



**Department of Chemistry
IIT Kanpur**

Department Placement Brochure



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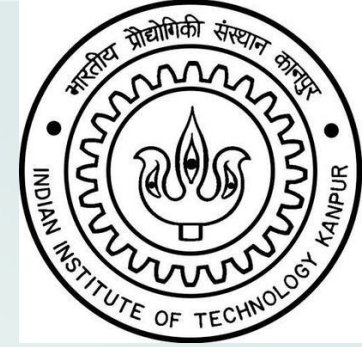
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VISION

To create, disseminate and translate knowledge in science, engineering and allied disciplines that will best serve the society.

About IIT Kanpur



- Motto : तमसो मा ज्योतिर्गमय
- Public engineering institution in Kanpur, Uttar Pradesh, Established in 1959
- Institute of National Importance by GOI
- During the first ten years of its existence, a consortium of nine US universities helped set up IIT Kanpur's research laboratories and academic programmes under the **Kanpur Indo-American Programme (KIAP)**
- The campus is designed by Achyut Kavinde in a modernist style

IIT Kanpur in QS University Rankings 2022

Jumps 73 places to be ranked at 277 in the world

4th best university in India

93rd in the world in terms of citations per faculty



About the Department

- One of the **premier** departments at IITK
- Contributes to **research** and **industry**
- Address problems of **societal importance**

- The Department started its journey in early 1960's under the headship of **Prof. C.N.R. Rao**
- The faculty propelled the department forward with excellence in modern chemistry teaching and research.

- To name a few present faculty members with distinguished awards;
Prof. Vinod K Singh - Synthetic Organic Chemistry - Padma Shri
Prof. Amalendu Chandra - Statistical mechanics and molecular simulations - Shanti Swaroop Bhatnagar
Prof. J. N. Moorthy - Physical Organic Chemistry - Shanti Swaroop Bhatnagar
Prof. V. Chandrasekhar - Bioinorganic and Supramolecular Chemistry - Shanti Swaroop Bhatnagar
Prof. Sandeep Verma - Chemical Biology - Shanti Swaroop Bhatnagar

From the HODs Desk

The Department of Chemistry, Indian Institute of Technology, Kanpur is one of the premier departments in the country today. The strength of the department has been and continues to be excellence in research and teaching.

The faculty of department is extremely well qualified, and motivated with a strong commitment to teaching and research. The commitment to research is reflected in the large number of projects sponsored by the Ministry of Human Resources and Development, Department of Science and Technology, Department of Atomic Energy, Department of Space and Council of Scientific and Industrial Research.

The alumni of the Department occupy high positions in industry and academia, in India and abroad. Their accomplishments have been outstanding and reflect on the quality training imparted at the undergraduate and graduate level.



Professor Jitendra K. Bera

Labs in the department

Main group, Coordination, Organometallic Lab	Theoretical Chemistry Group
Inorganic Synthesis And Bioinspired Catalysis	Molecular Functional Materials Research
Organometallic Synthesis and Catalysis	Quantum Thermodynamics Group
● Multifunctional Molecular Nanofilms	Femto Lab
Bioinorganic Laboratory	Computational Chemistry lab
Total synthesis of biologically active natural products.	Plasmonic Chemistry Research Group
Energetic Materials Lab	Bio-Nanoparticle Lab
Organic Photochemistry	Theoretical Chemistry Research Group
Organic Synthesis and Bioorganic lab	Ultrafast Spectroscopy Laboratory
● Synthetic organic chemistry	Supramolecular Lab

Recent Notable Achievements

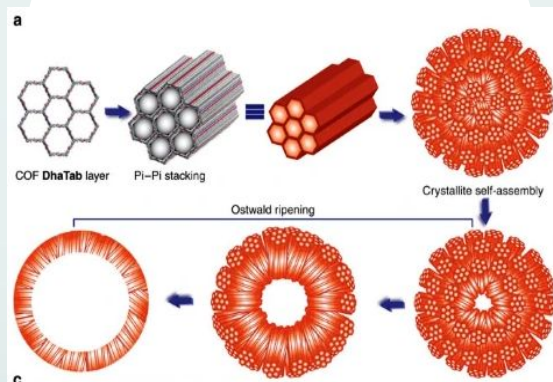
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Synthesis of Chiral Hexahydropyrroloindoles



