - Einstein statistics and Fermi - Dirac statistics. (2+6)3. Discuss briefly the failure of classical mechanics to explain : Atomic spectra. a. b. Black Body radiation. (4+4)4. What are matter waves? Mention any two of its characteristics. a. Deduce an expression for the de-Broglie wavelength and express it in terms of energy b. and temperature. (3+5)

- 5. State and explain Heisenberg's uncertainty principle. a.
 - Describe gamma ray microscope experiment to illustrate the uncertainty principle. b.
 - (3+5)

- 6. What is meant by Hydrostatic balance? a.
 - Derive Beer's law for the absorption of solar radiation by the earth's atmosphere. b.

(2+6)

- 7. What are fixed gases and variable gases of the earth's atmosphere? a.
 - Derive an expression for variation of atmospheric pressure with altitude and give b. (2+6)its graphical representation.



(2)

- 8. Mention the methods of synthesis of nano - materials. a. b.
 - What are zero, one and two dimensional nano systems? Give one example each.(2+6) PART - B

Answer any five questions. Each question carries four marks.

- A system contains 2 particles A & B and there are three quantum states or cells. With the $(5 \times 4 = 20)$ 9. help of a diagram show the number of arrangements according to
 - Maxwell Boltzmann. i.
 - ii. Bose - Einstein statistics.
- 10. Calculate the Fermi energy of Lithium at T = 0K. Given, the number of conduction electrons per unit volume in Lithium is 2.06×10^{27} m⁻³. Given h = 6.625×10^{-34} Js, me = 9.1×10⁻³¹ kg.
- Calculate the maximum velocity of photoelectrons, when ultraviolet radiation of 260nm is 11. incident on a metal whose threshold wavelength is 380nm. Given $h = 6.625 \times 10^{-34} J_s$, $m_c = 9.1 \times 10^{-31} kg$, $c = 3 \times 10^8 m s^{-1}$.
- 12. An electron has a de-Broglie wavelength of 1Å. Calculate the group velocity and phase velocity. Given $h = 6.625 \times 10^{-34} Js m_e = 9.1 \times 10^{-31} kg$.
- In Davisson Germer experiment, electrons accelerated through a potential difference of 13. 54V showed a maximum reflection at 50° (first order). Calculate the wavelength of the

electrons. Given d = 2.15 Å.

- Calculate the pressure gradient force per unit mass between two isobars of pressure 103.9kPa 14. and 100.3 kPa which are separated by 79 km from each other. Given density of $air = 1.2 \text{ kgm}^{-3}$.
- A mass weighing 0.9 kg is thrown from a point 30°N towards north (in the northern 15. hemisphere) with a velocity of 0.6kms⁻¹. Find the magnitude and direction of the Coriolis force acting on the mass. Given, $\omega = 7.27 \times 10^{-5} \text{ rad-s}^{-1}$.
- Calculate the total mass of the earth's atmosphere. Given the pressure at sea level is equal 16. to 1.013×10^{5} Pa, Radius of the earth = 6400 km and g = 9.8 ms⁻².

PART - C

Answer any five questions. Each question carries two marks. 17.

- Why do bosons and Fermions have different distribution function? a.
- He⁴ shows Bose Einstein condensation, while He³ does not. Explain. b.
- Can we use M-B statistics to explain the properties of photon gas? Explain. c.
- Are de-Broglie waves observed in case of macroscopic objects? Explain. d.
- Is water vapor a green house gas? Explain. e.
- f. Can optical microscope be used to observe nano - particles? Explain.
- Graphene is the strongest material. Justify. g.
- The properties of materials are different at nano level. Why? h.