QP – 159

V Semester B.Sc. Examination, March/April 2022
(CBCS) (F+R) (2018-19 and Onwards)
PHYSICS – V
Statistical Physics, Quantum Mechanics – I, Atmospheric Physics and Nano Materials

Time : 3 Hours Max. Marks : 70

Instructions : *i) Answer **any five** questions from **each** Part.*
*ii) **Use** of non-programmable scientific calculators are **permitted**.*

PART – A

Answer **any five** of the following. **Each** question carries **eight** marks : **(5×8=40)**

1. a) Define macrostate and microstate for a thermodynamic system.
   b) Derive the Maxwell-Boltzmann distribution function. **(2+6)**

2. What is photon gas ? Derive Planck's law of black body radiation using Bose-Einstein's distribution law. **8**

3. a) Write the expression for Fermi-Dirac distribution function and explain the variation of f(E) versus E with respect to temperature.
   b) Write any four comparisons between Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics. **(4+4)**

4. Explain briefly the failure of classical theory with respect to stability of Atom. How does quantum theory account for the same ? **8**

5. Discuss the theory of Davisson and Germer's experiment to demonstrate de-Broglie hypothesis. **8**

6. a) State and explain Heisenberg's uncertainty principle. Mention its different forms.
   b) Prove the non-existence of electron inside the nucleus using the uncertainty principle. **(4+4)**

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7. Define hydrostatic balance. Obtain an expression for variation of atmospheric pressure with altitude. **(2+6)**

8. a) Explain the two approaches in preparation of nano structures.
   b) Mention any two properties and two applications of nano technology. **(4+4)**

PART – B

Answer **any five** of the following. **Each** question carries **four** marks : **(5×4=20)**

Common data :

$h = 6.625 \times 10^{-34}$ Js

$m_n = 1.67 \times 10^{-27}$ kg

$k = 1.38 \times 10^{-23}$ Jkg^{-1}

$m_e = 9.1 \times 10^{-31}$ kg.

9. A system consists of seven indistinguishable particles distributed in two energy states. The first having 4 cells and second having 5 cells. Calculate the number of microstates in the macrostate (3, 4).

10. Calculate the number of ways of arranging three particles in 4 cells, if the particles are :
    i) Classical
    ii) Fermions.

11. Calculate the stopping potential for light of wavelength 200 nm incident on Tungsten. Given : Work function of material = 4.5 eV.

12. Calculate the de-Broglie wavelength of a thermal neutron at 27°C.

13. An electron has de-Broglie wavelength of 1.5 A°. Calculate the group velocity and phase velocity of electron in a non dispersive medium.

14. Calculate the pressure gradient force per unit mass at a hill station if the pressure gradient is 6 Pa/km. Density of air = 1.2 kg m^{-3}.

15. At what height, the pressure of atmosphere becomes 40% of the pressure at the sea level. Given : Scale height = 8 km.

16. A mass weighing 1.2 kg is thrown from a point 30° N towards north with a speed of 0.8 kms^{-1}. Calculate the magnitude and direction of coriolis force acting on the mass.

PART – C

Answer **any five** of the following. **Each** question carries **two** marks : **(5×2=10)**

17. a) Do the wave function of identical and distinguishable particle overlap ? Justify.

b) Can Pauli's exclusion principle be applied to neutrons ? Explain.

c) Why Alkali metals are most suitable for photoelectric emission ?

d) A charged particle is accelerated by applying an electric field. How does the de-Broglie wavelength change ?

e) The presence of water vapour is important in the atmosphere. Justify.

f) Does a Coriolis force exist at equator ? Justify.

g) Why is ball milling called a top down approach for synthesis of nano-materials ?

h) Is Graphene a strongest material ? Justify.