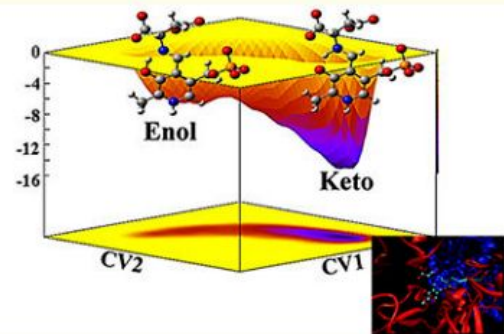
02

Hollow Frameworks



03

Multiscale Modelling



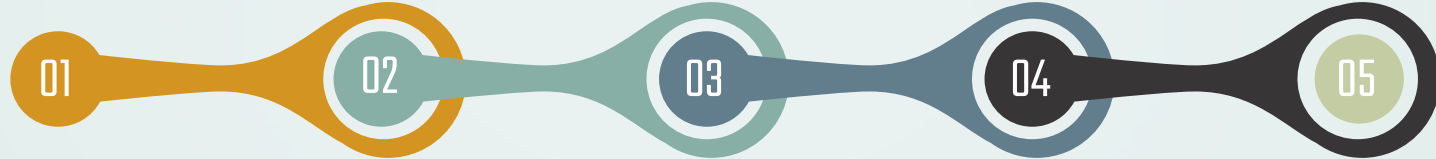
Major Degree Programs

Master of Science (M.Sc)

Post bachelors degree in chemistry
Admission via Joint Admission Test to M.Sc. (JAM)
Combination of compulsory and elective courses
Are required to carry out research

Dual-majors (BS-MS)

Bachelors-Masters Integrated program
5 years



Bachelor of Science (BS.)

4-year
Admission via Joint Entrance Examination (JEE)
Basic courses Electives in chemistry and open electives
Research projects (UGP)

Minors

Done along with Bachelor's degree
Offered in Organic, Inorganic and Physical Chemistry

PhD

Doctorate in Philosophy
5 years
Admission by either of the two nation-wide examinations post M.Sc
Rigorous Interview

INORGANIC CHEMISTRY

The research interests of inorganic section span diverse areas that include

- Coordination chemistry
- Bioinorganic chemistry
- Organometallic chemistry
- Catalysis
- Supramolecular chemistry

Some of them are

- The study of inorganic entities in biological systems is major topic of interest
- Studies on heme centers in heme protein
- Topics related to medicinal inorganic chemistry
- The creation of new chemical entities with interesting structures
- Magnetic and electrochemical properties for applications in catalysis and material chemistry





ORGANIC CHEMISTRY

Research areas in organic chemistry- Includes an eclectic mix of Traditional and Contemporary fields such as

- Bioorganic chemistry,
- New reaction development,
- Natural product synthesis,
- Photochemistry,
- Chemical biology,
- Organic materials
- Catalysis.

In addition to studying the chemistry of small molecules,

- The synthesis and application of carbohydrate and peptide based architectures
- Metal-organic frameworks for applications in medicine and material science

are also being performed in a number of laboratories.



