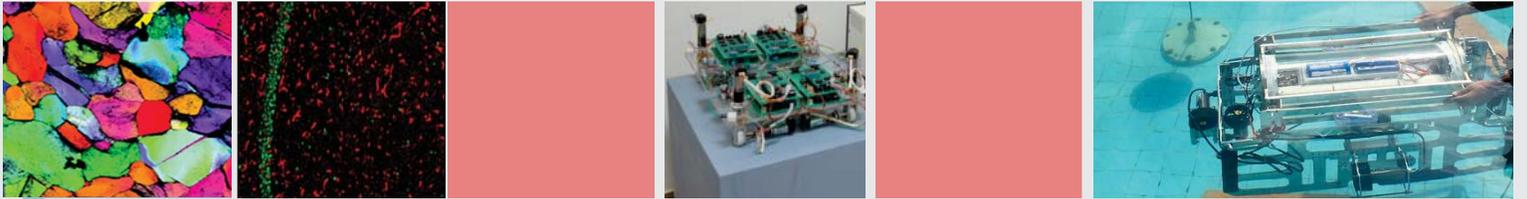




R&D PROFILE

at a glance

Indian Institute of Technology Kanpur



RESEARCH & DEVELOPMENT

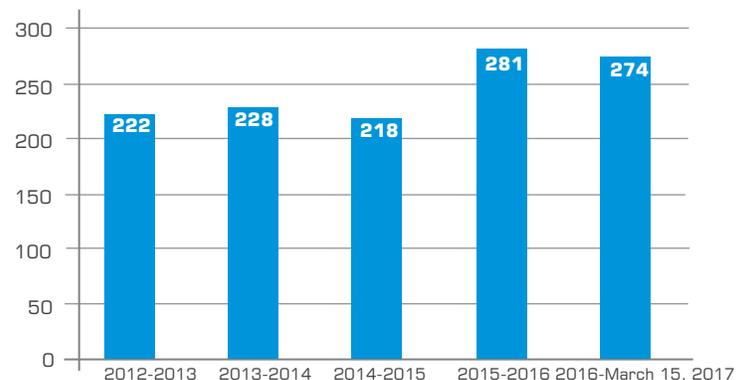


IT Kanpur has demonstrated its excellence in research in many areas. To cite a few of them: Finite Element Methods Using Domain Decomposition, Flow Induced Vibrations, Wind Tunnel Testing of Large Scale Prototypes, Computational Chemistry, Nano-materials and Nanotechnology, Geometric Optimization of Large Organic Systems, Genomics and Bio-Informatics, Electronic Structure Calculations, Aggregation and Etching, Molecular Dynamics, Thin Film Dynamics, Optical / EM Field Calculations, Computational Fluid Dynamics and Heat Transfer, Computer Aided Design and Rapid Prototyping, Tomography, Robotics, Multi-Body Dynamics, Geo-Seismic Prospecting, Stress Analysis and Composite Materials, Vibration and Control, Semiconductor Physics, Photonics, Neural Networks and Genetic Algorithms, Earthquake Engineering, Impurities in Anti-Ferro Magnet, Raman Scattering, Particle Physics, Spin Fluctuation in Quantum Magnets, Quantum Computation and so on. Some of the most recent initiatives from IIT Kanpur have been the Formation of Strong Research Groups in the areas of Nanoscience and Nanotechnology, Aerosol and Flexible Electronics. IIT Kanpur has received significant funding from new funding schemes of Government of India, namely Uchchar Avishkar Yojana: Ministry of Human Resource and Development and Impacting Research Innovation and Technology (IMPRINT: an MHRD supported initiative) while taking the leading role in the implementation of the IMPRINT scheme at the National level.

2016 at a glance

New Projects	297
Grant Received	106 Cr
Patents Filed	57
Patents Granted	13
Journal Papers	1016

Number of Projects over last 5 Years



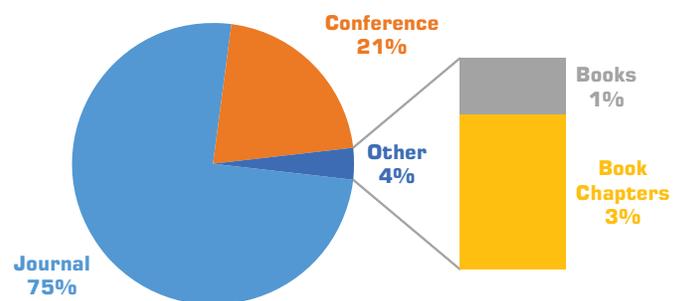
Externally Funded Ongoing Projects (as on 31st January 2017)

Total Number	547
Sanctioned Amount	~ 613 Cr
Project Staff	836

Externally Funded Research Fellowship

Total Number	136
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Publication Profile





Technology Day

National Technology Day is very special day which marks history of India's technological innovations and excellence. This day is commemorated to celebrate the anniversary of first of a series of successful nuclear test (Pokhran-II), which was held on May 11, 1998. Apart from Pokhran nuclear test, the first indigenous aircraft 'Hansa-3' was test flown at Bangalore on this day. On 11th May, 2016, IIT Kanpur celebrated its first ever Technology Day with Dr. R.K. Sinha, Homi Bhabha Chair Professor (former Chairman, Atomic Energy Commission and Secretary, DAE, and former Director of BARC, Mumbai) as the Chief Guest. On this occasion, two invited lectures were delivered by Mr. Vishnu Agarwal, CMD, Technical Associates Limited, and Mr. Rajiv Kumar, CEO, HAL Accessories. The faculty and students of the institute arranged a great exhibition of the technologies currently being developed at the institute. A poster exhibition of products developed at IIT Kanpur was displayed at the Hall of Fame of Outreach auditorium.



Make in India

IIT Kanpur enthusiastically participated in the exhibition and contest in the MMRDA Exhibition Ground, Mumbai as a part of the Make in India Week 2016 organised on 13th to 18th February 2016 and displayed the recently developed technological innovations by its students and scholars.

