

B.Sc. Semester-V Examination, 2022-23**CHEMISTRY [Honours]**

Course ID : 51416 Course Code : UG/CHEM/503/DSE-1

Course Title : Advanced Physical Chemistry

Time : 1 Hour 15 Minutes

Full Marks : 25

*The figures in the right-hand margin indicate marks.**Candidates are required to give their answers in their own words as far as practicable.*1. Answer any **five** of the following questions:

1×5=5

- a) Define constructive interference.
- b) Calculate the distance between two parallel 121 Miller planes for a cubic system with edge length 1.6 Å.
- c) Find the number of atoms per unit cell in an FCC crystal.
- d) State the Nernst heat theorem.
- e) Give any one statement of the Third law of Thermodynamics.
- f) Define 'degree of polymerization' of a polymer.

g) Write down the Boltzmann distribution for a degenerate system stating the terms involved.

h) What is a 'thermosetting plastic'?

2. Answer any **two** of the following questions:

5×2=10

- a) i) Five-fold rotational axis of symmetry is impossible in case of a crystal.—Justify.
ii) For a particular wavelength of x-ray the first order diffraction angles for NaCl and KCl are 5.3° and 5.9° respectively. Find the ratio of d_{100} for the two crystals.
2+3=5
- b) i) Show that the barometric pressure distribution is a special case of the general Boltzmann distribution.
ii) Show the possible Bravais lattices in case of an orthorhombic crystal.
iii) Define a 'canonical ensemble'
2+2+1=5
- c) i) Derive the integrated rate equation for a condensation polymerization reaction catalyzed by a mineral acid.

ii) What is residual entropy? Calculate the residual entropy of Co solid. $3+2=5$

d) i) Calculate the percentage of the space occupied by the atoms in case of a body-centred cubic lattice.

ii) Write four limitations of x-ray powder diffraction (XRD) method. $3+2=5$

3. Answer any **one** of the following question:

$10 \times 1 = 10$

a) i) Define 'partition function'. Find an expression of Helmholtz's function of any system in terms of the partition function.

ii) Ag is known to crystallize in face centred cubic form and distance between the nearest neighbours is 2.87 \AA . Calculate the density of silver (Given: Atomic wt. of silver is 108)

iii) Find an expression of translational partition function.

iv) Define the number average molar mass of a polymer. $3+3+3+1=10$

b) i) Derive Bragg's equation. What is the maximum wavelength of X-ray that can be used for Bragg's analysis of a crystal with interplaner spacings 1.5 \AA .

ii) Considering the classical vibrational energy of a system find the vibrational partition function. Hence arrive at the Einstein's expression of molar heat capacity of a monatomic solid.

iii) Why is radical polymerization generally carried out under a nitrogen atmosphere?

iv) Define Frenkel defect. $3+4+2+1=10$
