3. Write short notes on :

(i) axial glide

(ii) isogonal symmetry group [2½×2]

4. Define space group. State the principle of notation of a space group. Describe the space groups under monoclinic system. [1+1+2]

5. A compound with molecular weight 868 is found to crystallize in monoclinic space group ($P2_1/c$), which has the following parameters :

a = 9·718 Å, b= 17·469 Å, c = 23·109 Å, β = 91·864° and Z = 4.

Find out the density of the crystal in gm/cm^3. 2

★★★

M. Sc. CHEMISTRY EXAMINATION, 2025

(3rd Semester)

PAPER : XI-I

Inorganic Chemistry Special
(X-ray Crystallography + IR, Ramam, CD and ORD Spectroscopy)

Time : *Two Hours* *Full Marks* : 40

(*20 marks for each Unit*)

Use a separate Answer Scripts for each Unit.

UNIT—I-3112

Answer *any* ***four*** question :

1. *(a)* Explain Stokes and anti-Stokes shift in Raman scattering from classical theory. 3

(b) What will the intensities of Stokes and anti-Stokes shift in *(i)* Vibrational-Raman scattering *(ii)* Rotational Raman scattering? Give reason. 2

2. Nitrous oxide gives the following IR and Raman spectroscopic data.

$\bar{\nu}(cm^{-1})$	Infra-red	Raman
589	Strong, *PQR* contour	–
1285	Very strong, *PR* contour	Very strong, polarized
2224	Very strong, *PR* contour	strong, depolarized

(i) Predict the structure of Nitrous oxide from the above data. 1

(ii) What do you mean by strong or very strong, *PR* contour term from IR spectroscopic data? 2

(iii) What do you mean by very strong, polarized and strong, depolarized term from Raman spectroscopic data? 2

3. *(a)* In quantum mechanics energy of zero vibrational level is not zero. Comment. 1

(b) Give idea about the frequency of hot band, fundamental band, 1st overtone and 2nd overtone in IR spectroscopy. Discuss the effect of temperature on intensities of those bands. 2+1=3

(c) Comment on $\nu(O_2)$ trend of the following species : O_2^+, O_2, O_2^- and O_2^{2-} 1

4. *(a)* Comment on $\nu(CO)$ values of $Mn_2(CO)_8X_2$ compounds where $X^-=Cl^-$, Br^-,I^-. 2½

(b) How will you prove the occurrence of linkage isomerism in $[Pd(dmso)_4]^{2+}$ (dmso= dimethylsulfoxide) with the help of IR spectroscopy? 2½

5. *(a)* What will be the nature of cotton effect in case of diasteromers and enantiomers? 1

(b) CD (circular dichroism) is used for monitoring the changes in conformation of a nucleic acid as a function of solvent. Explain with a suitable example. 2

(c) How can we distinguish different conformers of nuclic acid using CD spectroscopy? 2

UNIT—I – 3111

CO1

1. What is a crystal system? Describe the different crystal systems in terms of unit cell parameters and indicate the number of variables for each system. [1+2+1½]

2. State the meaning and draw stereographic projection of *any* **three** of the following :

(i) mmm *(ii)* 32 *(iii)* $\bar{4}$ *(iv)* $\bar{6}$2m [1½×3]