Institute Lecture

The Institute Lecture Series is an avenue to invite specialist researchers from various domains like eminent historians, policy makers, technologists, and leading scientists who could disseminate to the campus community on subjects of broad interest.

Speakers in 2016

- ❑ **Science and Scientists**, Prof. V. Ramamurthy, University of Miami, Coral Gables, FL, USA.
- ❑ **Dynamics of Complex Systems: vibrating molecules, nanostructures, glasses, proteins in the cell, and swimming fish**, Prof. Martin Gruebele, University of Illinois Urbana-Champaign.
- ❑ **Micro-Organism Swimming: individual and collective behavior**, Prof. Timothy J Pedley, University of Cambridge.
- ❑ **MOM and SARA: Mars and Moon**, Dr. Anil Bhardwaj, Director, Space Physics Laboratory, Vikram Sarabhai Space Center, Trivandrum.
- ❑ **Graphene Analogues**, Professor C.N.R. Rao, National Research Professor and Honorary President & Linus Pauling Research Professor Jawaharlal Nehru Center for Advanced Scientific Research.
- ❑ **Turning Excellence into Impact**, Prof. Satish K. Tripathi, President, University at Buffalo, The State University of New York.
- ❑ **Prediction and Control of Combustion Instabilities in Gas Turbines for Propulsion and Power Generation**, Dr. Thierry Poinsot, Research Director, Institut de Mécanique des Fluides de Toulouse, CNRS.
- ❑ **Health Assessment of Civil Infrastructures**, Prof. Achintya Haldar, University of Arizona, Tucson.
- ❑ **Back to the Big Bang. The Large Hadron Collider**, Prof. Lyndon Evans, Visiting professor at Imperial College London and Director of the Linear Collider Collaboration.
- ❑ **String Theory and Cosmology: Tying the Two Ends**, Prof. Ashoke Sen, Professor, Harish-Chandra Research Institute, Allahabad.
- ❑ **From a Lab-on-a-Microchip to a Lab-on-a-Molecule**, Prof. Michael Schmittl, University of Siegen, Germany.
- ❑ **Simulation Enabled Discoveries: Examples from MHD and Turbulence**, Prof. Ravi Samtaney, King Abdullah University of Science and Technology (KAUST).
- ❑ **Innovations for a Sustainable World - A Journey from Lab to Market**, Dr. Samiran Mahapatra, R&D Director, Open Innovation, South Asia Unilever R&D Bangalore.
- ❑ **Paradigm Shift for the R&D Enterprise in India: Innovation Through a Symbiotic Partnership Between Universities and National Laboratories**, Prof. Satish V. Kulkarni, Executive Director, Office of Laboratory Programs, University of California.

R&D - Some Initiatives



ICME (Integrated Computational Materials Engineering) National Hub at IIT Kanpur - A Joint IITK-TCS Initiative

Integrated Computational Materials Engineering (ICME) is an emerging and transformative discipline with large potential. The focus in ICME is on Integration of models of various processes at different length scales, design and manufacturing processes, models with experiments, software tools addressing multi-physics problems etc. with the end objective of taking ICME to industrial scale. The vision of this joint initiative between TCS and IITK is to create a World Class Multidisciplinary Educational and Research Ecosystem for ICME at IIT Kanpur with an aim to create leadership position for India in this emerging domain and meet the needs of the nation in accelerating development, large scale production and deployment of advanced and strategic materials. The National Hub will have following the specific objectives:

- ❑ Carrying out cutting edge research
- ❑ Identification of priority research areas
- ❑ Built an eco-system consisting of interested researchers and research groups in the country from academia, national laboratories and the industry
- ❑ Human resource development
- ❑ Development of open-source tools.

Keeping this in view, IIT Kanpur and Tata Consultancy Services agreed to establish a National Hub on ICME at IIT Kanpur during the MoU signing ceremony in November 2015. ICME National Hub at IIT Kanpur has been inaugurated by Mr. Ananth Krishnan, CTO, Tata Consultancy Services on 2nd March 2017.



Science Day Celebration - 2017



National Science Day is celebrated in India every year to mark the discovery of the Raman effect by Indian physicist Sir C. V. Raman. As part of the National Science Day celebration, IIT Kanpur organised a thematic workshop on “Nanoscience and Nanotechnology” on 1st of March. The workshop is followed by an Invited Lecture on ‘*Next Generation Nanotechnology: Balance and Sustainability*’ from Dr. Sharmila Mukhopadhyay, Professor of Materials Science and Engineering and Director of Center for Nanoscale Multifunctional Materials at Wright State University, USA.

Some R&D Supported Conferences/Activities

(2015-2016)

- International Conference on Machines & Mechanisms
- Indo German Chemistry Meeting 2016
- The International Conference on Fiber Optics and Photonics - PHOTONICS
- Development of Policy Research Network - a unique policy research network at IIT Kanpur. more at <http://www.dprn.in/>

RESEARCH CENTERS



The institute has 10 Research Centers/Units in interdisciplinary areas endowed with state of the art facilities.

- Advanced Center for Materials Science
<http://www.iitk.ac.in/acms/>
- Advanced Center for Electronic Systems
<http://www.iitk.ac.in/ee/>
- BSNL-IITK Telecom Center of Excellence
<http://www.iitk.ac.in/dord/bitcoe/>
- Center for Mechatronics
<http://www.iitk.ac.in/robotics/>
- Center for Laser Technology
<http://www.iitk.ac.in/celt/>
- Center for Environmental Science and Engineering
<http://www.iitk.ac.in/cese/>
- National Information Center of Earthquake Engineering
<http://www.nicee.org/>
- SAMTEL Center for Display Technologies
<http://www.iitk.ac.in/scdt/>
- Thematic Unit of Excellence
<http://www.iitk.ac.in/nanoscience>
- Syndicate Bank Entrepreneurship Research and Training Center



Center for Environmental Science and Engineering



Nanoscience and Nanotechnology



SAMTEL Center for Display Technologies



Advanced Center for Materials Science

Advanced Imaging Center

Advanced Imaging at IIT Kanpur was started with a generous internal grant from the Institute to procure high-resolution transmission electron microscope for researchers engaged in cutting-edge materials research.



National Center for Flexible Electronics

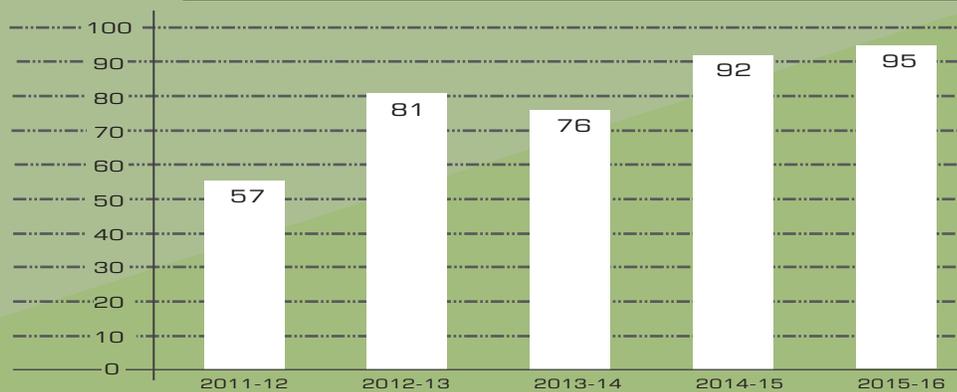
Honourable Prime Minister, Shri Narendra Modi conducted remote launching of the National Center for Flexible Electronics at IIT Kanpur on July 1, 2015 as a part of the national mission on 'Digital India', sponsored by the Department of Electronics and Information Technology (DeitY). The aim of this Center is to act as a catalyst for the development of the flexible electronics industry in the country. The Center will function as a National Resource Center functioning closely with the industry.

INDUSTRY COLLABORATION



IIT Kanpur is a premier technological institute in the country which engages in state of the art research in almost all fields of engineering and sciences. The focus of the research work is to generate new ideas, to create innovative solutions and to reveal basic principles of matter with an emphasis on using all these knowledge in developing practical engineering and technological applications. In this process, the institute work closely with its industry partners with the objective of adding value to their products and services, for the larger goal of bringing in novel solutions to the society at large. We look for opportunities to engage with challenges and in our constant quest for excellence, we try to bring forth best possible solutions in timely and cost-effective manner. There are various platforms for collaboration, such as contract research, development and consultancy, faculty exchange between Industry and IIT Kanpur, student projects and associated activities, industry assisted courses and courses for industry. The office of the Associate Dean, Industrial Collaboration (ADIC) strives to provide a structured interaction of IIT Kanpur with the industry.

Total Number of Industrial Projects Received Over last 5 Years



Selected MOUS Signed with Industry

- LG Soft India Private Limited, Bangalore, for renewal of Research Agreement.
- Steel Authority of India Limited, New Delhi, for exploring & identifying Joint research programs on topic of mutual interest.
- Coral Telecom, Noida, for development of Telecom hardware and software products as per the market requirements.
- Ikan Innovations and Technologies Pvt. Ltd., Lucknow, to collaborate in the areas of commercialization, evaluation and enhancement of technologies, products and services developed by IITK; consultancy services that match with IITK capabilities; creating work contracts worldwide.
- Samsung Research India, New Delhi for taking the collaboration to a higher level through special industry oriented courses, technical talks and industry expert lectures, student projects and student technical contests.
- Sterlite Technologies Limited, for joint Collaboration Agreement for intensifying academic and research cooperation.
- The Boeing Company, USA, for conducting the project.
- Intel Technology India Private Ltd, Bengaluru, for Collaboration in the areas of curriculum development, student intern programs, sponsored and/or consultancy projects, collaborative exploration of research, student contests, faculty and Intel staff exchange, fellowship program, knowledge sharing and student mentoring, pilt projects, lab development activities, workshops etc.
- NTPC Limited, Noida, Service Purchase Order for development of Intelligent Electronic Transformer (IET) with DC source interface with IIT Kanpur.
- Dow Chemical International Pvt.Ltd., Mumbai, to explore research and development opportunities and technical collaboration.
- Emerson Network Power India Ltd., Thane, to design, develop products in the field of AC and DC Power and Precision Cooling Solutions for Network Power India requirements.
- Tata Consultancy Services, Mumbai, for strengthening and developing the link between TCS and IITK through the formation of IITK-TCS Program.

SELECTED INDUSTRY PARTNERS



Selected Government Funding Agencies

- Board of Research & Nuclear Sciences
- Council of Scientific & Industrial Research
- Department of Science & Technology
- Department of Biotechnology
- Department of Atomic Energy
- Defence Research & Development Organisation
- Department of Electronics and Information Technology
- Science and Engineering Research Board
- Ministry of Human Resource & Development
- Ministry of Earth Sciences
- Ministry of Communications & Information Technology
- Ministry of Environment & Forests
- Ministry of Power
- Indian Space Research Organisation



Industry Suggested Chairs



Industry Connect Talk Series

Speakers from the industry are invited to present their company's research areas of interest to explore possibilities of collaboration with researchers at IIT Kanpur. Some of the companies visited in 2016:

LG Soft India Private Ltd
Mitsubishi Heavy Industries Ltd.
Zydus Cadila
Oil and Natural Gas Corporation

