

Approval: 9th Senate Meeting

Course Name:	Organometallic Chemistry
Course Number:	CY 508
Credits:	2-0-0-2
Prerequisites:	CY506 and CY507
Intended for:	M.Sc Chemistry (2 nd year)
Distribution:	core
Semester:	Odd/Even

Course Outline:

The course forms a core course for the M. Sc. (Chemistry) degree program. The course provides students a comprehensive introduction to the principles and general properties of organometallic compounds. This also includes information on reaction mechanisms, organic synthesis applications and catalysis. The course also provides an overview to the students about the important aspects of organotransition-metal complexes with a basic understanding of mechanism, structure-activity relationships and their utility in organic synthesis.

Modules:

Module-I(6 hours)

Introduction to organometallics: Brief history of organometallic chemistry, Werner Complexes, Types of Ligand, Soft Versus Hard Ligands, The Crystal Field, The Ligand Field, Back Bonding, Electroneutrality, Oxidation State, Coordination Number and Geometry, Effects of Complexation, Differences between Metals, Outer-Sphere Coordination, Kepert Model, VBT, MOT, The Trans Effect and its theory

General Properties of Organometallic Complexes: The 18-Electron Rule, Limitations of the 18-Electron Rule, Electron Counting in Reactions

Metal Alkyls, Aryls, and Hydrides and Related σ -Bonded Ligands Transition Metal Alkyls and Aryls, Related σ -Bonded Ligands, Metal Hydride Complexes, σ Complexes, Bond Strengths for Classical σ -Bonding Ligands

Carbonyls, Phosphine Complexes, and Ligand Substitution Reactions Metal Complexes of CO, RNC, CS and NO, phosphines and related ligands

Module-II.....(10 hours)

Oxidative Addition and Reductive Elimination Concerted Additions, SN2 Reactions, Reductive Elimination, Oxidative Coupling and Reductive Cleavage, Dissociative Substitution, Associative Mechanism, Redox Effects, the I Mechanism, and Rearrangements in Substitution, Photochemical Substitution, Steric and Solvent Effects in Substitution, **Insertion and Elimination** Reactions Involving CO, Insertions Involving Alkenes

Nucleophilic and Electrophilic Addition and Abstraction Nucleophilic Addition to CO, Electrophilic Addition, Electrophilic Abstraction of Alkyl Groups, Single-Electron Transfer Pathways

Module-III.....(6 hours)

Homogeneous Catalysis Alkene Isomerization, Alkene Hydrogenation, Alkene Hydroformylation, Hydrocyanation of Butadiene, Alkene Hydrosilation and Hydroboration, Coupling Reactions, Surface and Supported Organometallic Catalysis, Grubbs' and Schrock catalysts

Clusters and the Metal–Metal Bond Structures, The Isolobal Analogy, Synthesis, Reactions, Giant Clusters and Nanoparticles, Giant Molecules, Borane, carborane, metalocarborane, bimetallic and clusters complexes structure and application in catalysis

Applications of Organometallic Chemistry Alkene Metathesis, Dimerization, Oligomerization, and Polymerization of Alkenes, Activation of CO and CO₂, CH Activation, Organometallic Materials and Polymers, σ -Bond Metathesis

Module-IV.....(6 hours)

Introduction to Bio-organometallic Chemistry : Organometallic enzymes and coenzymes, Vitamin B12 coenzyme, B12 model compounds, Organometallic compounds as drugs, Organometallic compounds as radiopharmaceuticals, tracers, ionophores and sensors
Introduction to metallocenes

Important Reactions :Beta hydride elimination, Olefin Metathesis and Cross Coupling Reactions, reaction with metals and transmetallation, hydrometallation, Heck reaction, Suzuki-Miyaura coupling, Sonogashira coupling, Stille coupling and Negishi coupling, industrial applications of cross coupling reactions.

Text books:

1. The Organometallic Chemistry of the Transition Metals by Robert H. Crabtree, publisher: Wiley-Blackwell; 5th Edition, (23 April 2009) ISBN-10: 0470257628
2. Basic Organometallic Chemistry by B D Gupta & A J Elias (Univ Press)
3. Organometallics by Christoph Elschenbroich
4. Fundamentals of Organometallic Catalysis by Dirk Steinborn

Reference Books:

1. Organometallic Chemistry: A Unified Approach, by R. C. Mehrotra, publisher: New Age International Publishers; 2 Edition edition (1 December 2009) ISBN-10: 8122412580
2. Applied Organometallic Chemistry And Catalysis by Whyman Robin, publisher: Oxford University Press (2012), ISBN-10: 0195674162