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V Semester B.Sc. Degree Examination, March - 2021**PHYSICS-V****Statistical Physics, Quantum Mechanics-I Atmospheric Physics and Nanomaterials
(CBCS Scheme 2018-19 and Onwards)****Paper : V****Time : 3 Hours****Maximum Marks : 70****Instruction to Candidates:**

- 1) Answer any Five questions from each Part.
- 2) Non-programmable scientific calculator is allowed.

PART - AAnswer any **Five** of the following questions. Each question carries **Eight** marks. **(5×8=40)**

1. What is photon gas? Derive Planck's law of black body radiation from Bose - Einstein distribution law.
2. a) Give the assumptions of Fermi - Dirac statistics.
b) Derive an expression for Fermi - Dirac distribution function.
3. Compare Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics.
4. Explain the success of quantum theory in explaining
 - a) Photoelectric effect and
 - b) Stability of an Atom.
5. Explain G.P. Thomson's experiment with necessary theory.
6. a) Define
 - i) Reflectivity and
 - ii) Transmittivity of atmospheric layers.
b) Derive Beer's law.
7. a) Write a note on erosion of river banks.
b) Derive an expression for pressure gradient force in the earth's atmosphere.
8. a) What are Fullerenes? Explain.
b) Explain ball-milling method of synthesis of nanomaterials.

[P.T.O.]



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PART - B

II. Solve any Five problems. Each problem carries Four marks. (5×4=20)

9. Two distinguishable particles, each of which can be in one of the E, 2E, 3E and 4E energy states, have total energy 6E. Find all the possible distributions of particles in the energy states. Also, find the number of microstates in each case.
10. Calculate the average speed of oxygen molecules at 27°C .
[Given : molecular weight of oxygen is 32 units, Avogadro number is 6.023×10^{23} per mole and $k = 1.38 \times 10^{-23} \text{JK}^{-1}$.]
11. Estimate the fraction of electrons excited above the Fermi level at 600 K for copper. The Fermi energy of copper is 6 eV.
[Given : $k = 1.38 \times 10^{-23} \text{JK}^{-1}$]
12. An electron has a de-Broglie wavelength of $1.8 \times 10^{-3} \text{nm}$. Calculate the group velocity of its de-Broglie waves.
[Given : rest mass of electron = $9.1 \times 10^{-31} \text{kg}$ $h = 6.625 \times 10^{-34} \text{Js}$ and $c = 3 \times 10^8 \text{ms}^{-1}$].
13. A radiation of wavelength 450 nm is incident on a metal surface of work function 1.2 eV. Calculate the maximum velocity of the photoelectrons.
[Given: Mass of an electron = $9.1 \times 10^{-31} \text{kg}$, $h = 6.625 \times 10^{-34} \text{Js}$ and $c = 3 \times 10^8 \text{ms}^{-1}$]
14. A photon of wavelength 600 nm emitted by an atom is measured with uncertainty of 3nm. Calculate the uncertainty in the lifetime of excited state.
[Given : $h = 6.625 \times 10^{-34} \text{Js}$ and $c = 3 \times 10^8 \text{ms}^{-1}$.]
15. Find the magnitude of Coriolis force that acts on a body of mass 800 kg, which is moving with a velocity of 50ms^{-1} at a place where the latitude is 30°N ,
[Given : period of rotation of the earth is 24 hours].
16. The saturated vapour pressure at -15°C is 5.0 mb at a place with atmospheric pressure of 780 mb.
- The vapour pressure was measured to be 0.8 mb. What is the relative humidity of this place?
 - When the relative humidity becomes 50%, what is the vapour pressure at the same temperature and pressure.



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PART - C

Answer any **Five** of the following questions. Each question carries **Two** marks. **(5×2=10)**

17. a) What is the condition for non-degenerate and strongly degenerate systems?
- b) Give the conditions for the particles to obey M-B statistics.
- c) Why does an atom give rise to a line emission spectrum?
- d) An electron and a proton have same velocity. Which one has larger de Broglie wavelength? Explain.
- e) What is ultra violet catastrophe?
- f) Where is ozone layer located and what is its importance?
- g) Mention any two greenhouse gases.
- h) What is the principle of scanning electron microscope?

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