



**GIAN Course**  
**on**  
**Metal-Ligand Interplay in Advanced Coordination Chemistry**  
**at**  
**Indian Institute of Technology Indore**  
**on**  
**February 5 – 9, 2018**

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## Overview

The lectures will be directed towards Master and PhD students with an inorganic/coordination chemistry background. After briefly reviewing generalities about Coordination Chemistry and its broader impact, we will examine how chelating ligands can bring about unique properties to their metal complexes, in particular when the donor functions are chemically different. Those with P-O, P- N, N-O types donors will serve to illustrate these points. Such hybrid ligands can behave as static or dynamic ligands showing hemilabile behaviour, and in both cases, major effects can be observed in homogeneous catalysis. One specific reaction will be examined, the selective oligomerization of ethylene. A recently developed new class of ligands, associating N-heterocyclic carbene donors with O-, S-, or P donors will also be discussed.

Furthermore, combining different metal centres within the same molecule can produce a considerable diversity of structures. Special emphasis will be on systems containing a direct metal-metal bond in dinuclear and cluster complexes. The latter can serve as unique precursors to new nanomaterials and heterogeneous catalysts. Finally, complexes displaying metallophilic interactions (between close-shell ions) will be introduced together with their applications in photophysics.

## Objectives

This course aims at highlighting for the students the links between basic concepts operating in coordination/organometallic chemistry and recent research achievements. In turn, experimental research may lead to new concepts that need to be introduced in modern teaching. These lectures will largely make use of research results from the speaker (but not only), which should offer a rather unique vision of the topics discussed.

Another objective of this course is to illustrate the specificity and added value of coordination chemistry and how new concepts and experimental achievements have advanced the field. The diversity of applications encountered and the numerous interfaces with the areas of functional materials, nanosciences and catalysis, and the exciting challenges ahead of us could attract students towards PhD programmes. Numerous examples will be given to illustrate the concept of serendipity and how it can affect the direction of future research. The course would also update college teachers on recent advances in the field of metal-ligand interactions.

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**Lecture Schedule**

**Module 1: 4 hours**

- Generalities about Coordination Chemistry
- Static and Dynamic Chelating Ligands; Catalytic Relevance

**Module 2: 3 hours**

- Hybrid Chelates of the P-O, P-N, N-O types and their Role in Catalytic Ethylene Oligomerization
- N-Heterocyclic Carbene Donors in Hybrid Ligands

**Module 3: 4 hours**

- Metal-Metal Bonding and Metal Clusters: Synthetic and Structural Aspects, Electron-Counting Rules
- Metallophilic Interactions
- Fluxionality in organometallics – Introduction and techniques

**Module 4: 3 hours**

- Assembling approaches in cluster chemistry for enhanced cooperativity
- Hybrid Ligands: Metal Complexes, Catalysts and Precursors to Nanomaterial
- Fluxionality in organometallics – Metal carbonyl exchange process

**Module 5: 3 hours**

- Synthesis and Coordination Chemistry of Quinonoid Zwitterions
- Functional N-Heterocyclic Carbenes : Unusual Metal Complexes and Metallophilic Interactions
- Fluxionality in organometallics – Fluxional  $\pi$  – hydrocarbon complexes

**Who Should Attend**

- \* Masters and PhD students from Chemistry, Physics, Material Science and Engineering from different institutes across the country.
- \* Researchers in R&D laboratories.
- \* Faculty and academics interested in interdisciplinary research in design and synthesis of molecular magnets.
- \* Researchers in education from reputed institutes as catalysis by metal complexes is a much sought after, but little taught in India, subject.



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**Registration Process**

One time registration (mandatory) to be done at GIAN Portal <http://www.gian.iitkgp.ac.in/GREGN/index>

**Course Registration**

**Registration Fees (excluding GIAN portal registration fees)**

- \* Academic Institutions: Rs 5,000/- per participant for each institute
- \* Participants from industry: Rs 40,000/- per participant for each institute
- \* Participants from abroad: US \$ 500
- \* Free for participants from host institute

*Note: The above fee includes all instructional material, tutorials, and refreshments. Participants can use institute accommodation on payment basis, subject to availability and on first come first serve basis.*

**Bank Details for NEFT**

Name of the Beneficiary: IIT Indore Project and Consultancy Account

Name of Bank: Canara Bank

Branch: IIT Indore, Simrol Campus Branch

Beneficiary Account No.: 1476101027440

Bank MICR Code: 452015003

Bank IFS Code: CNRB0006223

**Course Co-ordinator**

Professor Pradeep Mathur

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## About the Experts



**Pierre Braunstein** received his Dr. Ing. Degree in Inorganic Chemistry from the University Louis Pasteur Strasbourg (France) and then spent a year at University College London, with Profs. R. S. Nyholm and R. J. H. Clark as a Royal Society/CNRS post-doctoral fellow. After his State Doctorate from the University Louis Pasteur Strasbourg, he went to the Technical University Munich with Prof. E. O. Fischer (Nobel Laureate) as Alexander-von-Humboldt post-doctoral fellow.

He became Research Director Exceptional Class within the CNRS, and is Emeritus Research Director and “Professeur Conventionné de l’Université de Strasbourg” since Sept. 2014 (Coordination Chemistry Laboratory, Institute of Chemistry, UMR 7177 CNRS).

His broad research interests lie in the inorganic and organometallic chemistry of the transition and main group elements, where he has (co)authored almost 600 scientific publications and review articles. They cover the study of metal-metal bonded (hetero)dinuclear and cluster complexes, coordination clusters, of functional and hemilabile ligands (N, P, O, NHC donors, ...), of quinonoid zwitterions with delocalized organic p-systems, suitable for electronic communication, and their deposition as thin films. Applications range from homogeneous catalysis, e.g. ethylene oligomerization, to cluster-derived nanoparticles for heterogeneous catalysis and nanosciences.

He has received numerous awards and honors from France, China, Germany, Italy, Japan, Portugal, Spain, The Netherlands and the United Kingdom. He is a member *i.a.* of the French Academy of Sciences, of the German Academy of Sciences Leopoldina and since 2015, Head of the Division of Chemical Sciences in the European Academy of Sciences.



**Pradeep Mathur** is the Director of the Indian Institute of Technology Indore. He is also a Professor of Chemistry at the same institute as well as at Indian Institute of Technology Bombay. Prior to joining IIT Bombay in 1984, Dr. Mathur was at Yale University as a postdoctoral research associate and has been a Visiting Professor at Cambridge University, Freiburg University and Karlsruhe University. He obtained his Ph. D. and DSc-hc from Keele University and a BSc (Hons) in Chemistry from the University of North London. Dr. Mathur is a recipient of the prestigious Shanti Swarup Bhatnagar Prize in Chemical Sciences. He is a J. C. Bose Fellow and a Fellow of the Indian Academy of Sciences, Bangalore. He is a member of various committees of the Government of India’s largest funding agency, the Council of Scientific and Industrial Research and has authored over 200 research papers and has supervised 27 PhD theses. He has been or is on Editorial Boards of several journals, including *Organometallics*, *Journal of Organometallic Chemistry* and *Journal of Cluster Science*.