Volume 5, Issue 3

August 2017

R&D Newsletter

Indian Institute of Technology Kanpur

"Vibhram" - a prototype design of unmanned helicopter by IITK students -Page 3

Highlight of the Issue

IIT Kanpur logo is now protected with trademark

IIT Kanpur has filed the application for trademark registration of its logo on 23rd May, 2017. The application has covered seven different classes of trademark sections for broader scope. Now the Institute can use the IITK logo superscribed with TM. It can also negotiate the use of logo with other entities.

7 Different Classes of Trademark application

- **Class 41** - Education; providing of training; entertainment; sporting and cultural activities.
- **Class 42** - Scientific and technological services and research and design relating thereto; industrial analysis and research services; design and development of computer hardware and software.
- **Class 16** - All kinds of stationery items including pens, pencils and paper.
- **Class 18** - Backpacks, etc.
- **Class 21** - Cups/mugs
- **Class 25** - T shirts, shirts, caps
- **Class 09** - Scientific, nautical, surveying, photographic, cinematographic, optical, weighing, measuring, signaling, checking (supervision), life-saving and teaching apparatus and instruments; apparatus and instruments for conducting, switching, transforming, accumulating, regulating or controlling electricity; apparatus for recording, transmission or reproduction of sound or images; magnetic data carriers, recording discs; automatic vending machines and mechanisms for coin-operated apparatus; cash registers, calculating machines, data processing equipment and computers; fire-extinguishing apparatus.

TM

INVENT Program @ IIT Kanpur

INVENT social incubation program was initiated by the Technology Development Board (TDB), Government of India in partnership with Department for International Development (DFID). This program is designed to create a platform to support inclusive innovation solutions, both technological and business process oriented, that have a positive social and economic impact on people in the lower income segments. The INVENT program aims to support and build capacity of existing incubators to identify, pilot and fund inclusive innovations for benefit of people in low income states.

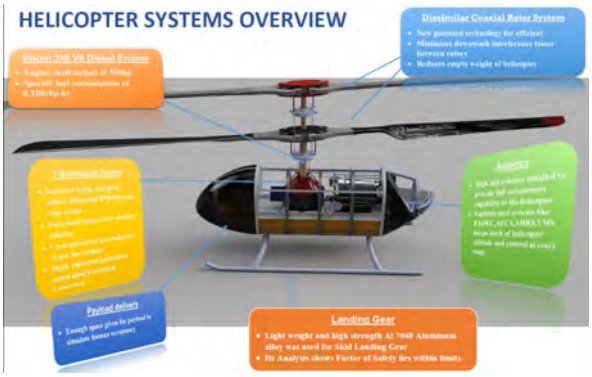
SIIC IIT Kanpur is one of the successful Partner Incubators of INVENT programme. As of July 2017, IIT Kanpur has received more than 70 applications from potential social entrepreneurs. Of these, eleven (11) social enterprises have been approved for incubation with several more in the pipeline.

More details can be found at www.iitk.ac.in/invent

Unmanned Helicopter Prototype, Vibhram, designed by IIT Kanpur Students

A team of postgraduate students of Aerospace Department including Karthik S. (Team leader, MTech), Rahul Ramanujam (Team technical leader, PhD), Ramdas (PhD), Diksha Aggarwal (MTech), Sakshi Gupta (MTech), Avinash Shet (MTech), Vishesh Kumar Singh (MTech), and Naba Kishore Routray (MTech) under the guidance of Prof. Abhishek and Prof. C. Venkateshan have successfully carried out the conceptual design of an 'unmanned helicopter' named "Vibhram". This design effort was carried out as course project for AE 660: Preliminary Design of Helicopter course in Aerospace Department. The team won third prize in the graduate category of 34th Annual Student Design Competition organized by the American Helicopter Society (AHS). This is the first time in 34 years history of this competition that a team from Asia has finished on the podium of this competition in the graduate category. The objective of this year's competition was to carry out system level design of an unmanned helicopter that can fly continuously for 24 hours while carrying a payload of 80 kg.

This activity resulted in a highly innovative novel dissimilar coaxial rotor concept (patent filed) which has been predicted to be more efficient than any existing helicopter configuration such as conventional (single main rotor and tail rotor) and regular coaxial helicopter by 15-30%. This revolutionary new design is expected to have a strong impact on the future of helicopter technology enabling them to hover with significantly improved efficiency.



IIT Kanpur made it to podium finish in the Amazon Robotics Challenge 2017

Amazon organizes a global competition event – **Amazon Robotics Challenge**, since 2015. This year the competition was held in Nagoya, Japan during July 27 to 30 2017. IIT Kanpur and TCS jointly put up a team that was selected in the final event under the tag-name IITK-TCS. Sixteen international teams from various universities across the world including MIT, Princeton, Duke University, Carnegie Mellon University and Nanyang Technological University have participated in this event. The competition had three events: Stowing, Picking and stowing-cum-picking. A customized robotic system was required to perform these tasks autonomously. The Challenge combined object recognition, pose recognition, grasp planning, compliant manipulation, motion planning, task planning, task execution, and error detection and recovery.

This time IITK-TCS team had excellent performance in all parts of the event. In stowing IITK-TCS team robot secured 5th position while in picking, the team robot secured 3rd position. By virtue of their good performance in both stowing and picking, the team qualified for the final event of stowing cum picking event where the

robot scored 170 points and the team secured 4th position.
The IIT Kanpur team was led by Prof Laxmidhar Behera from the Department of Electrical Engineering. Other team members are Prof KS Venkatesh, Anima, Samrat, Ashish, Ravi Prakash, Mohit, Siddharth and Abhay.

Unique Ferromagnetism in α-Mn Nanorods

Abhinav Prakash, Krishanu Biswas and Somnath Bhowmick
Department of Materials Science and Engineering

In the periodic table, Mn is located just before the ferromagnetic family of metals, namely, iron, cobalt and nickel. However, it's allotrope at room temperature (α-Mn) is known to be paramagnetic. Thus, at room temperature, Mn cannot achieve the magnetic strength of its fellow ferromagnetic metals. Magnetism in ferromagnetic metals can be described in terms of direct exchange interaction, where the coupling strength depends on the ratio (λ) of the inter-atomic distance to the radius of d-shell of an atom in a material. In case of Mn, λ value is just below 1.5, which is slightly less than that for its ferromagnetic neighbours. This implies that, increasing the separation between Mn atoms will favourably alter the ratio and leading to ferromagnetism. This is normally achieved either by alloying Mn with a non-magnetic element or by growing epitaxial layer of Mn on Fe or Co or Ni. The ferromagnetic ternary alloys containing Mn, known as Heusler alloys (such as Cu_2MnAl) are typical examples of the first type. The other way of imparting ferromagnetism in Mn is by a technique in which an epitaxial layer of Mn grown on Fe (100) exhibits a net magnetic moment.

However, it may be possible to induce ferromagnetism in pure metallic α-Mn by altering the morphology of the Mn crystallites, i.e. preparing 1D nanostructure. We report the ferromagnetic order in pure and freestanding α-Mn nanorods prepared by ball milling at low temperature (152K). The bulk α-Mn is known to be a complicated system with Mn having a tendency towards anti-ferromagnetic order. It is worthwhile to note that Schull and Wilkinson have demonstrated earlier that Mn can undergo transition from paramagnetic to anti-ferromagnetic state below its Neel temperature of 100K. However, there is no report in the literature on ferromagnetic behaviour of either bulk or nano-structured α-Mn. We observe for the first time that, indeed, ferromagnetic order can be induced in the nanorods, which can be explained by considering surface magnetism. The DFT calculations indicates that the origin of such ferromagnetism is due to surface atoms that are less co-ordinated, giving rise to ferromagnetic surface with antiferromagentic core.

