

**20CY102 INORGANIC CHEMISTRY - 2**

Hours Per Week :

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**COURSE DESCRIPTION AND OBJECTIVES :**

The main objectives of this course are to understand the basics of inorganic compounds belong to S & P block elements, their synthesis, structure, bonding and reactions. The students are able to gain skills in advanced inorganic chemistry topics such as organometallic catalysts, supramolecular motifs and coordination polymers etc. Finally, by using this knowledge they should be able to apply for industrial applications such as engineering materials, catalysts and Dyes & pigments etc.

**COURSE OUTCOMES:**

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes
1	Understand the basics knowledge about S & P block elements for their synthesis, structures, bonding and properties.
2	Apply the concept of organometallic chemistry to homogeneous catalysis and their industrial applications.
3	Investigate the concept of supramolecular chemistry for their synthesis, structures, properties and applications.
4	Understand the basics knowledge about porous coordination polymers and apply them to their structure-property relations.
5	Analyze various inorganic compounds mainly used for industrial and manufacturing processes.

**Unit - I:****The Chemistry of s & p-block Elements :**

Organo-magnesium chemistry, Heavier alkaline earth metals in Catalysis; Use of Metal-oxide catalysts in Organic synthesis; Inorganic Chains: Chain Catenation, Heterocatenation, Silicate Minerals, Intercalation chemistry; Rings: Borazines, Phosphazenes, Heterocyclic & homocyclic inorganic rings; Cages: Phosphorous Cages, Boron Cages – Boranes and Carboranes, Zeolites: Synthesis, Properties and applications.

**Unit - II:****Organometallic compounds of Transition metals & Homogeneous catalysis:**

Synthesis and properties of organometallic compounds with carbonyl, hydrocarbyl, phosphines and nitrosyl ligands; Fluxionality of OMC's; Organometallic compounds as electrophiles, nucleophiles, activating agents, protecting agents, redox agents; Homogeneous Catalysis: Tollman's catalytic cycle, Oxo process, Monsanto Process, Wacker Process, Epoxidation, Reppe's catalysis, Heck reactions and Suzuki coupling.

**Unit - III:****Supramolecular Chemistry :**

Nature of Supramolecular Interactions, Solvation and Hydrophobic Effects, Porphyrins and Tetrapyrrole Macrocycles, Cation-Binding Hosts: Crown Ethers, Lariat Ethers, Podands and Calixarenes, Anion-Binding Receptors: Biological Anion Receptors, Guanidinium-Based Receptors, Neutral Receptors, Inert Metal-Containing Receptors, Ion-Pair Receptors; **Crystal Engineering**: Tectons and Synthons, The Special Role of Hydrogen Bonding, Hydrogen Bond Acidity and Basicity, Crystal Nucleation and Growth, Polymorphism in pharmaceutical drugs, Co-crystals and Crystal Engineering Design Strategies.

**Unit - IV:****Coordination Polymers :**

Coordination Polymers, MOFs and Other Terminology, Zero-dimensional Coordination Clusters, 1D, 2D and 3D Structures, Magnetism, Negative Thermal Expansion, Interpenetrated Structures, Porous and Cavity-Containing Structures, Metal-Organic Frameworks, Catalysis by MOFs, Hydrogen Storage by MOFs

**Unit - V:****Industrial Inorganic Chemistry :**

Introduction, Heavy and Fine chemicals; Manufacture of ammonium phosphates, carbon blacks, manufacture of graphite, calcium carbide, silicon carbide, Glass and Ceramic materials. **Industrial Catalysts**: Raney Nickel, Palladium, Copper chromate, Vanadium and Platinum based catalyst. **Industrial applications**: Dyes & pigments: Inorganic pigments, classification, properties, Azo-dyes, natural dyes and their interactions with metals.

**Text Books:**

1. Inorganic Chemistry: Principles of Structure and Reactivity by J. E. Huheey, E. A. Keiter and R. L. Keiter, 4th Ed. Harper Collins 1993.
2. Organometallic Chemistry of the Transition Metals by R. H. Crabtree, John Wiley, 4th Ed. 2005.
3. Supramolecular Chemistry – Fundamentals and Applications by Katsuhiko Ariga · Toyoki Kunitake, Springer-Verlag Heidelberg, 2006.

**Reference Books:**

1. Supramolecular Chemistry, by Jonathan W. Steed and Jerry L. Atwood, 2<sup>nd</sup> Ed. A John Wiley and Sons, Ltd, Publication,
2. Alkaline-Earth Metal Compounds – oddities and applications: Topics in Organometallic Chemistry, by Sjoerd Harder. 2013.
3. Organometallic chemistry by R. C. Mehrotra and A. Singh, 1992, Wiley Eastern Ltd.
4. Design and Construction of Coordination Polymers by Mao Chun Hong Ling Chen, John Wiley & Sons, Inc. 2009.
5. Inorganic Pigments by Pfaff, Gerhard, De Gruyter Textbook, 2017. ISBN: 978-3-11-048451-9.
6. Industrial Inorganic Chemistry by Karl Heinz Büchel and Hans-Heinrich Moretto, 2<sup>nd</sup> Ed., 2000.