

Indian Institute of Technology Kanpur

13th December 2010

Research achievements: an overview

Indian Institute of Technology Kanpur (IITK) is in celebration as its Golden jubilee year comes to end. Over the past five decades, the Institute has been striving to develop itself into an institution of excellence in education and research, in consonance with the needs of the country. These goals have been achieved through a meaningful education program, original research of the highest standard and leadership in various spheres of technology. With path-breaking innovations in both its curriculum and research, the Institute has gained a considerable reputation.

Research at the Institute aims at creativity and technological development while maintaining academic and research collaborations with universities, various arms of the government, and the industry. The contribution of the Institute to the growth of the country has been recognized in various surveys. Acknowledging the Institute's research capabilities, the government has allocated key projects to the Institute.

The faculty and students of the Institute continue to break new grounds at the frontiers of research. They have been duly recognized in the form of various awards and honors including fellowships of professional societies, editorship of international journals, best paper awards to the students, patents, and collaboration with the private sector.

A survey of the research profile of IIT Kanpur is presented below.

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➤ **Research Centers of Excellence**



1. *Center for Environmental Science & Engineering* is conceived with the specific objective of integrating the fields of engineering, science and medicine to address technological solutions to environmental issues.
2. *BSNL-IITK Telecom Center of Excellence* is focused on Multimedia and Telecom, Cognitive Radio and Computational Mathematics. It will build excellence which is on par with world standards.
3. *SAMTEL Center for Display Technology* is a significant effort towards meaningful industry-academia interaction that will meet the challenges of emerging technologies in electronic displays, solar cells, and large-area electronics.
4. *Center for Nanoscience and Nanotechnology*
 - has a state-of-the-art facility and resources for soft matter nanoscience and nanotechnology
 - explores new techniques of nano-fabrication based on a creative combination of a top-down approach with soft lithography, self-assembly and self-organization
 - executes projects related to nano-scale understanding, fabrication and use of soft materials in coatings, NEMS, functional interfaces and bulk-nano materials.
5. *National Wind Tunnel Facility* was established to meet the national needs in areas of aeronautical and non-aeronautical R&D activities. It houses the most versatile and efficient wind tunnel in India and certainly the largest in the region.
6. *SIDBI Innovation & Incubation Centre (SIIC)* was established in collaboration with the Small Industries development Bank of India (SIDBI) to foster innovation, research, and entrepreneurial activities in technology-based areas. SIIC provides a platform to start-ups prospective entrepreneurs and intrapreneurs to convert their innovative ideas into commercially viable products. There are 15 companies presently being incubated, while 8 companies have graduated and operate on their own. SIIC comprehensively manages the Institute IPR, innovation and entrepreneurship.
7. *Archaeology and Cultural Resource Management*: The focus areas of the center are geoinformatics, CAD and computer application in archaeology and archaeo-materials. The Institute offers short and long term training programs for capacity building for the officers of The Archaeological Survey of India in the application of modern technology in archaeology.
8. *Autodesk IITK Digital Innovation Laboratory*: It has 20 state-of-the-art graphics workstations with multiple licenses. It is open to faculty, students and staff of the Institute to conduct research. These include software for design and drafting as well as specialized products for electrical, civil, aerospace applications and animation tools.

9. *National Information Center of Earthquake Engineering*: It collects and maintains information resources on Earthquake Engineering and makes these available to interested professionals, researchers, academicians and others with a view to mitigate earthquake disasters in the country.
10. *Prabhu Goel Research Center for Computer and Internet Security*: The vision of the Centre is to become the nodal R&D centre for all aspects of computer security. It aims to educate various governmental and non-governmental organizations on the security issues and help them in this regard.
11. *Centre for Mechatronics*: Special areas of interest include autonomous vehicles, vision-based control, lunar rover, and inverse kinematics. The Centre gives support for students in the form of training and disseminates information through continuing education programs.
12. *HAL-IITK Cell*: The Cell devotes its resources to the conduct of advanced research related to aircraft system development.
13. *Space Technology Cell*: Projects related to the Department of Space are coordinated by the Cell.
14. *Media Technology Center*: The center is presently conducting the NPTEL project. The main objective of this program is to enhance the quality of engineering education in the country by developing over 100 curriculum-based video and web courses.