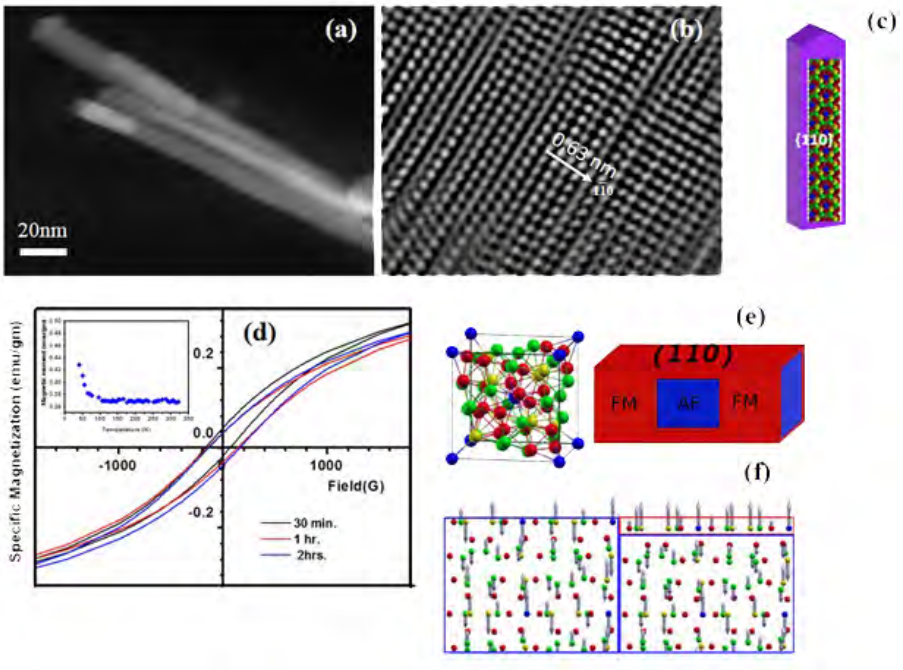


Figure: (a) and (b) High resolution TEM images of α-Mn nanorods; (c) schematic of the nanorods with planes ; (d) showing ferromagnetic hysteresis loop ; (e) Unit cell used for Ab-initio calculations showing arrangement of atoms. Mn nanorod, the face shown is (110) face - the color code is same as the color code used for Mn unit cell (Red Mn I, Yellow Mn II, Green Mn III and Red Mn IV. (f)Actual spin density calculated using DFT simulations. A vertical crosssection of the nanorod is shown in the figure, where the atoms in top layer (red box) belongs to (110) surface. Ferrmoagnetic and antiferromagnetic region is denoted by the red and blue box, respectively.

References

J. App. Physics, 121, 2017, 084304

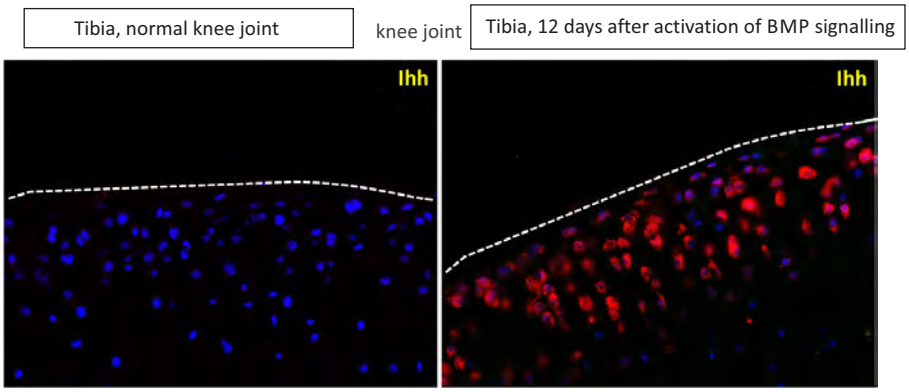
Investigating the Role of BMP Signaling in Pathogenesis of Osteoarthritis

PI: Prof. Amitabha Bandyopadhyay, Dept. of Biological Sciences & Bioengineering

Sponsor: Department of Biotechnology

In adult limb skeleton there are multiple elements. However limb skeletal development begins with a single cartilaginous template which is branched and segmented to give rise to the distinct skeletal elements. Further, while the early limb skeleton is made of pure cartilage, in mature skeleton most of the cartilage is replaced by bone, therefore, is referred to as transient cartilage. Only the cartilage adjoining the plane of segmentation remains as cartilage forever, therefore, is referred to as permanent cartilage. In adults, during osteoarthritis the permanent cartilage undergoes molecular and histological changes reminiscent of transient cartilage differentiation. We are investigating whether BMP signaling pathway, a key driver of transient cartilage formation, is necessary and sufficient for the pathogenesis osteoarthritis.

Activation of BMP signaling is sufficient to promote transient cartilage differentiation in adult mouse permanent cartilage (Ihh is a maker for transient cartilage)

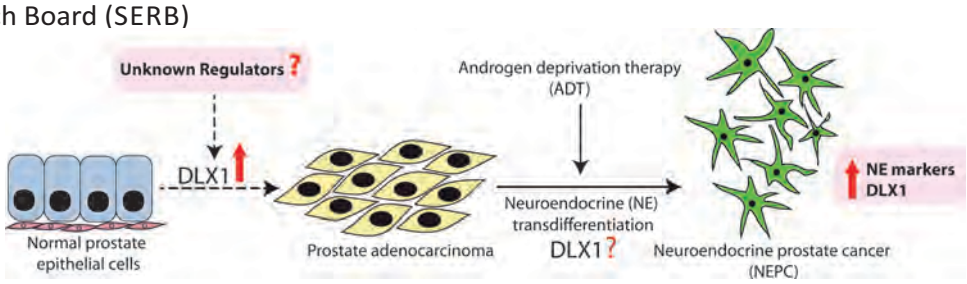


Investigate the Role of Distal-less Homebox-1 (DLX1) in Trans-Differentiation of Prostate Cancer Cells and Neoplastic Progression

PI: Prof. Bushra Ateeq , Dept. of Biological Sciences & Bioengineering

Sponsor: Science & Engineering Research Board (SERB)

Androgen signaling plays a critical role in the development of prostate as well as in cancer associated with this gland. Since the prostate gland development depends on androgen and androgen receptor (AR) signaling, thus prostate cancer (PCa) patients initially responds to androgen-deprivation therapy (ADT), a gold standard for PCa treatment. Nonetheless, as the disease progresses, patients succumb to resistance to the given therapy resulting in development of castration resistant PCa. With the current understanding, it has become evident that cancer and normal prostate gland development share common biological switches involved in cell proliferation and differentiation. Many genes such as NKX3.1 and HOX gene family are known to be involved in prostate gland development and differentiation; nevertheless these genes are also reported to be dysregulated in cancer. Similarly, homeodomain-containing transcription factors such as Distal-Less Homeobox-1 (DLX1) are expressed during embryonic development, and are reported to be re-expressed in several cancer types including prostate. Moreover, elevated levels of DLX1 were detected in both primary and metastatic tumors compared to normal prostate samples. In the proposed research we plan to explore the molecular mechanism behind DLX1 over-expression in PCa, unravel its role in the neoplastic progression and understand the complex processes which drive trans-differentiation of PCa cells, thus allowing us to leverage the knowledge gained for developing targeted molecular therapies for this lethal PCa subtype.