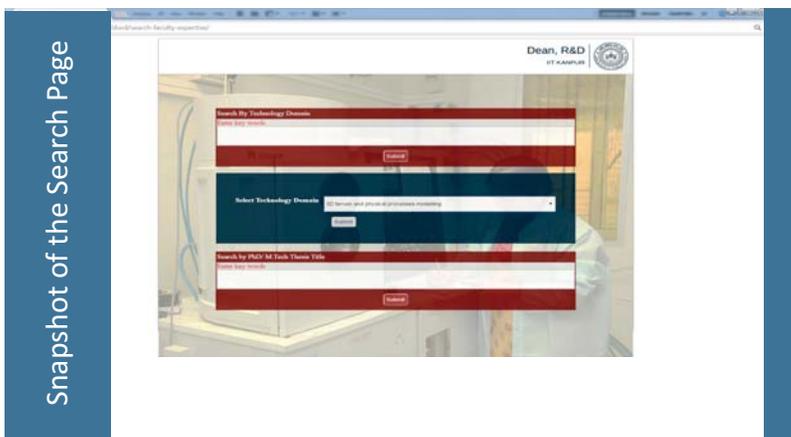
Search the Expert

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

Post Your Query

Post your queries related to Research, Technology, Collaboration

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



Snapshot of the Search Page

Contact

Prof. Animangsu Ghatak
Associate Dean, Industrial Collaboration (ADIC)
Indian Institute of Technology Kanpur
Phone: +91-512-259 7146
adic@iitk.ac.in

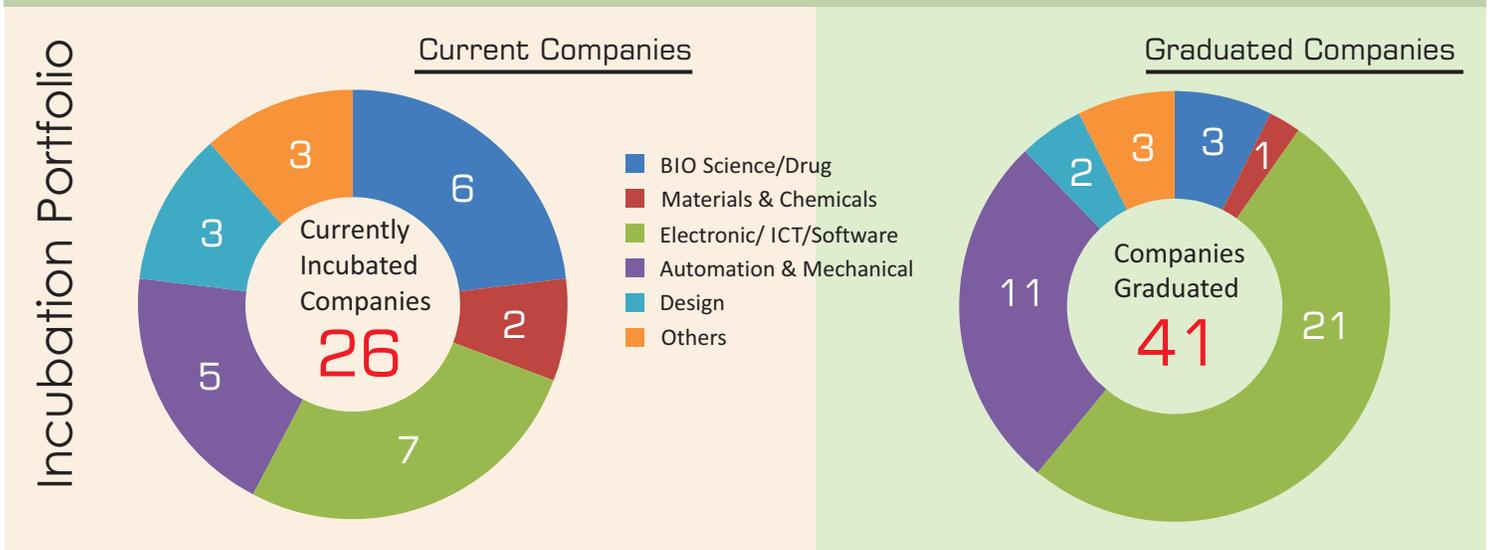
INNOVATION & INCUBATION



IT Kanpur set up SIDBI Innovation and Incubation Centre (SIIC) in collaboration with Small Industries Development Bank of India in 2000 to foster innovation, research, and entrepreneurial activities in technology-based areas. SIIC provides a platform to start-ups and prospective entrepreneurs for converting their innovative ideas into commercially viable products. SIIC also provides services related to patenting and commercialization.



During 2015-16, 45 patents including 7 design patents were filed and 8 earlier filed patents were granted and 4 technologies were licensed for commercialization. Over the years, 388 patents have been filed, 56 technologies have been commercialized.



Currently Incubated Companies

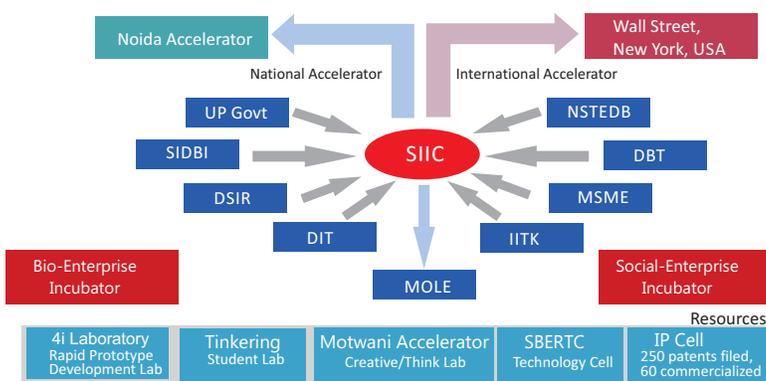
- Apcegen Technologies Pvt. Ltd.
- Aarav Unmanned Systems Pvt. Ltd.
- Aniketana Ecosystem Pvt. Ltd.
- Binventor Labs Pvt. Ltd.
- Cenogen Material Pvt. Ltd.
- Cloudshell Technologies Pvt. Ltd.
- Decentrik Technologies Pvt. Ltd.
- E-Spin Nanotech Pvt. Ltd.
- Gen Pro Therapeutix Pvt. Ltd.
- Giti Tech Pvt. Ltd.
- InvivoD Solutions Pvt. Ltd.
- Innosium Technologies Pvt. Ltd.
- Kanopy Techno Solution Pvt. Ltd.
- Kristnam Technologies Pvt. Ltd.
- Mudgal Engineers Pvt. Ltd.
- Naturesense Technologies Pvt. Ltd.
- NURBS 3D Solutions Pvt. Ltd.
- Ortho Regenics Pvt. Ltd.
- Orane Infosystems Pvt. Ltd.
- Promorph Techno Solutions.
- Prosoc Innovators Pvt. Ltd.
- Robust Results Pvt. Ltd.
- Simplified Logistic Solutions Pvt. Ltd.
- Srashta Automation Labs Pvt. Ltd.
- Taral Engineering Solutions Pvt. Ltd.
- Trident Analytical Solutions.