15. *Computer Centre*: Computer Centre provides email, web, DNS, FTP, Internet access, HPC and other services 24 hours a day and 365 days a year to the faculty, staff and students for their research and teaching. It provides various advanced and special purpose software for all the users. It also supports the Institute-wide 1000 Mbps fiber optic network that connects the academic departments, hostels, library and other central facilities to the Computer Centre. It has a number of state-of-the-art servers, high-end Linux and Windows laboratories and applications software. The high performance computing facility is located in the computer center.

➤ **International collaboration**

The Institute has entered into several MoUs with world-class universities. The objectives of these MoUs consist of promoting, strengthening, maintaining scientific and academic co-operation, exchange of faculty, students, and staff. The Institute has attracted funding from a variety of international sources based in USA, Europe, and Japan. Examples can be seen in the Boeing-sponsored projects along with those from Chevron, Intel, Microsoft, JICA, and AOARD.

➤ **Tie-ups with the private sector:** There are over 60 ongoing projects with the private sector where faculty provides expert advice in the form of models, design and analysis. To name a few projects:

- **Agropedia** is a comprehensive, seamlessly integrated model of digital content organization in the agricultural domain. It aims to bring together a community of practice through an ICT-mediated knowledge creating and organizing platform with an effort to leverage the existing agricultural extension system. It is envisioned to be a one-stop shop for all types of information related to the Indian agriculture. The practice of crop knowledge models has been defined and developed for the first time worldwide to create the architecture that accumulates known codified and approved information about crops. This work has been carried out with the support of the Food and Agriculture Organization (FAO), Rome.

The screenshot displays the Agropedia website interface. At the top, it features the Agropedia logo and the URL www.agropedia.net. Below the header, there are several informational boxes:

- What is agropedia?**: A box defining Agropedia as an online repository for agricultural knowledge, utilizing social networking and semantic technologies. It notes that it combines certified content from Gyandhara with Janagyan (emergent knowledge).
- Knowledge Model - Basis of agropedia**: A complex diagram showing the interconnected relationships between various agricultural concepts, categorized into Production Technology (Green), Post Harvest Management (Yellow), and Climate & Soil (Blue).
- Crop Knowledge Model ?**: A box explaining that this is a visual representation of important agricultural concepts and their relationships, designed for interactive use and efficient information dissemination.
- Content from agropedia**: A section showing sample content related to crops, with a map of India highlighting the locations of the content.
- agropedia as of November '09**: A statistics box reporting that the platform deals with 9 crops, is accessed by over 150 countries, receives over 350 visits per day, has over 1400 registered users, contains over 3500 pages, and has over 25,000 pageviews.

At the bottom, there is a call to action: "Be a part of the agriculture knowledge revolution - Join agropedia today" with the website URL.

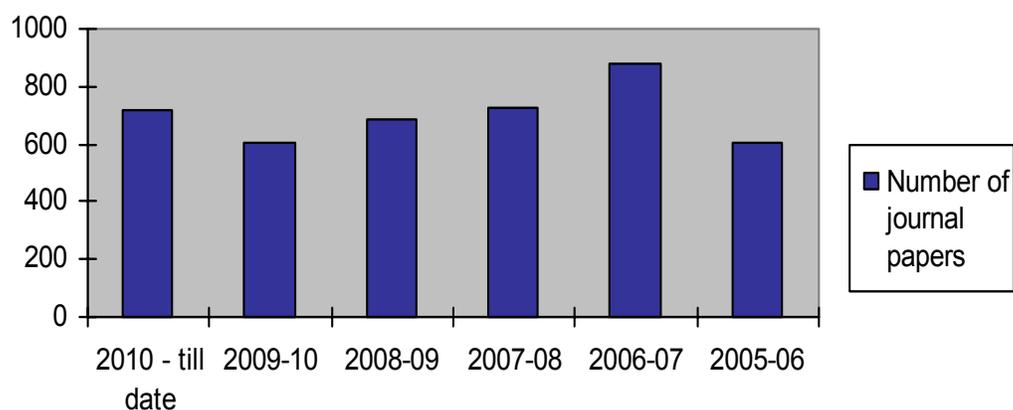
- **Moser Baer India Limited, New Delhi (MBIL)** has funded several projects in organic photovoltaic devices for developing a strategic partnership and futuristic research, conducting basic studies and scientific investigations, and establishing partnership with the governmental agencies.
- The **Boeing** funded project on high lift aerodynamics seeks to enhance understanding of high lift flow physics and obtain highly accurate and detailed measurements for two-dimensional aerofoil cross-sections using imaging techniques.

