Raman and IR spectroscopic investigations of solids are of fundamental importance as they provide valuable information about the nature and symmetry of the vibrating ions and molecules, effect of crystalline field, degree of structural disorder, strength of hydrogen bonding etc. The thesis deals with Raman and IR investigations of some heteropoly, isopoly and simple hydrated tungstates and certain phosphates.

It starts with a general introduction to the basic ideas of vibrational spectra with special reference to normal modes determination in crystals, selection rules for IR and Raman Spectra, solid state effects, influence of perturbations such as anharmonicity, Fermi resonance and hydrogen bonding on the spectra etc. A brief review of the earlier works on the relevant tungstates and phosphates is also included.

Raman and IR spectral analysis of the 3 heteropoly tungstates $Na_{12}P_4W_8O_{40} \cdot 20H_2O$ and $M_{12}^nP_4W_{14}O_{58} \cdot nH_2O$ ($M = K$, $n = 21$ and $M = Na$, $n = 36$) discussed in chapter 2 reveals the existence of highly distorted $WO_6$ octahedra and $PO_4$ tetrahedra in them. The presence of both free and strongly hydrogen bonded water molecules have also been established. The spectra of $MgWO_4 \cdot nH_2O$ ($n = 1, 2$) and $Na_2WO_4 \cdot 2H_2O / D_2O$ have been discussed in chapter 3. To get a better picture of the intensities of some of the bands, a curve fitting analysis of some of the Raman bands is also done. It is found that the $WO_4$ tetrahedra are distorted considerably and the water molecules are strongly hydrogen bonded.
Isopoly tungstates are interesting in several fields of Chemistry such as catalysis, solid state applications, medicine etc. In the thesis (Chapter 4) the analysis of the IR and Raman spectra of the isopolytungstates \( \text{Na}_{10}H_{2}W_{12}O_{42}\cdot26H_{2}O \) and \( \text{Mg}_{5}H_{2}W_{12}O_{42}\cdot38H_{2}O \) have been carried out. The presence of distinct water molecules of varying hydrogen bond strength is noticed. The results also suggest that the \( \text{WO}_6 \) octahedra are highly distorted in the lattice.

The ion \( \text{P}_2\text{O}_7^{4-} \) can have different symmetries in a crystal. From a detailed analysis of the IR and polarised Raman spectra of \( \text{Na}_4\text{P}_2\text{O}_7\cdot10\text{H}_2\text{O} \) it is inferred that the \( \text{P}_2\text{O}_7^{4-} \) ion has \( C_{2v} \) symmetry in it. Multiple bands observed for the stretching and bending modes of water are explained on the basis of different hydrogen bond strengths and correlation field effect. These results are presented in Chapter 5.

In amino acids, usually protonation of the nitrogen atom takes place at the expense of the proton from the carboxyl group. The analysis of the IR and Raman spectra of \( \text{N},\text{N}-\text{bis (phosphonomethyl glycine) dihydrate} \) reveals the protonation of the nitrogen atom at the expense of the proton of phosphonium group.

The trimetaphosphate ion \( \text{P}_3\text{O}_9^{3-} \) exhibits a cyclic or a chain structure in different substances. The ring-chain polymorphism can effectively be studied by IR and Raman spectroscopy. The results obtained for the polycrystalline \( (\text{CH}_3\text{NH}_3)_3\text{P}_3\text{O}_9 \) and single crystal \( \text{K(NH}_3\text{CH}_2)_2\text{P}_3\text{O}_9 \) have been given in the last two chapters. In the first compound, the \( \text{P}_3\text{O}_9^{3-} \) ion is found to have a ring structure with moderate hydrogen bond
strength between NH$_3^+$ and the external oxygens of P$_3$O$_9^{3-}$ ion. In the second compound also the results conform to a ring structure for the P$_3$O$_9^{3-}$ ion. Unusually high frequencies have been observed for the stretching vibrations of P–O–P bridge. Strong hydrogen bonding of the NH$_3^+$ ion with the external oxygens of P$_3$O$_9^{3-}$ ion is also noticed in this crystal. Fermi resonance between NH stretching fundamentals and overtones of the NH deformation modes have been observed.