Innovation Ecosystem

The Innovation Ecosystem at IIT Kanpur is a unique experimental and incubation space fostering innovation and entrepreneurship in the whole country. The ecosystem is driven by a set of laboratories and testing facilities encompassing the entire gamut of engineering disciplines from Bio-Engineering, Mechanical, Electronics and Electrical to IT & ITES and is open to anyone with an innovative idea. SIIC along with the Innovation Council is at the epicentre of this ecosystem fostering, facilitating and funding the nascent entrepreneurial ventures. IIT Kanpur faculty plays an important role in this ecosystem in providing knowledge and technical expertise as mentors to make them globally competitive.



Vibrant eco-system of innovation and entrepreneurship at IITK

Recently Granted Patents

- A Process for Preparation of Micron Sized High Molecular Weight Polymer
- A Wind turbine device
- Recuperative Liquefied Petroleum Gas (LPG) Vortex Burner System
- Conversion of vegetable oils to biodiesel
- Novel low temperature synthesis of Nd-doped bismuth titanate nanoparticles
- A low complexity symbol timing estimator for MIMO Modem using two samples per symbol
- A Process for generating miniaturised replicas of a 2D or 3D pattern or an object
- Polysilicon Amoled Self- Biased Cascode Pixel Circuit with High
- A Carbon nanotubes coated long fiber and a process for preparation thereof
- Business purpose Utility Vehicle-Vegetable Car
- Design for disability: A waist wearable for visually challenged for Indoor Navigation
- Wound Dressing Polymer Matrix
- Synthesis of stable nanocrystalline iron carbides by reaction milling in a dual-drive planetary mill
- Functionally Graded Polymer Nanocomposites, Composites having cross linking density variation and their manufacture
- A novel functionally graded polymer(s)/polymeric nanocomposite(s) [FGP(s)]/FGPNC(s) having glass transition temperature variation and a process for preparation thereof

Recent Programs & Initiatives

- INVENT program, PRISM and NIDHI PRAYAS for providing grants and stipends to individuals.
- NIDHI-EIR Scheme and MSME program offer a monthly stipend to budding entrepreneurs at the institute.
- SIIC is involved in the development of the Research Park, sanctioned by MHRD and DST, GoI.
- MoLE program to support training program and Incubation for ITI graduates.
- Bio Incubation facility was established by BIRAC, under the Bio-Incubator Support Scheme (BISS).

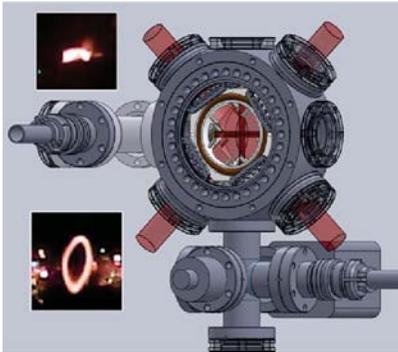
Contact

Prof. Sameer Khandekar
Associate Dean, Innovation and Incubation (ADII)
Indian Institute of Technology Kanpur
Phone: +91-512-259 6652
samkhan@iitk.ac.in

Recently Licensed Technologies

- Licensed to Robust Results
- Briter Cell Line
- Recuperative Liquefied Petroleum Gas (LPG) Vortex Burner System
- Conversion of vegetable oils to biodiesel
- A Novel viscoelastic media used for a nano-finishing of materials through abrasive flow machining process and a method of manufacture thereof
- Novel low temperature synthesis of Nd-doped bismuth titanate nanoparticles
- A low complexity symbol timing estimator for MIMO Modem using two samples per symbol
- A Process for generating miniaturised replicas of a 2D or 3D pattern or an object
- "PM 1 Sampler"

SOME RECENT PROJECTS



The project titled a **Triggered Source of Single Photons and Photon Pairs** funded by SERB proposes to develop a high brightness triggered source of single photons and photon pairs, using laser cooled ensemble of Rubidium atoms coupled to two optical cavities. A cascaded four-wave mixing scheme is proposed for optically pumped cold atoms to generate ondemand photons together with a fast multi-photon counting system to characterize the source. The key novelty of the project is implementation of a double-cavity system integrated in conjunction with the atomic ensemble to enable operation at extremely low light levels. The high brightness photon source, once developed will be used, in conjunction with a confocal microscope to couple triggered photons to single nanoparticles, towards creating an interface between cold atoms and solid-state materials.

The project titled **Understanding Innate Responses To Odors And Odor Mixtures: Across-Species Integrated Approach** is funded by the University Grants Commission (UGC) and the Israel Science Foundation (ISF). Mosquitoes detect humans using a variety of cues, among which host odors play an important role. Similarly, in other species such as mice, specific odors can elicit innate attraction or aversion, and these behavioral responses help in the detection of food, danger, or mates. The mechanisms which determine the innate valence for odors are not well understood. The project would involve a set of experiments that combine electrophysiology, behavioral tests, and optogenetics stimulations in two animal systems (mosquitoes and mice) to determine the underlying mechanisms.

The Department of Science and Technology funded the project titled **Developing Prototype of a Smart Superconducting Fault Current Limiter (SCFCLSM) with Three Dimensional Field and Current Mapping Technology for Early Fault and Hot Spot Detection**. There is an ever increasing need for protecting power grids against damage by making them resistant to faults which are major fluctuations in the power drawn from a grid. The project aims to build the prototype of a smart superconducting circuit breaker which isolates the power grids during a fault condition. A new imaging technique which helps in detecting local hot region (hot spots) generated in superconducting switches is also being developed. Image of a hot spot imaging technique that is being built is shown here.



