Indian Institute of Technology Kanpur

On Research and Development

K. Muralidhar
Dean: Research & Development
Presentation details

- Organization of the Institute
- Research initiatives
- Large research projects
- Academic contributions
- Concern for society
- Vision
The Institute is organized into 9 engineering departments, along with Physics, Chemistry, Mathematics, and Humanities.

In addition it runs inter-disciplinary programs such as laser technology, materials science, and nuclear engineering and several Centers.
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<table>
<thead>
<tr>
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<tr>
<td>Undergraduate</td>
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<td>Master’s</td>
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<td>Ph.D.</td>
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<td>23497</td>
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<td>+ 300 contract</td>
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Research output

- Doctoral and master’s students
- Publications (journals, books, monographs, conferences)
- Patents (products)
- Projects
- Programs
- Missions
Statistics

Sponsored & consultancy projects (Rs. in crores)
Patents filed

- Patents
- Books, book chapters
- Tech and Software developed
IPR & Patents

(A) Number of Indian patents
pre 2005 [2-3 per year]
2005-2006 [10]
2007-2008 [15]
2008-2009 [35]
2009-2010 [45]

(B) Number of International patents
2005-2009 [04]

(C) Technology Transfer
before 2009: Nil
after 2009 : 24

[Rs 67 lakhs]

We reach the market place via firms such as Intellectual Ventures.
Research Centers and Centers of Excellence

1. Environmental Science & Engineering
2. BSNL-IIITK Telecom Center of Excellence
3. Prabhu Goel Research Center for Computer and Internet Security
4. SAMTEL Center for Display Technology
5. Nanoscience and Nanotechnology
6. Archaeology and Cultural Resource Management
7. Autodesk IIITK Digital Innovation Laboratory
National Facilities

National Wind Tunnel Facility
National Information Center of Earthquake Engineering
Activities

- Sponsored research
- Consultancy
- Testing
- Project management
  - finances, staff, space
- Collaboration could be national as well as international
- Management of Centers
Funding agencies

MHRD (Ministry of Human Resources Development)
DST (Department of Science and Technology)
DBT (Biosciences and bioengineering)
DRDO (defense)
AR&DB (aerospace)
MCIT (communications)
MNES (energy)
MEF (environment)
Funding agencies

BRNS (nuclear)
DOE (electronics)
CSIR (pure and applied sciences)
ISRO (space)
NAIP (agriculture)
MoT (textiles)
Thrust areas

- Energy
- Environment
- Communication
- Materials
- Computation and algorithms
- Manufacturing
Large projects

(a) CFD-software (BRNS) and
(b) Railway safety (MHRD-MoR)

UNDP projects on
(i) Computer-aided Design
(ii) saddle development
LCA program

- The Autolay software for computer-aided design saved the exchequer over 7 million US dollars in the era when foreign currency was in short supply.
- Turn around time (tat) analysis for carbon brake unit of LCA and resin route cc discs completed
- Report on vent hole size analysis generated
- Analysis of emission of carbon for various interface areas and its effect on brake cooling was performed.
TECHNOLOGY MISSION on RAILWAY SAFETY

The Mission will comprise of four Mission Programs:

1. Mission Program 1: Traction And Rolling System - 10.5 crores
2. Mission Program 2: Track And Bridges - 8.5 crores
3. Mission Program 3: Signal And Communication - 4.5 crores
Coordinated missions

- Indo-US Centers
  - fabrionics and advanced manufacturing biomaterials
  - microwave sintering

- HAL-IITK initiative
An example for multidisciplinary approach

- Environmental Technologies
- Environmental, Chemical and Civil Engineering (IITK)
- Medical Institutions (Indian)
- Biosciences (IITK)
- Mechanical Engineering (IITK)
- Human and Ecological health and diseases
- International Universities
- CSE and Media Lab Asia (IITK)
- Pharmaceutical and others (Indian and MNCs)
New initiatives

BSNL-IITK collaboration on multimedia, communication technologies, cognitive radio and computational mathematics

IGCAR-IITK initiative on futuristic mechanics and materials.

Ganga management plan
Recent projects

- A major project entitled DISANET - Information Network for Natural Disaster Mitigation and Recovery has been granted by the Japan International Cooperation Agency (JICA), Japan. It deals with risk mitigation in the context of earthquakes.

- Another major project is recently sanctioned by DST. This will be the largest Real time Digital Simulator in the country and the largest in any of the Asian Universities.
Recent projects (cont.)

- The *Syndicate Bank Entrepreneurship Research and Education Centre (SBEREC)* at IITK aims to promote and support research in entrepreneurship, develop and teach courses, impart skills to successfully manage new ventures, and help new entrepreneurs succeed.

- IIT Kanpur will participate in the GATE (Gas Turbine Enabling Technology) initiative of AR&DB New Delhi. The aim here is to design the Gas turbine Engine of the future, for both civilian and military applications.
Major projects

- The project *India-UK Advanced Technology Center (IU-ATC) of Excellence in Next Generation Network Systems and Services* seeks to study the feasibility of transmitting high data-rates through frequency selective fading channels.

- The project titled *Engineering Articular Cartilage: A Novel Interdisciplinary Approach* is funded by DBT.

- The project funded by the Ministry of Earth Sciences envisages the use of an integrated approach for understanding river dynamics and flood risk evaluation of the Kosi river in north Bihar.
Open Philosophies for Associative Autopoietic digital Ecosystems

- 20 Universities/Organizations/Research Labs from Europe, Asia, South America, Africa
- Coordinated by London School of Economics

www.agropedia.net
Lunar Rover

- Control of a lunar rover considering wheel slip and sinkage.
- Development of a prototype rover for experimental evaluation of slip and sinkage.
- Integration on the Lunar Rover on Chandrayaan -2 in 2012.
Research Agreement with Chevron, USA, Advanced Refining Technologies, USA and Hindustan Petroleum Corporation Ltd.