PHYSICAL CHEMISTRY

Research areas in the domain of physical chemistry encompass

- Computational and Theoretical chemistry
- Reaction dynamics
- Spectroscopy
- Materials chemistry

Specific areas include

- Fundamental gas phase molecular dynamics
- Statistical mechanics

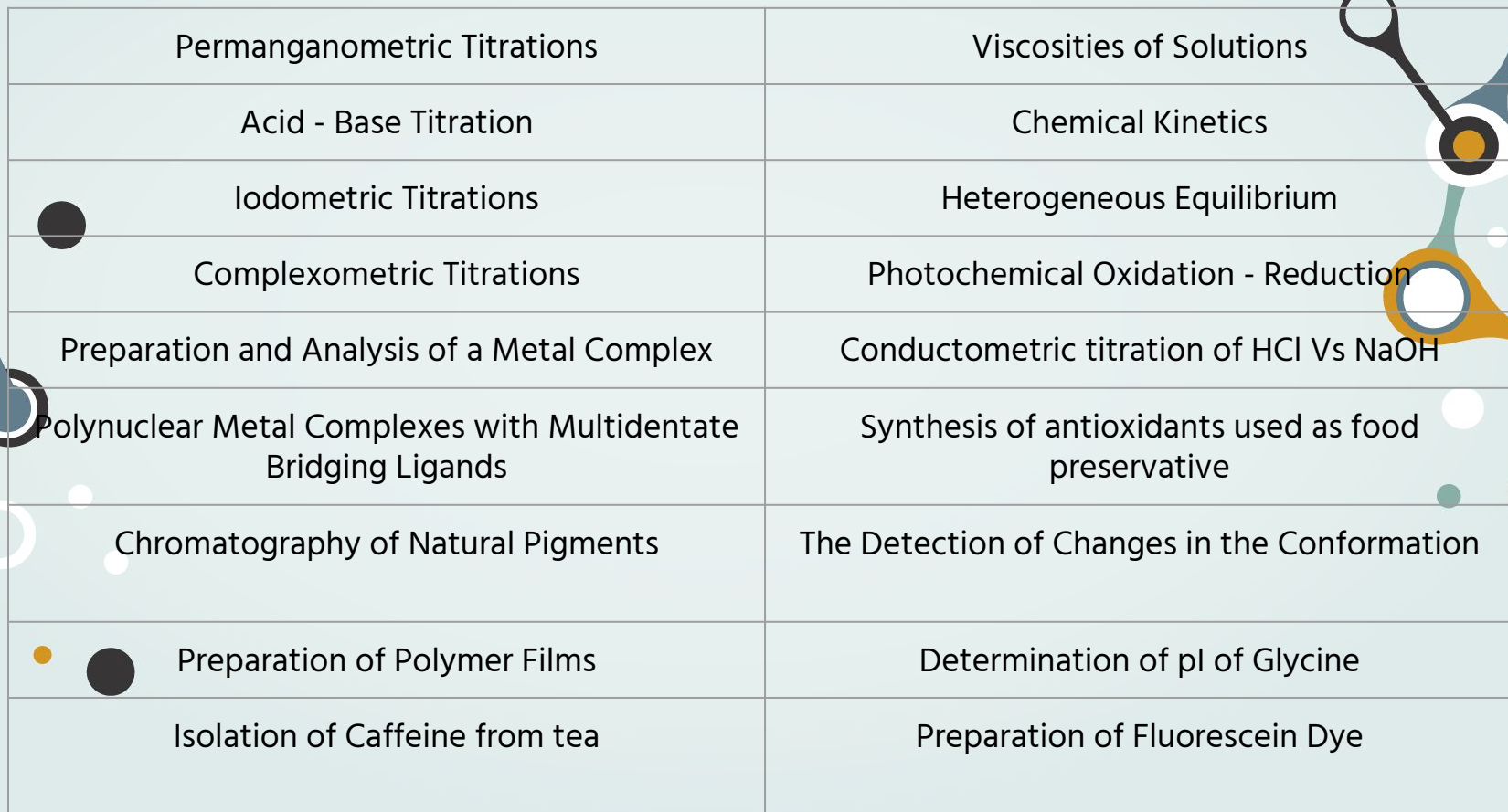
Application of modern techniques like

- Ultrafast pulse-shaping
- Molecular beams
- Single molecule spectroscopy and imaging
- Fluorescence correlation and up-conversion

Both experimental and theoretical research components are strongly represented.