Ministry of Human Resource and Development (MHRD) has funded the establishment of a **Design Innovation Center** at IIT Kanpur to promote a culture of innovation and creative problem solving. The Center aims to facilitate interdisciplinary design-focused education, research, and entrepreneurial activities, besides encouraging partnerships between academia and industry for commercialising the technologies.

Cognizant of the rapid advances and changes in the area of online , NPTEL Phase IV has proposed new activities which is in tune with the recently initiated scheme of the Ministry of Human Resource of Development (MHRD) called the **Central Sector Scheme (CSS) for MOOC-compliant e-content creation**. The goal of the scheme is to produce e-content that can be offered as Massive Open Online Courses (MOOCs) at different levels of education.

MHRD funded a project titled **Teaching And Learning Center**. The Center will work at multiple levels: at Teacher enablement and quality improvement; Curriculum audit, Curriculum design, Curriculum adoption strategy; design and develop powerful electronic platforms to enable the above the two modes of interaction. This portal will play the host of all electronic course offerings from IIT Kanpur.

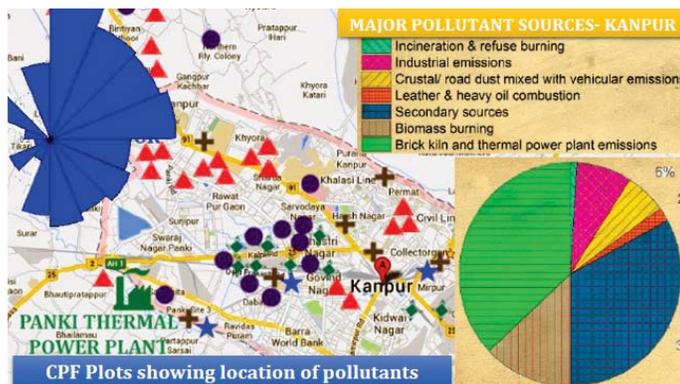
SOME RECENT PROJECTS



The project titled **Installation of a Pilot Plant of 10KLD Capacity** is about providing a solution for industrial effluents consisting of organic dyes which are harmful to environment and are not dischargeable. The solution is provided by using the soil mediated photocatalytic remediation of industrial dye present in the effluents by using ZnO nanostructures in presence of sunlight. The collaborator for this activity is CETP jodhpur and the goal is to setup a plant of 10 KLD capacity which would be based on solar energy. The project has been funded by Department of Science & Engineering.

The project titled **Active Fault, Paleoseismic and Crustal Deformation In North-West and Central Himalaya India : An Integrated Approach Towards Seismic Hazard Assessment** is part of a national initiative by Ministry of Earth Sciences. It covers area from Kumaon-Garhwal and Himachal Pradesh in Himalaya. The objectives of the project is to identify the most earthquake prone (seismically active) areas in Himalaya; to prepare Digital Active Fault Atlas of Himalaya; reconstruction of Paleo-earthquake history; measure Crustal Deformation through a permanent GPS-network; and assessment of earthquake hazard in Himalaya and its neighborhood.

Ministry of Environment, Forest and Climate Change has funded a major project titled **National Carbonaceous Aerosols Programme (NCAP): Carbonaceous Aerosol Emissions, Source Apportionment and Climate Effects**. The broad objectives of this major national initiative involving more than a dozen institutes are extensive understanding of carbonaceous aerosol emissions from regional sources including emission inventory, source apportionment, and their seasonal and long-term atmospheric abundance. Specifically, IIT Kanpur will be estimating emission magnitude and uncertainty of carbonaceous aerosols and co-emitted species from major vehicular tail pipes. In addition, an inverse modelling methods will be employed with the aid of molecular markers and isotope fingerprinting for deducing regional atmospheric abundance of carbonaceous aerosols, measured over a two year long period, from two North-East Himalayan sites.

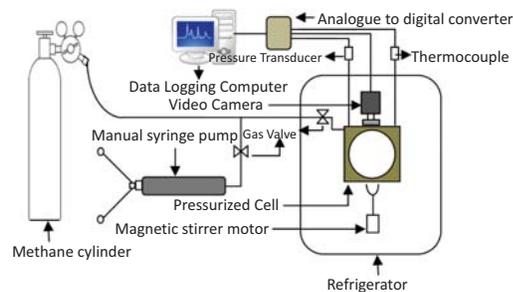


The Wellcome Trust DBT India funded a major project on **Coding of Innate Olfactory Preferences in the Mosquito Brain**. Mosquitoes detect humans using a variety of cues, including the exhaled carbon dioxide and skin odors. Presently, the understanding about how the information relayed by the sensory neurons is processed in the mosquito brain and how it results in specific behavioral preferences is lacking. In this project, an electrophysiology lab will be established and technique of in-vivo intracellular recordings for mosquitoes will be optimized. By measuring the responses of projection neurons to attractive, repulsive and neutral odorants and examining their morphologies, it will be tested whether different attractive and repulsive odors are encoded by dedicated neural pathways.

The project titled **Integration and Enablement of 0.18 Micron RF SOI Technology for Analog Mixed Signal Applications** is an endeavor towards "Make in India" for an RF-SOI technology that will enable manufacturing of superior integrated circuits (IC) in India, especially for analog & mixed signal RF applications, such as cell-phones, radars, and set-top boxes. It will create production level RF-SOI Analog MixedSignal (AMS) technology for the first time in the country and will create PDK and offer country's first multi-project wafer (MPW) service. Project will be undertaken in collaboration with IIT Delhi and Semi-Conductor Laboratory (SCL), Chandigarh - and funded by Department of Science & Technology (DST).

SOME RECENT PROJECTS

The project titled **Optical Diagnostics of Transport Phenomena during Gas Hydrate Formation and Dissociation** funded by Oil & Natural Gas Cooperation Limited (ONGC) deals with the laboratory-scale experiments of CH₄ extraction from the marine hydrate sediments. The idea is to visualize the physical phenomena as well as to measure the methane fluxes during formation and dissociation of CH₄-hydrate. The proposed experimental techniques focus on concentration-field reconstruction of laser schlieren imaging and X-ray tomography. The primary objectives of the project include: Laboratory-scale evaluation of Methane recovery strategies, Providing a test-bed for new technologies and Supplying benchmark results for the (computational)



Proposed experimental setup for gas hydrate formation and dissociation

IMPRINT India Initiative

IIT Kanpur is the national coordinating institute for the implementation of research projects under IMPRINT (Impacting Research, Innovation and Technology), a Pan-IIT Initiative of MHRD. A total of 60 projects have been approved for funding in the first cycle of IMPRINT scheme, with a total funding of Rs 35 crores from the MHRD and the remaining 50% being contributed by other ministries. IIT Kanpur is implementing 11 of these projects worth Rs.6.91 crores.

UAY

IIT Kanpur has got approval of 5 major projects under the new scheme of Uchchar Avishkar Yojana (UAY), Ministry of Human Resource and Development. Under this scheme 50% of the total project cost will be supported by MHRD and the rest 50% will be shared equally by the partner Industry and the concerned ministry.

The project titled **Engineering of Security Hardened Cryptographic Protocols for Critical National Infrastructure** is sanctioned under the scheme of Uchchar Avishkar Yojana (UAY) of Govt. of India. IITK and Nivetti Systems are partnering in this project to develop a secure implementation of SSL/TLS libraries which Nivetti system will commercialize both by implementing it in their routers and switches, and also possibly as standalone libraries to be mandated by the government to be used in critical products in the country. It is planned to develop cryptographic co-processors for the symmetric key encryption to speed up the performance of the secure communications through cryptographic tunneling. Apart from Nivetti system, the industrial partner for this project, The MHRD/Department of Science & Technology and the Ministry of Communication & Information Technology have funded the project jointly.

Department of Biotechnology funded a major project titled **Development of Transition Metal doped -Carbon Nanofiber based Biosensor for the - Detection of Glucose, Cholesterol, and Creatinine in Human Blood**. In this study, the transition metal carbon nanocomposite material is to be prepared as a stable, high performing and economically viable electrode material of a biosensor for the simultaneous detection and measurements of glucose, cholesterol, and creatinine in biofluids. The electrode material will be prepared by catalytic a chemical vapor deposition, using activated carbon microfiber as a substrate. The proposed biosensor will be tested on human blood samples in a clinical environment, using an electrochemical cell assembly and amperometric techniques. This is the first time that the synergetic effect of the hierarchal web of activated micro nanofibers (ACFs/CNFs), transition metal and metal oxide NPs, and cholesterol/glucose oxidase (ChOx) is to be demonstrated for the amperometric detection of cholesterol/glucose and creatinine.

SOME RECENT PROJECTS



The Department of Mechanical Engineering has received DST-FIST grant for establishing the following two major facilities.

- **Metal Additive Manufacturing facility.** The facility, based on selective Laser melting of a powder bed, will be capable of creating metal parts of both reactive and non-reactive materials. The facility will be used to address thermal-material interactions in metal additive manufacturing in detail with an aim to obtain scientific understanding of the physical mechanisms involved. The facility at large can help in indigenous product and technology development and will also provide a boost to the newly evolving area of metal additive manufacturing in India.
- **3D Tomographic PIV facility:** This whole-flow-field technique, based on recent developments in camera and laser technology, can provide instantaneous velocity vector measurements in the entire flow thus enabling simultaneous observation of spatial and temporal variation of the flow. The instrument will be used in understanding locomotion of underwater creatures, flow control, bio-medical fluid mechanics etc.

Research Park

IIT Kanpur has received a major grant of Rs. 70 crore for setting up the **Science and Technology Research Park**. The Research Park will foster to enhance the Industrial and Transitional research eco-system of the institute, in partnership with the industry and start up entrepreneurs. The aim of the initiative is to provide necessary environment, infrastructure and policy frame-work for collaborative research between Academia and Industry, create mechanisms for co-sharing technology and business skills of academia and industry partners, enhance industry sponsored projects to give the IITK students more opportunity to work directly on real-time problems and to create a self sustained revenue generation model with transitional/industrial research.

The park will have an energy-efficient and environment friendly state of the art multi-storied building complex with a total constructed area of approximately 40000 m². Once fully operational, the entire eco-system will be equipped to host about 50 industrial research units/companies and 100 incubates and startups.



New Facilities under the FIST Scheme (2015-16):

The Department of Civil Engineering received generous equipment grants of Rs. 6.60 crore to procure 2500 kN servo-hydraulic four column loading frame and controller of Universal Testing Machine (UTM), 600 lpm Hydraulic Power Unit, Cyclic Simple Shear Apparatus, Instrumentation and Data Acquisition system for the Pseudo Dynamic testing facility, Water Isotope Analyzer, Short range laser scanner.

Department of Biological Sciences and Bioengineering received FIST funding to augment its research infrastructure and also to initiate new lines of investigations. Under the current funding an high-end Fluorescence-Activated Cell Sorting (FACS) and a Next-generation sequencing system, a robotic device for crystallisation membrane proteins are to be added to augment the molecular biology and structural biology core facilities. As a new initiative, an high-resolution micro-computed tomography (micro-CT) system is being added for imaging small animals.

Department of Science and Technology (DST) India, under the FIST program (Level-II), has sanctioned a new project titled 'Structure, Interfacial Phenomena and Cell-Molecule Interactions of Complex Chemical Systems' in the department of chemistry.

Department of Science and Technology funded the project titled **Agarose based Wound Dressing** under Technology Systems Development Programme. The project has proposed the fabrication of cost-effective agarose based materials that can be used for wound dressing as well as drug delivery patches. Different cross-linkers, reinforcements and functionalization strategies would be employed to manipulate the strength of the material, swelling percentage, water vapor transmission rate and gas permeability to suite various wound types.

