



COURSE BROCHURE
GLOBAL INITIATIVE OF
ACADEMIC NETWORKS(GIAN)

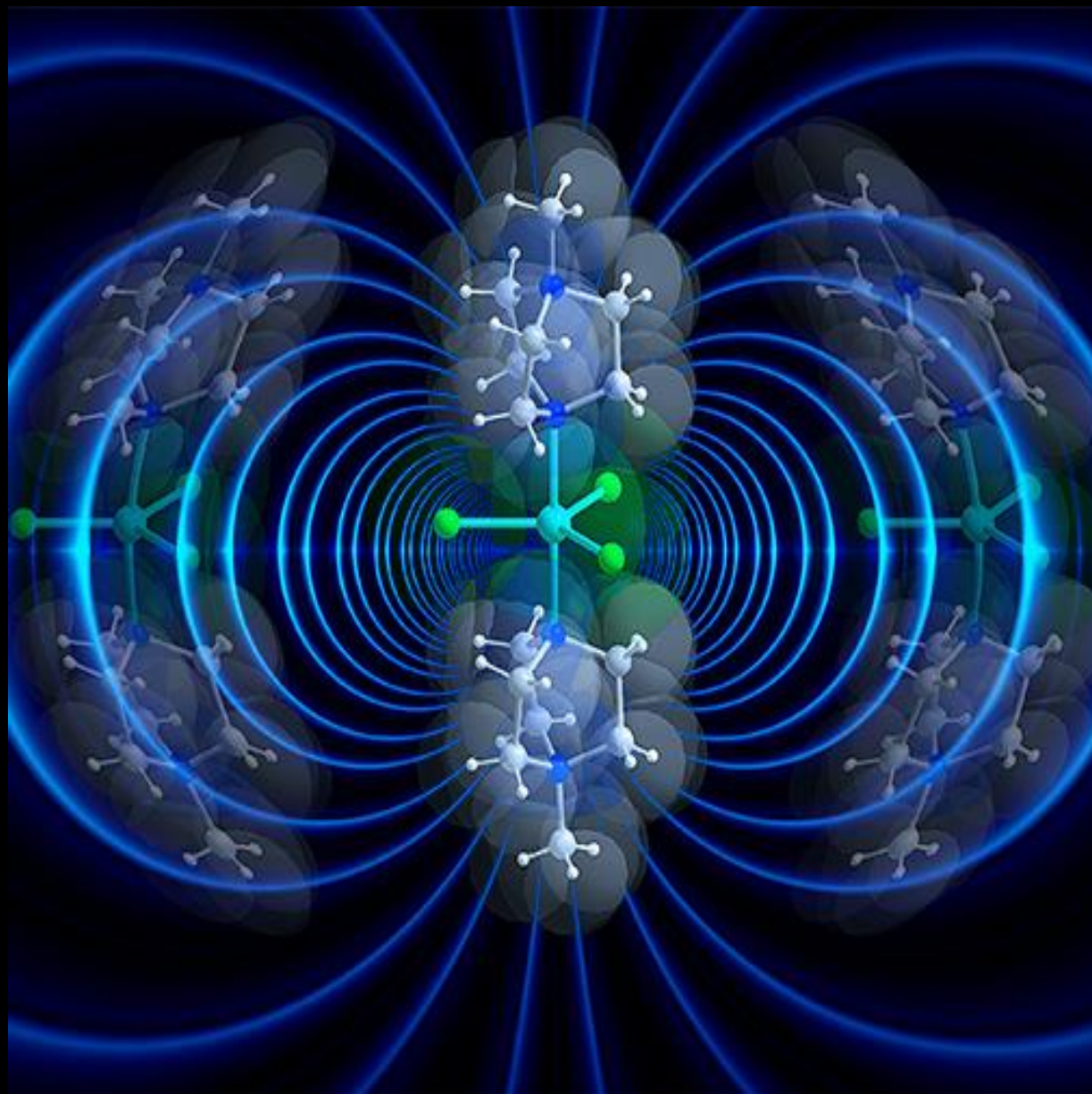


INTERNATIONAL SUMMER
TERM COURSE 2017

ON

SINGLE MOLECULE
MAGNETISM

(August 6th to 10th) and
(October 22nd to 27th)



Organized at IIT indore and Guru Nanak Dev University, Amritsar

Single Molecule Magnetism

Overview

Molecular magnetism is one of the most active areas of research in modern chemistry. Molecule-based magnets comprise a class of materials which differ from conventional magnets. Whereas most traditional magnetic materials are comprised purely of metals or metal oxides, in molecule-based magnets, the structural building blocks are molecular in nature. These building blocks can be a combination of both organic and inorganic moieties. The f -block metals play a significant part in the design and synthesis of molecular magnets. Chemical tailoring of the molecular building blocks to tune the magnetic properties poses a stiff challenge in this area. While all of the main group and transition metal (d block) is fairly well covered in most Indian institutions in their teaching curriculum, the component on lanthanides and actinides (f -block) is rather limited. This, and the broader topic of molecular magnetism will be covered at IIT Indore and GNDU, Amritsar by an internationally renowned expert, Professor Richard Layfield, Professor of Inorganic Chemistry in the School of Chemistry and Assistant Vice-Dean for Research in the Faculty of Engineering and Physical Sciences, in coordination with Professor Pradeep Mathur, Professor of Chemistry at IIT Indore (f -block chemistry) and by Professor Geeta Hundal, Professor of Chemistry at Guru Nanak Dev University, Amritsar (molecular magnetism)

Course participants will learn these topics through lectures and hands-on experiments. Also case studies and assignments will be shared to stimulate research motivation of participants.

The International Faculty
Professor Richard Layfield,
University of Manchester,
England.



At The University of Manchester, **Richard Layfield** is Professor of Inorganic Chemistry in the School of Chemistry and Assistant Vice-Dean for Research in the Faculty of Engineering and Physical Sciences. He graduated with a Masters degree from the University of Leeds in 1999, and a PhD from the University of Cambridge in 2002. His research covers a range of topics centred on synthetic organometallic and coordination chemistry, with emphasis on lanthanides, molecular magnetism and carbene complexes. He has received numerous awards, including: the RSC's Meldola Medal (2006) and Frankland Fellowship (2013); an Experienced Researcher Fellowship from the Humboldt Foundation; and a Rising Star Lectureship from the ICC. He currently holds an ERC Consolidator Grant and an EPSRC Grand Challenge Fellowship.

Transition metal and lanthanide complexes in molecular magnetism (Course I) (to be taught at Guru Nanak Dev University, Amritsar from August 6th to 10th)

The course on molecular magnetism has following components:

Module 1 - Introduction to molecular magnetism (1 hour)

Historical aspects; playing with the periodic table; magnetic orbitals; units in molecular magnetism.

Module 2 - Electronic structures of free ions (1 hour)

‘Gas-phase’ ions; spin–orbit coupling.

Module 3 - Electronic structure of complex ions: transition metals (2 hours)

The crystal field; simple examples from coordination chemistry; the angular overlap model; magnetic anisotropy.

Module 4 - Electronic structure of complex ions: lanthanides (2 hours)

Structure, bonding and kinetics; simple examples from coordination chemistry; crystal field effects; term symbols; magnetic anisotropy.

Module 5 - Synthetic methods (2 hours)

Survey of common ligand types and synthetic methods; common characterization techniques.

Module 6 - Magnetism of ions (1 hour)

The Curie law; the van Vleck equation; anisotropy revisited.

Module 7 - Molecular orbital of isolated magnetic centres (1 hour)

Moving to MO; correlation effects; brief survey of theoretical methods.

Module 8 - Exchange-coupled molecular magnets (2 hours)

Magnetic interactions; spin Hamiltonians; the giant-spin model and multicentre interactions exchange and super-exchange; *f* orbitals and orbital degeneracy; *d* orbitals; *f-d* interactions.

Module 9 - Dynamic properties and single molecule magnets (2 hours) Mn₁₂; quantum tunnelling; the phthalocyanine family; the polyoxometalate family; SMMs with lanthanides; single chain magnets (SCM); the special case of dysprosium.

Module 10 - Applications of molecular magnetism (1 hour)

Molecular spintronics; NMR; magnetic resonance imaging; magnetocaloric effect; luminescence; electroluminescent materials for OLEDs; biological assays and medical imaging.

f-Block Chemistry (Course II)

(to be taught at Indian Institute of Technology Indore, Indore from *October 22nd* to 27th)

This course is structured using the following topics:

Module 1 - 6 hours

Atomic, ionic and electronic structure: $4f$ and $5f$ orbitals, lanthanide contraction, separation of lanthanides, Oxidation states: commonly occurring and 'exotic', Chemical bonding: ionic vs. covalent, Thermodynamic aspects of *f*-element chemistry.

Module 2 - 6 hours

Coordination chemistry of Ln(III), Ln(II) and (IV) (hydrides, oxides and hydroxides, halides, chalcogenides, pnictides, carbides, borides), mixed ligand complexes, complexes with neutral ligands, Organometallic compounds.

Module 3 - 3 hours

Physicochemical properties of Lanthanides-

Magnetism-Magnetic properties, role of lanthanides in molecular magnets, spin states, Models for the magnetic coupling of *f* and *s*, *p*, *d* electrons, nature of magnetic coupling involving Gd(III), Zero, one and two dimensional systems of lanthanides involving transition metal ions or organic radicals.

Spectroscopy-

Crystal field spectra of lanthanides, $4f$ - $4f$ transitions, $5d$ - $4f$, LMCT transitions.

Luminescence

Long lived excited states, Time resolved emission spectroscopy, Antenna effect,

Applications in biology (medical imaging, cancer research, pH probes, virology, hydrogen peroxide sensors, bio-sensors), FRET phenomenon,

Shift reagents in nuclear magnetic resonance,

Role of Lanthanides in catalysis

You Should Attend If...

- 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.

Fees

- The participation fees for taking the course is as follows:
- Academic Institutions: Rs 1,500/- per participant per course (for students), Rs 3,000/- per participant (for faculty).
- Participants from industry: Rs 20,000/- per participant for each course.
- Free for participants from host institutes

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.

Registration Process

Step 1: One Time Registration for GIAN courses is not free because of constraint in the maximum number of participants allowed to register for a course. In order to register for any course under GIAN, candidate will have to get registered first time to GIAN Portal of IIT Kharagpur using the following steps:

1. Create login and password at: <http://www.gian.iitkgp.ac.in/GREGN/index>
2. Login and complete the Registration Form.
3. Select Courses.
4. Confirm your application and payment information.
5. Pay Rs. 500/- (non-refundable) through online payment gateway.
6. Download and print “pdf file” of your enrolment application form for your personal records and copy of the same to be sent to the Course Coordinator.
6. If a participant is already registered with GIAN. he/she only needs to select the course i.e. step 7.

7. For this course selection candidate should opt the course under Title “single molecular magnetism” Host institute IIT Indore. Take a printout. Then candidate will be contacted by the host institute for their choice of course (I or II) at GNDU or IIT Indore. Once a candidate is shortlisted for the course by the coordinator, he/she will be informed by email. The candidate then should submit his/her application form duly filled and participation fee paid (as instructed in the form) to IIT Indore.



About GNDU

Guru Nanak Dev University was established on Nov. 24, 1969 to commemorate the 500th birth anniversary of Shri Guru Nanak Dev Ji, the founder of Sikh religion. Guru Nanak Dev University is one of the premier universities of the country, which was two times accredited with the 5 star (the highest level) accreditation among the universities in India by National Assessment and Accreditation Council (NAAC), an autonomous institution of University Grants Commission. Recently, Guru Nanak Dev University has attained the highest status of University with Potential for Excellence (UPE) which is the highest status award by UGC. Apart from traditional areas of higher education, university has the reputation of promoting education and research in professional and technological fields, with the aim of creating human resources in the new but highly required areas in the country. In addition to academics, the University has the pride of winning the highest Inter-University National Sports Award of the country “Maulana Abdul Kalam Azad Trophy” (MAKA) for a record number of 22 times.



About Department of Chemistry

The department of chemistry was established in 1971 and over a period of time it has emerged as one of the premier departments not only in the university but also has acquired a prestigious status at the national level. The department has been recognized as a **Center for Advanced Studies** by UGC. Department of Science and Technology has funded the department twice under its “Fund for Improvement of Science and Technology” (FIST) program. The department offers courses of B.Sc. (Hons. School) in Chemistry, M. Sc. (Hons. School) in Chemistry, M. Sc. Chemistry and Ph. D. The semester system with credit based continuous evaluation is followed for teaching programmes. The research activities of the department focus on supramolecular chemistry, synthetic organic and inorganic chemistry, solid state chemistry, electrochemistry, material chemistry, medicinal chemistry surfactant chemistry, oils and fats, theoretical chemistry, thermodynamics, analytical chemistry etc.,. The research projects are funded to a significant extent by agencies like CSIR, SERB, UGC, DST, DAE, DRDO and DBT.



