This thesis describes the synthesis and characterization of various organic-inorganic hybrid solids of polyoxometalates and transition metal complexes, based on Cobalt, Copper and Molybdenum and investigation of its properties. A brief summary of the work discussed in previous chapters and the general conclusions drawn from the research are outlined in this chapter.

*Chapter I* provides a brief review on organic-inorganic hybrid solids; its historical perspective and development. A detailed discussion on the structure, properties and applications of POM cluster based hybrids (Class A) and transition metal based hybrids (Class B) were presented. Various synthetic methods used for the preparation of hybrid solids were also discussed. Finally, the motivation for the present work was briefly outlined.

*Chapter II* describes the self-assembly of Anderson-Evans type POM cluster based hybrid solids, prepared via solvent evaporation method and pyrazole as the organic precursor. The synthesized solids were characterized by SCXRD, PXRD, FTIR and TGA. The synthesized Anderson clusters were found to be promising candidates for effective polymerization of pyrrole and for preparing polymer based composite materials.

One of the objectives of the work was to explore the nature of reaction conditions such as temperature, pH, nature of reacting molecular units and effect of solvent in the formation of various hybrid solids which in turn can affect the final properties. Hence, in *Chapter III*, an attempt was made to synthesize POM cluster hybrids with 2-aminopyrazine as the organic precursor. However, it resulted in the formation of a new complex of cobalt namely, $[Co(2\text{-H}ampz)_2Cl_4]$ which was a pseudopolymorph of $[Co(2\text{-}ampz)_4Cl_2]$. The synthesized Co(II) complexes were screened for their antibacterial activity against various bacterial strains. Molecular docking studies were also carried out using DNA gyrase as

the protein target. The *in vitro* and *in silico* studies indicated that the complexes can cat as novel antimicrobial agents.

*Chapter IV* investigates the phenomenon of chromotropism in aminopyridine based tetrachlorocuprates, particularly, solvatochromism, vapochromism and thermochromism. Tetrachlorocuprate(II) anions stabilized by protonated aminopyridines was found to be a significant class of chromogenic materials which may find application as sensors and detectors.

*Chapter V* describes the synthesis and characterization of surfactant (CTAB) templated phosphomolybdate solid. The hybrid was investigated for its potential in removing cationic and anionic dyes from aqueous solutions and was found to be an effective adsorbent for removing cationic dyes. It could also be reused upto 6 cycles without any loss in its adsorption efficiency and hence it can serve as a novel adsorbent for selective removal of cationic dyes in effluent treatment process.

*Chapter VI* explores the synthesis and characterization of a novel composite based on ammonium phosphomolybdate and Polypyrrole. It was found that the new composite displayed interesting color variations in acidic, basic and neutral solutions and hence, can be used as a pH sensor and as an end point indicator in different acid-base titrations.