- Washcoating of monoliths
- Immobilization of an ionic liquid catalyst on a solid substrate
- Effect of sulfiding protocol on catalyst activity

Chemical & Engineering News: 2003
Nano-science research

Mesoscale Structures, Patterning and Properties with Emphasis on Soft Materials and Thin Films

- A state-of-the-art facility and resources for soft matter nanoscience and nanotechnology.

- Explore new techniques of nano-fabrication based on a creative combination of “top-down” including soft lithography, self-assembly and self-organization.

- Projects related to nano-scale understanding, fabrication and use of soft materials in coatings, NEMS, functional interfaces and bulk-nano
Organic Electronics and Displays

- State-of-art facilities housed in Class 1000 clean room
- Several industrial partners: Samtel, Moser Baer, Tata Corus/Steel, Manipal Press
- PPA partnership

OLED displays, lighting, O-TFT, O-solar, printable electronics, O-sensors
Solar Energy Research Enclave

- 500 KW solar power station/modular research test-grid
- Long term research & development in solar power generation, storage and distribution
- Involvement of graduate and undergraduate programs
Solar energy enclave (imagined)
Pan-IIT project: Vertically integrated solar energy initiative for generation and delivery of 1 MW power, 8 hours a day
Multi-core Curriculum for Intel

- IIT Kanpur selected as one of the ten institutes from all over the world (other schools include CMU, Tel Aviv, UC Berkeley, and ETH).
- Intel has set up labs (providing both hardware and software), and is continuously upgrading them.
- The partnership has grown into a research collaboration.
- We are recognized as India’s first Centre of Excellence in Multi-core Technologies.
- The curriculum has been adopted in a large number of universities in India.
Undergraduate student-driven research

- Nanosatellite (with ISRO)
- Autonomous vehicle (with Boeing)
- Glucoband
- Publications (NERD)
- Project activity (POWER)
- Undergraduate research conference
R&D related major student initiatives – NERD, GE3 and PoWER

- **NERD (Notes on Engineering Research and Development)**:
  - A student publication celebrating the work done by students
  - 6 issues published in a span of one year

- **GE3 (Group on Environment and Energy Engineering)**:
  The group increases awareness about importance of energy efficiency

- **PoWER (Promotion of Work Experience and Research)**:
  - A platform for interaction between students, faculty and industries for free flow of ideas, information and resources
  Currently working on nanosatellite, lunar rover, and Glucoband
Incubation and enterprise

**Category I:**
Try a novel technological idea, scaling up a laboratory proven concept.

**Category II:**
Technology-based start-up company promoted by I

**Category III:**
R&D company that desires to have close technology interface with IIT Kanpur.

Coordinated by: **SIDBI INNOVATION AND INCUBATION CENTRE (SIIC)**

10 companies incubated and 15 companies presently on campus.
Innovation initiative

A futuristic fabrication facility (4-I) that interfaces with the incubation center (SIIC) and the digital innovation laboratory (DIL) is being configured.

4I lab: Innovation, Integration, Incubation, Implementation
Mentoring new Institutes

IIT Guwahati
IIIT Jabalpur
IIIT Gwalior
IIT Rajashtan

Close links with UPTU, IIIT Allahabad, and NIT Allahabad.
Awards

Wellcome Trust 4
Bhatnagar award 16
Fellowships of National academies 50
Humboldt 20
JSPS 12
Bessel 3

apart from editorship of leading journals.
Faculty, staff and students are engaged in community education and illustrative scientific experiments for school students.
Children of daily-wage workers are supported by a school backed by the Institute.

Vocational training is provided to young adults in the Opportunity college.

IIT Kanpur students participate actively in this venture.
3-I Network

A collaborative project involving
IDFC, IIT Kanpur, IIM Ahmedabad

Objectives

- To identify and articulate specific areas and issues pertaining to various infrastructure sectors.
- Carry out projects dealing with policy, organization, and specialized techno-managerial elements relating to infrastructure.
- Prepare and publish an India Infrastructure Report each year.
  - 8 reports published since 2001.
- Enhance the intellectual capital in the infrastructure sectors by bringing together academia and the policy makers, professionals, practitioners, and users.
High Performance Computing facility

The Institute is in the process of upgrading its HPC infrastructure to a state-of-the-art facility with generous support from the DST.

The main HPC system will be a linux cluster with a master node, 3 management nodes and 256 compute nodes, 40 gbps QDR infiniband interconnect and 100TB usable storage.
Courseware and Distance Education

i. **NPTEL**: The main objective of this program is to enhance quality of engineering education in the country by developing curriculum based video and web courses.

ii. **NKN**: Three virtual classrooms shall be set up at the Institute. Lectures would be delivered enabling two-way interactions using this infrastructure for mentoring of the new IITs.

iii. **Smart classrooms**
Cyber Security

- Algorithms
- Smart card
- Biometrics
Biometric System Development

- Development of indigenous monomodal biometric systems such as Ear, Face, Fingerprint, Iris, Palmprint, Signature, Vein Pattern for human verification and identification.
- Development of an efficient fusion strategy for multimodal biometric system.
- Reduction of search time in a large database with the help of suitable classification, clustering and indexing strategy.
A viewpoint

We would like to support
inter-disciplinary
inter-departmental
inter-institutional
international
research projects.
Mission Statement

We would like to be seen as an international technological university:

- Continue to hold top ranking for undergraduate education.
- Reach a status of a tier 1 research university on the world stage.
THANK YOU!