Question Bank

B.Sc. II (Sem IV)

BPT401: Thermal Physics and Statistical Mechanics

Q.1. Definition or One sentence type answer (2Mark Questions)

1) Thermodynamic system
2) State Joule-Thomson effect
3) Internal Energy.
4) What is perfectly black body?
5) State Kirchoff's law of radiation.
6) State Stefan's law.
7) State Wein's displacement law.
8) What is Plank's hypothesis?
9) Microstates
10) Ensemble
11) Thermodynamic Probability
12) Root mean square velocity
13) Most probable velocity
14) Accessible states with example
15) Inaccessible states with example
16) Entropy
17) Macrostates
18) Statistical Mechanics
19) Probability
20) Gamma space

Q2. Short Answers Questions. (5 marks each)

1) Show that C_P-C_V=TE$\langle^2$V, Where C_p, C_v are the specific heat at constant pressure and constant volume respectively, E be the modulus of elasticity, $\langle$ be the coefficient of volume expansion and V be the specific volume.
2) Obtain Clausius- Clapeyron equation from Maxwell's thermo dynamical relation.
3) 'There is no Joule- Thomson effect for a perfect gas.' Explain.
4) Show that, $\frac{C_P}{C_V} = \frac{K_T}{K_S}$, Where K_T and K_S are the isothermal and adiabatic compressibility's of gas respectively.
5) Show that, $TdS = C_V dT + \frac{\alpha T}{K} dV$
6) Water boils at temperature of 101°C at a pressure of 787 mm of mercury. One gram of water occupies 1.601 cm^3 on evaporation. Calculate latent heat of steam.(Given: J=4.2 x 10^7 ergs/cal)

7) Derive the relation; $H = G - T(\frac{\partial G}{\partial T})_P$

8) What do you mean by pressure of radiation? Show that pressure of radiation is equal to the energy density?

9) Describe how energy distribution in the spectrum of black body radiation has experimentally been studied?

10) Discuss Planck's distribution law?

11) Discuss Rayleigh Jean's law?

12) Explain in detail black body radiation spectrum.
13) Write a note on Phase space.
14)Explain microstate and macrostate
15)Write a short note on ensemble.
16) Describe microcanonical ensemble.
17) Explain canonical ensemble.
18) Assuming Maxwell- Boltzmann distribution of molecular speeds, show that
$V_{mp} = \sqrt{2kT/m}$
19) Assuming Maxwell- Boltzmann distribution of molecular speeds, show that
$\overline{V} = \sqrt{8kT/\pi m}$
20) Assuming Maxwell- Boltzmann distribution of molecular speeds, show that
$V_{rms} = \sqrt{3kT/m}$

Q3.LongAnswers Questions. (10 marks each)

1) Derive Maxwell's four thermodynamics relations and hence find first TdS equation.
2) Define thermodynamic potentials U, F, G and H. Derive their relationship with state variables. Give their physical significance.
3) What is Joule-Thomson effect? Obtain an expression for Joule-Thomson coefficient.
4) Show that the Planck's radiation law reduces to Wein's law for shorter wavelength and to Rayleigh Jean's law for longer wavelength.
5) Explain Planck's hypothesis for black body radiation. From Planck's law deduce Wien's law and Rayleigh Jean's law.
6) Define thermodynamic probability and obtain expression for it.
7) What do you mean by ensemble? Discuss microcanonical and canonical ensembles.
8) Explain the term phase space in brief? Discuss microstate and macrostate.
9) Derive Maxwell-Boltzmann distribution law.
10) Write in detail phase space and μ space.
11) Write in detail constrains on the system and statistical ensembles.
12) Write the specification of state of system and postulate of equal priori probability.
13) Explain the term

i) postulate of equal priori probability

ii) thermodynamic probability

14) Explain all terms in molecular speed.

15) Write the relation between entropy and probability.

16) Calculate the r. m. s. velocity and average speed of H_2 at 27 ^oC.

17) At what temperature will the average speed of molecules of hydrogen gas be double the average
speed of oxygen at 300 K.

18)Assuming Maxwell- Boltzmann distribution of molecular speeds, show that

$V_{mp} = \sqrt{2kT/m}$ and $\overline{V} = \sqrt{8kT/\pi m}$

19) Calculate the r. m. s. velocity and average speed of H_2 at 50^oC.

20) Explain black body radiation for long and short wavelength region.

Question Bank

B. Sc. II Physics

Optics & Lasers (BPT 402)

Shot note

1) Lateral magnification.
2) Plane diffraction grating.
3) Positive and negative crystals.
4) Dextrorotatory and laevorotatory substances.
5) Two Properties of principal points.
6) Plane polarized light.
7) Specific rotation of a solution.
8) Interference of light.
9) Newton's ring.
10) Three pairs of cardinal points
11) Diffraction of light and its types.
12) Diffraction grating.
13) Angular magnification.
14) Axial magnification.
15) Diffraction of light
16) Resolving power
17) Magnifing power
18) Focal point
19) Nodal point
20) Principal points
21) Focal length
22) Double refraction
23) Equivalent focal length
24) Refractive index
25) Properties of light

Short answer question

1) Explain graphical construction of image using a thick lens. Derive Newton's formula.
2) Derive an expression for the optical path difference between two successively reflected rays of a monochromatic light for a thin parallel faced film and obtain the condition of minimum of interference.
3) Describe polarimeter experiment to determine the specific rotation of an optical active solution.

4) Derive the relation between the focal lengths f_1 and f_2 of any optical system.
5) Derive an expression for the radius of the n^{th} dark ring obtained by reflected light.
6) Show that the rings get closer as one goes away from the centre of the rings.
7) Explain double refraction by Huygens's method.
8) State the characteristics of the phenomenon of double refraction.
9) Obtain the condition of minimum of interference reflected rays of a monochromatic light for a thin parallel faced film
10) Describe polarimeter experiment to determine the specific rotation of an optical active solution.

Long answer question

1) Show that the distance between two principal points is equal to the distance between two nodal points.
2) Define the resolving power. Give difference between resolving power and magnifying power.
3) Explain interference in wedge shaped thin film.
4) State the properties of LASER's.
5) What is optical activity? State the laws of rotation of plane of polarization.
6) With the help of neat ray diagram discuss the experimental arrangement for the formation of Newton's rings.
7) Explain interference in wedge shaped thin film.
8) Write note on Fresnel's diffraction and Fraunhofer's diffraction.
9) What is optical activity? State the laws of rotation of plane of polarization.
10) What do you mean by crystals? State the relation between velocities, refractive
11) indices of O-ray and E-ray in each case.
12) Derive the relation between the Lateral Magnification & angular Magnification.
13) State the characteristics of the phenomenon of double refraction.

Explain the terms: (a) unpolarized light (b) plane of polarization (c) plane of vibration.