About IIT Indore

Indian Institute of Technology Indore located in Madhya Pradesh, known as IIT Indore or IITI, is an institute of national importance established by the Government of India in 2009. IIT Indore is one of the eight IITs established by the Government of India in 2008-09. During this short period IIT Indore has been able to carve a place for itself amongst the top technical institutes in the country. IIT Indore has a modern approach to teaching and has a strong research culture with an active involvement of undergraduate students. IIT Bombay is the mentor of IIT Indore. Prof. Pradeep Mathur has been appointed as the founder director of IIT Indore. Since , February 2016, IIT Indore has started functioning from its permanent campus. All the Administrative Offices, Material Management Section, Finance and Account Section, The School of Basic Sciences, The School of Humanities and Social Sciences, The School of Engineering, Basic Science Labs and Engineering Labs are all established in this campus. The Central Library is also situated in this campus.



About Discipline of Chemistry

Discipline of Chemistry at IIT Indore, which comes in the School of Basic Sciences, aims to provide exceptional training to all the students interested in cutting-edge research and education. Started in August 2009 our department is rapidly growing every semester in terms of size, research diversity, external funding and number of publications. At present we have 13 faculty members and approximately 40 Ph.D. students with research interests ranging from traditional areas (organic, inorganic and physical) to highly interdisciplinary and collaborative research areas such as nanotechnology, polymers, biochemical, materials and analytical. The main source of external funding comes from CSIR (Council of Scientific and Industrial Research) and DST (Department of Science and Technology). We have M.Sc (Master of Science) degree program in Chemistry from the academic year of 2013. We suggest all prospective students and other visitors to explore our website to learn more about our department.

Course Coordinator at GNDU Amritsar

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Dr. Geeta Hundal has obtained her Ph. D from Guru Nanak Dev University, Amritsar, in the field of small molecule crystallography. She did her post doctoral research from 1994-1996, at CSIC, Rocasolano, Madrid, Spain, working on protein and small molecule crystallography. She has worked in South Korea for two years (2008 and 2012) as Brainpool scientist in the Korean Research Institute of Chemical Technology. She is presently Professor in the department of Chemistry, Guru Nanak Dev University, Amritsar, India. She has published 150 research papers in journals of international repute. Besides crystallography, her other interests are chemical sensing, supramolecular chemistry and coordination chemistry. She teaches course on Ligand Field Chemistry and spectroscopy to graduate and post graduate students

Principal Coordinator and Course Coordinator at IIT Indore

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Professor 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