- **Chevron Corporation**, USA and **Hindustan Petroleum Corporation Limited** joined hands with the Institute to form a research consortium. Very significant methodologies have been developed in the domain of petroleum processing. The common goal of the consortium is to develop technologies related to petroleum refining as well as gas separation processes.

Two technologies developed at the Institute that have been highly appreciated are related to monolith catalyst blocks and separation process using the idea of HIGEE (separating gases such as SO₂, CO₂, and H₂S from petroleum).

- In the research agreement with **Qualcomm Incorporated**, a Delaware corporation, areas of interest are fundamental and applied research in computing, communications, wireless and mobility, including but not limited to: (i) joint research programs with relevance to India, (ii) applications with relevance to social behavior, usage patterns and business needs, (iii) deployment models as applicable to emerging markets and populations, and (iv) speech, video and user interface research relevant to local languages and behavior.
- The **Intel** Higher Education Program is a worldwide collaboration between Intel Corporation and more than 150 universities in 34 countries. This program will be coordinated by IIT Kanpur in India to form the first Focus School of Intel in the country. IIT Kanpur and Intel have established a strategic tie-up to conduct research in areas such as multi-core and VLSI and offer faculty development programs from all over India.
- Permanent Magnet (PM) motors have come into vogue, in recent times, principally from the point of view of saving in energy. **IHI** Japan has funded a project titled Optimization of efficiency of outer-rotor Surface Permanent Magnet Synchronous Motor (SPMSM) over a given speed range.

➤ Publication statistics



Faculty members have published research papers in reputed national and international journals. In 2008, Dr. Animangsu Ghatak (Chemical) published a paper in SCIENCE, a journal that has an impact factor of 30.

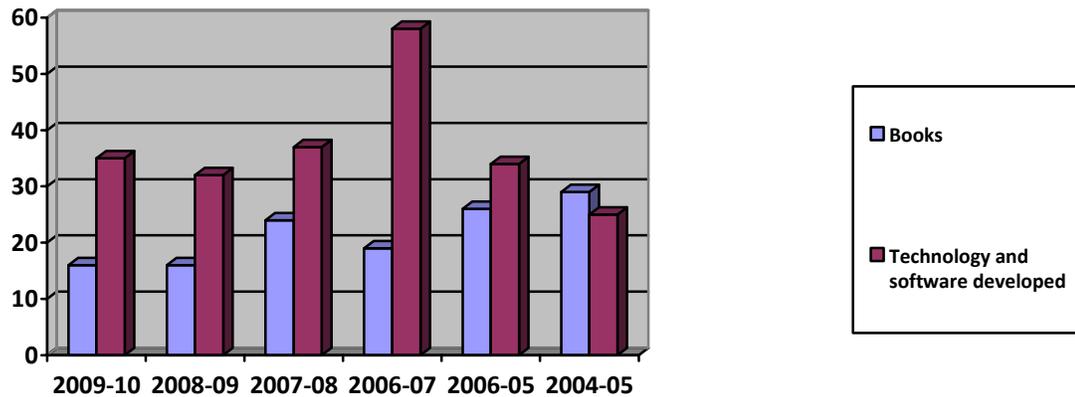
➤ **Selected list of books**

1. Numerical Methods for Engineering and Science, Saumyen Guha and Rajesh Srivastava in the Department of Civil Engineering, Oxford Higher Education Series, Oxford University Press, New Delhi, 2010.
2. Basic Organometallic Chemistry: Concepts, Synthesis and applications. B. D. Gupta, Professor in the Department of Chemistry. University Press, Hyderabad, 2010.
3. Intelligent Systems and Control. Laxmidhar Behera, Associate Professor in the Department of Electrical Engineering. Oxford University Press, Nov 2009.
4. Digital Communications and Signal Processing. K. Vasudevan, Associate Professor in the Department of Electrical Engineering. Universities Press, Hyderabad, 2010.
5. Services Marketing – People, Technology, Strategy. 6th Edition. Professor J. Chatterjee, Professor in the Department of Industrial Management and Engineering. Pearson, New Delhi.
6. Statistical Analysis of Designed Experiments. Shalabh, Associate Professor of the Department of Mathematics and Statistics. Springer 2010.
7. