

Subject Code: 02CY1452**Subject Name: Inorganic Chemistry-II****M.Sc. Sem - II****Objectives:**

- To understand the key features of symmetry and group theory, including the variety of theory and its applications in inorganic chemistry.
- To be able to understand Mossbauer Spectroscopy, its application and implementation on inorganic compounds.
- Increase awareness of the contributions of bioinorganic chemistry.
- To learn about organometallic compounds and its importance in inorganic chemistry.

Credits Earned: 6 Credits**Course Outcomes:** After completion of this course, student will be able to

- Explain the fundamental concepts in symmetry and group theory.
- Explain the application of Mossbauer spectroscopy.
- Analyse and implement bioinorganic chemistry in day to day life.
- Realize the importance of organometallic compounds and its role as catalyst in organic transformation.

Pre-requisite of course: Students must have basic knowledge of spectroscopy and of bioinorganic chemistry. Also they should be aware of quantum chemistry and ion exchangers..**Teaching and Examination Scheme**

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial/ Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE (E)	IA	CSE	Viva (V)	Term work (TW)	
5	-	2	6	50	30	20	25	25	150

Contents:

Unit	Topics	Contact Hours
1	Symmetry and Group Theory Symmetry elements and operations, point group and their symmetry elements, Group multiplication tables and their operations, characteristics of point groups, group theory and its transformation, reducible and irreducible representations, applications of group theory.	15
2	Mossbauer Spectroscopy Introduction and Schematic Diagram of Mossbauer Spectrophotometer, Principle and Instrumentation of Mossbauer spectra, Applications, Quadrupole splitting. Recoil energy, Doppler effect. Experimental techniques. Chemical Shift.	10
3	Bioinorganic Chemistry Introduction, Biological importance and toxicity of metal ions, Na ⁺ - K ⁺ pump, Ionophores and crown ethers. Metal ion transport and storage: Ferritin, Transferrin and Siderophores. Electron Transfer: Cytochromes, Iron-Sulfur Proteins and Copper Proteins. Oxygen transport and storage: Hemoglobin, myoglobin, hemerythrin and hemocyanin. Oxygen activation: Cytochrome P450, Cytochrome c oxidase. Other metal containing enzymes: Catalase, peroxidase, superoxide dismutase, alcohol dehydrogenase, carbonic anhydrase, carboxypeptidase, nitrogen fixation, vitamin B12coenzyme, Structure of chlorophyll, photosynthesis.	15
4	Advance Organometallic Chemistry Introduction, Classification of organometallic compounds, Nomenclature of organometallic compounds, ionic organometallic compounds, organometallic compounds of various group, Classification of ligands in organometallic compound, 18-electron rule, metal carbonyl, metal nitrosyl, metal cluster, isolobal analogy. Metal alkyls, alkenes, alkynes and allyl complexes. Metal hydrides, metallocene, Metal arene complexes and Fluxional molecules. Agostic interaction, Oxidative addition and reductive elimination, insertion and elimination reactions. Homogeneous and heterogeneous catalysis. Introduction to Homogeneous and heterogeneous catalysis, types of catalyst and its commercial applications, Ziegler-Natta catalyst, Wilkinson catalyst, Fischer-Tropsch, Zeolites as catalyst for organic transformations.	20
	Total Hours	60

References:

1. Inorganic Chemistry, Catherine E. Housecroft and Alan G. Sharpe.
2. Vogel's Text book of Quantitative Inorganic Analysis, ELBS Press.
3. J. E. Huheey, E. A. Keiter, R. L. Keiter, Inorganic Chemistry, 4thedn., HarperCollins, 1993.
4. D. F. Shriver and P. W. Atkins, Inorganic Chemistry, 3rdedn., OxfordUniversity Press.
5. E. J. D. Lee, Concise Inorganic Chemistry, 5th edn., Blackwell Science, London.

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6. Advanced Inorganic Chemistry- F. A. Cotton & G. Wilkinson, John Wiley.
7. Elements of Bioinorganic Chemistry- G. N. Mukherjee & A. Das.
8. B. R. Puri, L. R. Sharma, Kalia, Principles of Inorganic Chemistry, Milestone Publishers, New Delhi.
9. B. Douglas, D. Mc Daniel, J. Alexander, Concepts and models in Inorganic Chemistry.
10. The Organometallic chemistry of transition metal, Robert H. Crabtree.
11. Advance Inorganic Chemistry volume II, SatyaPrakash, Dr. G. D. Tuli, Dr. S. K. Basu, Dr. R. D. Madan, S. Chand Publication.
12. G. O. Spessard, G. L. Miessler, Organometallic Chemistry, Prentice Hall, 1997.
13. C. Elsehenbroich and A. Salzer, Organometallic Chemistry, 2nd edition, Wiley VCH, 1992.
14. N. N. Greenwood and A. Earnshaw, Chemistry of the Elements, 1st edition, Pergamon.
15. Ajai Kumar, Organometallic and Bioinorganic Chemistry, Aaryush Education, Ghaziabad.

Suggested Theory distribution:

The suggested theory distribution as per Bloom's taxonomy is as per follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember	Understand	Apply	Analyze	Evaluate	Create
10%	15%	15%	25%	20%	15%

Suggested List of Experiments:

1. Qualitative analysis: Analysis of mixture containing six radicals.
2. Qualitative analysis: Analysis of mixture containing six radicals including one rare metal ions-Li.
3. Qualitative analysis: Analysis of mixture containing six radicals including one rare metal ions-Mo.
4. Qualitative analysis: Analysis of mixture containing six radicals including one rare metal ions-W.
5. Qualitative analysis: Analysis of mixture containing six radicals including one rare metal ions-V.
6. Qualitative analysis: Analysis of mixture containing six radicals including one rare metal ions-Zr.
7. Qualitative analysis: Analysis of mixture containing six radicals including one rare metal ions-Se/Ti.

Reference Books:

1. Vogel's textbook of quantitative chemical analysis, fifth edition, Longman Scientific & Technical.

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2. D. A. Skoog, D. M. West, and S. R. Crouch, Fundamentals of Analytical Chemistry 8th edn, Brooks/Cole Nelson.
3. G. D. Christian, Analytical Chemistry, JohnWiley and Sons.

Instructional Method:

- a. The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.
- b. The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.
- c. Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.
- d. Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory.
- e. Use of hazardous/toxic chemicals should be avoided as far as possible in laboratory.
- f. All students in the laboratory must wear safety goggles and lab coats during lab session.

Supplementary Resources:

1. <http://store.elsevier.com/Comprehensive-Inorganic-Chemistry-II/isbn-9780080977744/>
2. <http://chemistry.about.com/cs/generalchemistry/a/aa072103a.htm>
3. <https://www.youtube.com/watch?v=LkPNsgAVeeQ>
4. https://www.youtube.com/watch?v=HC81oYe43DI&list=PLm8ZSArAXicL3jKr_OnHHs5TwfhdKMFhh
5. https://www.youtube.com/watch?v=jOf_zHw2Hd4
6. https://www.youtube.com/watch?v=EE_T20QYSvw
7. <http://www.nptel.ac.in/courses/104103069/#>
8. <http://ocw.mit.edu/courses/chemistry/>
9. <http://vlab.amrita.edu/index.php?sub=2>
10. http://www.vlab.co.in/ba_labs_all.php?id=9