Prof. Palwinder Singh
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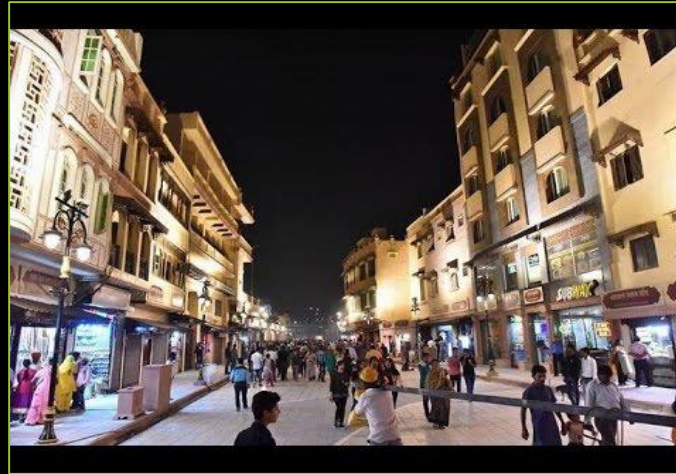
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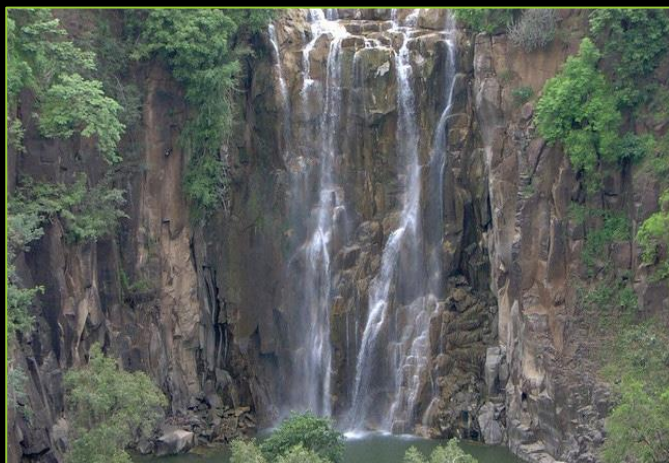
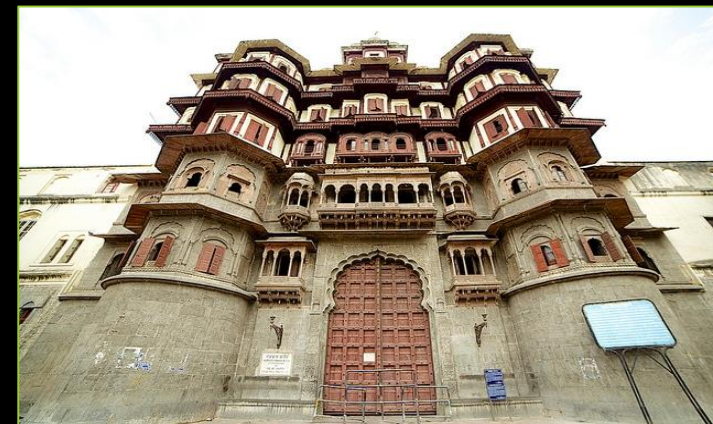


For Course I
We are waiting for
you in the Holy city
Amritsar





For course II
We are waiting for you
in the city
Indore



Application form

An International Summer Term Course – 2017,

As per the MHRD Scheme “Global Initiative of Academic Networks (GIAN)”

On Topic

Single Molecule Magnetism

(6th August to 11th August, 2017 and 22nd October to 27th October, 2017)

Organized by

Department of Chemistry

Indian Institute of Technology

Indore

And

Department of Chemistry

Guru Nanak Dev University, Amritsar

(Punjab) India

Name (Block Letters):

M/F:.....

Designation/Professional Title:.....

Organization:.....

Address:.....

.....

Tel.....Mobile.....E-mail.....

Application ID (Generated during One-time registration at GIAN portal of IIT Kharagpur):

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Course Applied (Tick in applicable box)

(a) Course I - Transition metal and lanthanide complexes in molecular magnetism (to be taught at Guru Nanak Dev University Amritsar from 6th to 10th August 2017)

☐

(b) Course II- *f*-Block Chemistry (to be taught at Indian Institute of Technology Indore from 22nd To 27th October 2017)

☐

(c) Both (Course I and Course II)

☐

Course Fee: Covers only course materials without boarding and lodging

Students/Research Scholars: Rs. 1500/-per course/per participant

Faculty: Rs. 3000/-per course/per participant

Industry/Research Personnel: Rs. 20000/-per course/per participant

Participants from abroad: US\$100/-per course/per participant

Free for participants from host institutes

Accommodation Required: Yes/ No

If accommodation required, then Additional Fees for desired accommodation: • Food on actual basis. •

*Limited shared accommodation is available in Institute Guest House/Hostels on request against the Advance payment on first come and first serve basis.

Payment may be made through:

1. Demand Draft: In favour of “ Registrar, IIT Indore ” payable at Indore

Amount: _____ Bank: _____ DD No. _____

OR

2. National Electronic Funds Transfer (NEFT) to the account.....

Name of the Beneficiary:

IIT Indore Project and Consultancy A/c

Name of Bank	Canara Bank
Branch	Indore Navlakha
Beneficiary Account No.	1476101027440
Bank MICR Code	452015003
Bank IFS Code	CNRB0001476

Signature of Candidate

APPROVAL FROM AFFILIATED INSTITUTE OF CANDIDATE The applicant will be permitted to attend the above Course, if selected.

Date:

Signature and Seal of approving Authority