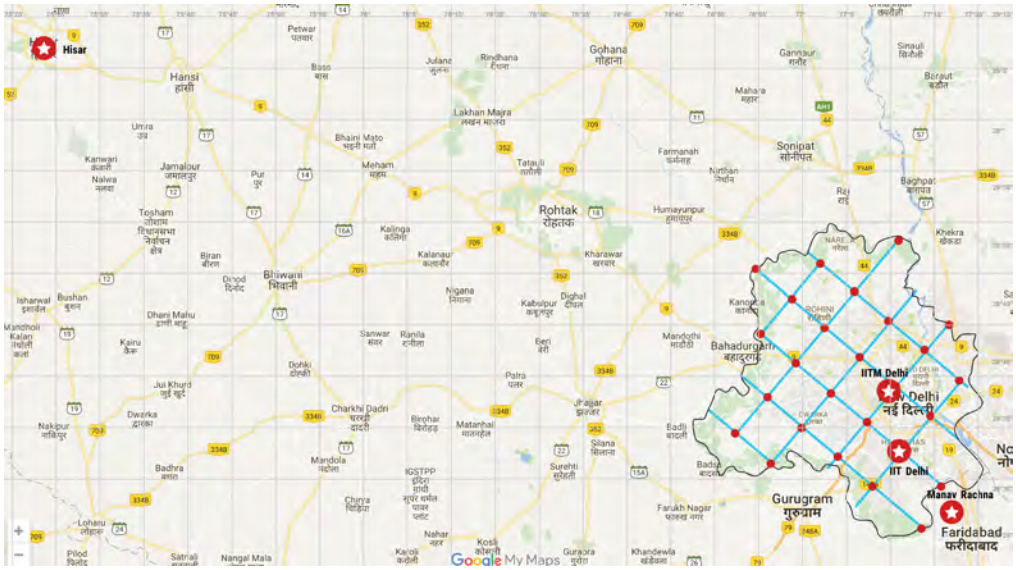


DAPHNE: Delhi Air Pollution Health and Effects

PI: Prof. SN Tripathi, Dept. of Civil Engineering/Center for Environmental Sc. & Engineering

Sponsor: Department of Biotechnology

DAPHNE is a joint project between India and UK co-funded by two countries. The over arching goal of the project is to understand causal relationship between air pollutants primary particulate matter and human health. More than one dozen institutions are collaborating including IITs, AIIMS from Indian side and Edinburgh University and others from UK. The attached map shows sampling locations for particulate matter. It has been planned to carry out source apportionment studies which will then be related to exposure and finally their impacts will be assessed using large cohorts of women and children.

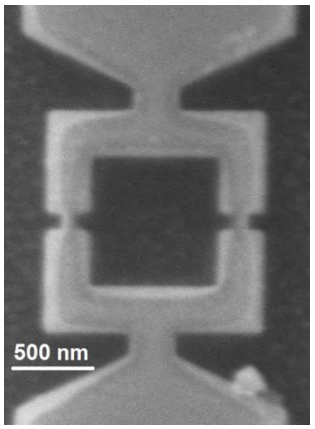


Micro-SQUID Magnetometry of Nano-Scale Magnetic Structures

PI: Prof. Anjan Kumar Gupta, Dept. of Physics

Sponsor: Indo-French Centre for the Promotion of Advanced Research (IFCPAR), DST

Magnetic nano-structures offer intriguing physics as well as applications in various areas, such as magnetic data storage, biomedicine and energy. μ-SQUID magnetometry [1] is a unique single-particle probe giving direct access to the magnetism of a single magnetic nano-particle. The bulk measurements on a collection of such nano-particles have not been conclusive due to inter-particle interactions and, averaging over various size and shape-distributions of the particles. Hysteresis in the μ-SQUIDs poses limitations in terms of sensitivity and speed. Our recent work gives methods and insights for non-hysteretic μ-SQUIDs [2]. This project aims to make a μ-SQUID magnetometry setup and to study various magnetic nano-particles for better understanding their physics.