Basic Chemistry Lab



Permanganometric Titrations	Viscosities of Solutions
Acid - Base Titration	Chemical Kinetics
Iodometric Titrations	Heterogeneous Equilibrium
Complexometric Titrations	Photochemical Oxidation - Reduction
Preparation and Analysis of a Metal Complex	Conductometric titration of HCl Vs NaOH
Polynuclear Metal Complexes with Multidentate Bridging Ligands	Synthesis of antioxidants used as food preservative
Chromatography of Natural Pigments	The Detection of Changes in the Conformation
Preparation of Polymer Films	Determination of pI of Glycine
Isolation of Caffeine from tea	Preparation of Fluorescein Dye

Organic qualitative and quantitative analysis

1. Experimental Techniques

(A) Purification of Organic Compounds

- Recrystallisation
- Sublimation
- Steam distillation
- Distillation
- Bulb-to-bulb distillation

(B) Chromatography

- Thin layer chromatography (TLC)
- Column Chromatography
- Preparative TLC

(C) Physical Constants

- Melting Points and Boiling Points
- Optical rotation and molecular rotation

(D) Spectroscopic Methods

- Preparation of ester (Confirmation by IR ,NMR)
- Structure elucidation (by spectral data)

2. Investigation and Characterization of Organic Compounds

- Detection of elements present in a given organic compound.
- Identification of functional groups in a given organic compound.
- Identification of unknown organic compounds.
- Separation of organic mixture by chemical methods, preparation of derivatives, and identification of the material

Inorganic Chemistry Laboratory

Estimation of iron in minute quantities by **UV-vis spectrophotometry**

Principles of **colorimetric analysis**: determination of iron content of an unknown sample.

Preparation of hexamminenickel(II)chloride: estimation of ammonia and nickel by **titrimetric** and **gravimetric** methods

● Preparation of diamagnetic and paramagnetic main-group and transition-metal acetylacetonates

Synthesis, isolation and **spectroscopic characterization** of the complexes

Synthesis and characterization of **ferrocene** and **acetylferrocene**

Synthesis of the complex and their purification using **chromatography**

Acid-base and **redox titration** of tablets containing Vitamin-C

Estimation of ascorbic acid in Vitamin-C tablets

Paper chromatographic separation of Cu^{2+} , Fe^{3+} and Ni^{2+}

Utilization of paper chromatographic techniques to separate the metal salts

Spectrophotometric determination of phosphate: estimation of phosphate in cola drinks

Determination of concentration of phosphates applying Beer-Lambert law

Potassium tris-oxalatoferate(III): synthesis, analysis and photochemistry

Synthesis of the complex and its utilization in **blue-printing experiment**

Physical Chemistry Laboratory

- Calibration of **volumetric apparatus**
- Analysis of the **rotational-vibrational spectra**
- Determination of **partial molal volume Isotherm** for a three component system
- Kinetics of fast reactions by **stopped-flow technique**
- Spectrophotometric determination** of acid dissociation constant
- The measurement of **electrical conductance** for the determination of the equivalent conductance at infinite dilution
- Rate of the hydrolysis of sucrose using **polarimeter**
- Determination of pKa of poly-basic acid with the **pH meter**
- Determination of **critical micelle concentration**
- Determination of transport number by **moving boundary method**
- Polarizability** from refractive index measurements
- Formula and **stability constant** of a complex by spectrophotometry
- Fluorescence quantum yield** determination of an unknown molecule.
- Fluorescence spectrum** and **stern-volmer quenching** constant
- IR and Raman spectroscopy** of solvent mixtures
- Computing **Potential Energy Surface** of molecules using Quantum Mechanics
- Introduction to **Scanning Probe Microscopy**

Inorganic Chemistry Laboratory-II

Invisible ink Utilization of coordination chemistry

Ligand-exchange concept

Crystal-field splitting parameters of 3d metal ions.

Acidic and basic salts **Hydrolysis** of salts and its consequences.

Various **spectroscopic techniques**

Synthesis, isolation and characterization of complex

Geometrical isomers: synthesis, identification using spectroscopic techniques.