UNIQUE FACILITIES



National Wind Tunnel Facility

It was established to meet the national needs in aeronautical and non-aeronautical activities. It houses the most versatile and efficient wind tunnel in India and is capable of testing at wind speed up to 80 m/sec.



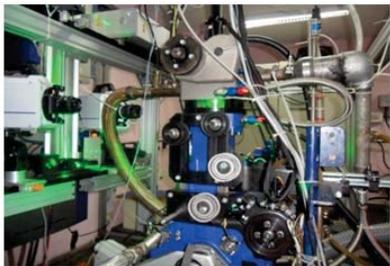
Real Time Digital Simulator (RTDS)

A 6-rack Real Time Digital Simulation (RTDS) Facility carries out advanced research on power systems. The facility is the biggest amongst Asian universities and can simulate the transient behaviour of practical systems using a time step of upto two microseconds. It will be used for Synchrophasor Applications in Power Systems and Grid Integration of Wind Farm/Solar Photovoltaic using DC micro grids.

Nanoscale Imaging Facility

The Institute is in the process of commissioning this facility for materials and biological science at a cost of about INR 15 crores. It houses a HRTEM and a cryo-TEM along with all the complete infrastructure/accessories requirements for materials and biological sample preparation. The HRTEM is FEI make Titan G2 60-300 model, the world's most powerful commercially available STEM/TEM.

Engine Research Lab



It houses a flexible internal combustion system with provision to vary fuel injection strategies and timing, supercharging boost pressure, control and measurement of fuel pressure and injection pattern. It is equipped with an AC dynamometer, state of art intake air measurement system and gravimetric fuel flow meter. The engine also has provision for installation of endoscope for visualization of combustion at higher engine operating load.

Focused Ion Beam (FIB) System

It allows milling, imaging and deposition at nanometer scales. The FIB is a product of FEI Company (Nova 600 Nano Lab) and has a dual beam facility. The two beams are :

(i) An electron beam which has a spot size of 2–10 nm, beam current of 1–35 nA and energy varying from 500 eV to 30 keV. The electron beam is primarily utilized for scanning electron microscopy (SEM)

(ii) A Gallium (Ga) ion beam which has a spot size of 10–15 nm, beam current of 1–35 nA and energy varying from 5–30 keV. The Ga ion is utilized for machining of samples and fabrication of nanostructures



STUDENTS' RESEARCH



AUV

'Varun' is the Autonomous Underwater Vehicle currently being developed by a team of undergraduate students under the Science and Technology Council, IIT Kanpur. After a year of designing and building several experimental prototypes, the team won the second position in their debut at the 5th National Student Autonomous Vehicle (SAVe) organized by the National Institute of Technology (NIOT), under the Ministry of Earth Science at Chennai, India. The competition aims to provide a platform for students to explore the underwater technologies and kindle their interest in marine research.



Pushpak



Team Pushpak represents a group of students from Aeromodelling Club under the Science and Technology Council, IIT Kanpur. Over the years the team has participated in the SAE Aero design chapter in 2013, 14,15 and 16. The team participated in SAE Aero Design East 2016, Dallas, Texas and secured overall second runner-up position in both the Micro Class and in the payload fraction category. They are known for their expertise in designing UAV based solutions to modern day problems from baseline designs developed for SAE Aero Design. The expertise developed at this platform has inspired the Team's Alumni to setup their own start-up (Aaruv Unmanned Systems) on UAV based imaging and analysis.

ROBOCON 2016

A team of IIT Kanpur students participated in ROBOCON 2016. The team stood second runner up among 105 teams from all over the country. ABU ROBOCON is an Asia Pacific Inter Colligate Robotics competition which aims at providing a platform to robotics enthusiasts and help drive advancements in robotics technology. IIT Kanpur has been participating in the event since its inception. The problem statement of ROBOCON 2016 dealt with the theme of 'Clean energy recharging the world'.



Abhyast

A team of 8 undergraduates designed an Unmanned Ground Vehicle (UGV) that could successfully perform simple path planning and obstacle avoidance. Body engineering aspects of the vehicle were also factored in to make it suitable for unstructured landscape. After successfully navigating in an arena filled with randomly moving obstacles, complexities were introduced into the objectives for Phase II of the project. Phase II mainly aimed at developing gas sensors for detection and monitoring of gases in a chemically hostile environment. The endeavour is supported by The Boeing, USA.

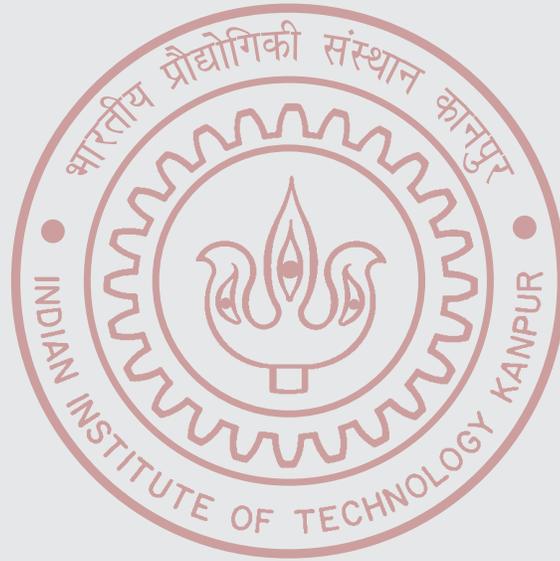
Formula Racing Car

SAE Club, IIT Kanpur represents the team of students who are involved in designing and manufacturing of an off-road racing vehicle using institute's in-house facility. The club activities involve full scale car conceptualization, design, fabrication, assembly, testing and above all taking part in national and international Competitions.



NERD

NERD is a campus magazine meant for providing students a platform to share the excitement of science and technology. The magazine is created by students - be it their research work, hobby projects, interviews with scientists, or book reviews.



Feedback/Suggestions

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

Contact

Dean of Research & Development
Indian Institute of Technology Kanpur
Kanpur 208016
U. P. , India
Ph. No. +91-512-2597578
E-mail: dord@iitk.ac.in

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