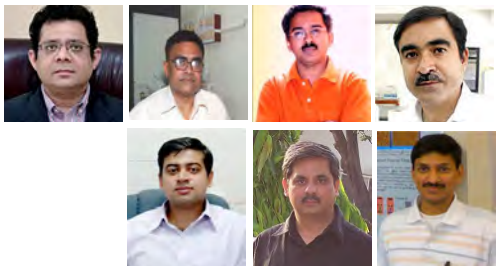


SEM image of a μ-SQUID with a Fe_3O_4 magnetic nano-particle (near the bottom right corner).

[1] "Single nanoparticle measurement techniques", W. Wernsdorfer, J. Appl. Phys. 87, 5094 (2000);

[2] "Reversibility of superconducting Nb weak links driven by the proximity effect in a quantum interference device", N. Kumar, T. Fournier, H. Courtois, C. B. Winkelmann, & A. K. Gupta, Phys. Rev. Lett. 114, 157003.

Development of Nano-Bio-Platforms for Early Diagnostics of Chronic Diseases



PI: Prof. Sandeep Verma, Department of Chemistry
Co-PI: Profs. S Sivakumar,Nishith Verma (Chemical Engineering),
Ashok Kumar (Biological Sciences & Bioengineering),
Santanu Bhattacharya (Mechanical Engg),
Dr. Prabhat Dwivedi, Dr. Manish Kulkarni (Center for Nano Science)

Sponsor: Department of Science & Technology

This research proposal will investigate diagnostic tools and methods for early detection of pathogens responsible for chronic and infectious diseases, under controlled environment, using nano-bio platforms. More specifically, the many sub-domains of this project will address peptide scaffolds for stem cell differentiation; cryogel platforms for screening and analysis; development of microcantilever sensors, electrochemical immunosensor and paper-based microfluidic biosensors for specific diseases and pathogens; and development of nanofiber mats for mycobacterial culture.

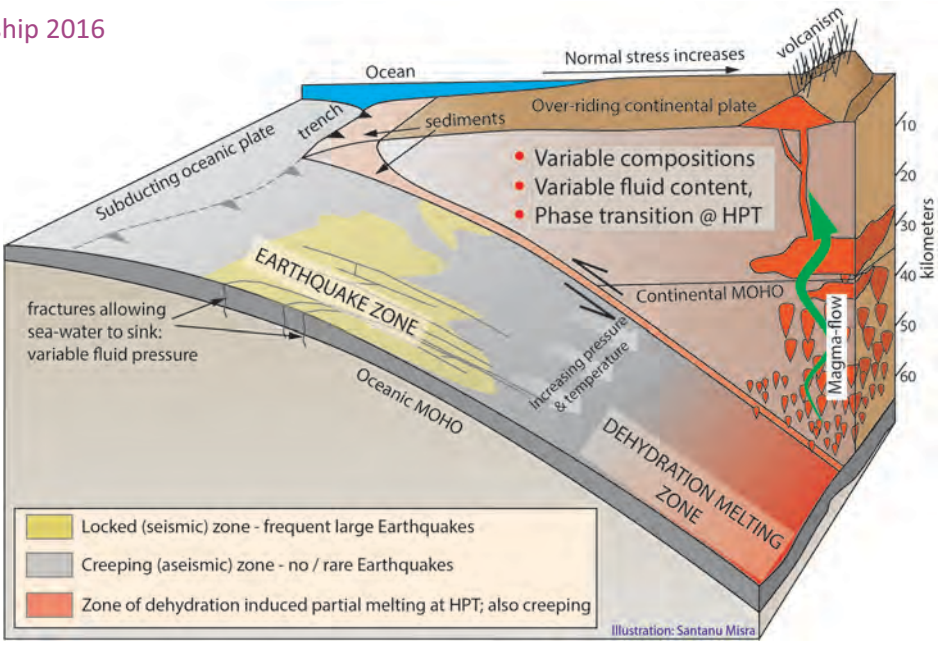
Dynamics of Subduction Interface and its Implications for Earthquake Generating Frictional Sliding to Volcano Feeding Partial Melting in Convergent Plate Tectonic Boundaries.