Investigation of **acid hydrolysis** of the complex

Resolution into **optical antipodes** Optical isomers

Titrimetric and **gravimetric** methods

Synthesis of an **air-sensitive organometallic** complex

Ferrocene ,acetylferrocene **Synthesis, chromatography, characterization**

Organic Preparations Lab

Benzil – Benzilic Acid Rearrangement

Fisher: Indole Synthesis:
Diazotization
Reductive Coupling Prep

Molecular Rearrangement
Pinacol – Pinacolone – rearrangement

Reimer-Tiemann Reaction

Perkin Reaction

Aldol condensation and epoxidation

Department Facilities

The Department of Chemistry has excellent facilities including a wide range of sophisticated instruments offering technical support to the research activities.

High Field Nuclear Magnetic Resonance	Cyclic Voltammetry
Resonance Raman Spectrometer	Elemental Analyzer PE
Spectrophotometer	UV-VIS Spectrophotometer
Surface Plasmon Resonance	Micro-Analytical Facility
Mossbauer spectrometer	REACT IR (Metler Toledo)



Department Facilities

NMR Spectroscopy

The department operates three high field NMR (both 400 and 500 MHz) spectrometers for recording high resolution spectra from solution phase samples. NMR spectrometers are run and maintained by dedicated operators who also routinely train and assist students in recording simple 1-D spectra as well as multidimensional hetero-nuclear experiments.

Mass Spectrometry

This facility allows for collection of routine and high resolution mass spectra under a variety of ionization conditions from the state-of-the art. Waters Q-TOF Premier HAB213 and Waters GC Premier mass spectrometers.

X-Ray Crystallography

Determination of molecular structures of organic, organometallic and coordination compounds are performed by single crystal X-ray diffraction measurement using two state of-the-art single crystal X-ray diffractometers. (Bruker Apex-II and D8 Quest Single Crystal Microfocus X Ray Diffractometer) equipped with a low temperature device.

Femtosecond Transient Absorption Spectrometer

Early time structural and excited-state dynamics of molecules and materials in the condensed phase can be studied using this facility. The time resolution of setup is 120 fs.

Department Facilities

Resonance Raman Spectrometer

A tunable laser source (Argon ion) coupled to a high resolution Raman spectrometer enables us to record resonant Raman spectra of molecules and materials. This technique can be used to probe subtle changes in the structure of a complex molecular system.

Other departmental facilities

Include FT-IR spectrometer, UV-vis-NIR spectrophotometer, elemental (CHN) analyzer, Mossbauer spectrometer, circular dichroism spectrometer, Pico second Time-Resolved Fluorimeter, Atomic Force Microscope, powder X-ray Diffractometer, Thermo Gravimetric/Differential Thermal Analyzer, polarimeter, etc

EPR Spectroscopy

Electron Paramagnetic Resonance spectroscopic measurements are done using Bruker EMX300 EPR spectrometer installed in the department. Our facility routinely records EPR spectra of solid, liquid and frozen samples under variable temperature condition.

Nano science Center

Nano science center at the institute caters the state of the art facility and resources for carrying out research, development activities in the areas of soft nano fabrication. Some of the major equipments at the center are NSOM/RAMAN/Confocal/AFM, Scanning Electron Microscope with electron beam lithography, small angle and wide angle XRD.

Past Recruiters

Pal ReMaterials (ModRoof)

Syngene International Ltd

PharmaAce analytics

Reckitt Benckiser

Mastercard

Proctor and Gamble

Zomato

Reading right

FN Mathlogic Consulting Services Pvt Ltd

Distinguished Alumni



P. Balaram



Swaminathan Sivaram - ...



Prof T K Chakraborty



Prof. Pushpito K. Ghosh



Uday Maitra | The Depa...



Sen, Ayusman |



Dr Sourav Pal



P. V. Ramachandran - P...



Arun K. Ghosh | MCMP



Amitabha Chattopadhy.

THANKYOU



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