PI: Prof. Santanu Misra, Dept. of Earth Sciences

Sponsor: Swarnajayanti Project, Department of Science & Technology

The project is awarded Swarnajayanti Fellowship 2016

In tectonically active subduction zones the slipping interfaces are the sites of large earthquakes and explosive volcanoes. The plate motion (slip kinematics) is locally locked (a condition prior to seismic events) in places and creep (aseismic) in other zones. The micro-mechanisms responsible for the rheological transitions for earthquake generations are largely unknown owing to the difficulty in deep-earth accessibility and direct geophysical observations. An outstanding challenge is thus to comprehend the critical and threshold thermo-mechanical conditions leading to unlocking of slip zones, and release of elastic strain energy in the form of seismic waves. The project aims to provide new insight to the complex and transient rheological phenomena, that facilitates the rheological-transition, and to recognize the critical geological factors that control the catastrophic earthquakes, fluid flow and resultant physical properties. Successful completion of the project will open a new window addressing the fundamental questions related to the deep-earth dynamics which eventually causes natural hazards.



A schematic illustration showing the salient features of a typical convergent tectonic margin. At shallow depth, the subducting plates occasionally stop slipping, due to frictional resistance (yellow patches). As the shear stresses overcome the strength of the locked interfaces, accumulated elastic energy releases suddenly in great earthquakes (seismic zone). At greater depth with higher pressure and temperature, the subduction interfaces creep aseismically either by dynamic recrystallization or by dehydration-partial-melting along the subduction channel (red-areas). The melts finally erupts as volcanoes after settling for a while in a magma chamber. [Illustration: Santanu Misra]

6th China India Japan Korea Mathematical Biology Colloquium

6th China India Japan Korea Mathematical Biology Colloquium (CIJKMB) held at IIT Kanpur during August 23 to 26, 2017. Mathematical Biology is one of the upcoming topics that has caught the attention of mathematicians worldwide in a big way. During the last few years, experts from Asian countries especially from China, Japan and Korea have come together to give this area a big boost in Asian region with periodicall conference or colloquium. These meetings have motivated young mathematicians and researchers across the countries and had triggered several state-of-art collaborative research projects. For the first time INDIA becomes the part of this ASIAN REGIONAL Activity.

The aim of the colloquium was to strengthen communication among mathematical biology researchers in China, India, Japan and Korea and in addressing the opportunities and challenges of mathematical biology. This meeting helped in bringing Mathematicians and other experts from Biomedical Engineering, Biology, and Engineering etc. to come together and explore the possibility of working together on the state of the art problems which are being addressed across the world in an Interdisciplinary manner by experts from sciences and engineering.

Institute lecture 2017 (August 2017)

Bhungroo: Empowering the underprivileged Theory

Mr. Biplab Ketan Paul, Ashoka Fellow
Director, Naireeta Services

CNR Rao Endowed Lecture Series 2017

Steelmaking: Engineering, Challenges And Opportunities

Professor Dipak Mazumdar,
Department of Materials Science and Engineering,
IIT Kanpur

Industry-Academia Collaboration

Online form for seeking technology/ research solutions

http://www.iitk.ac.in/dord/query-form

Search expertize by Technology Domain and/or by PhD/ M.Tech. Thesis Title

http://www.iitk.ac.in/dord/search-faculty-expertise/

Short term Industry Oriented Courses

https://www.iitk.ac.in/dord/industry-oriented-courses

Address for Correspondence

Dean, Research & Development
Indian Institute of Technology Kanpur
Kanpur 208016
dord@iitk.ac.in
Phone: +91-512-259 7578

Feedback/Suggestions

dord@iitk.ac.in
chitrab@iitk.ac.in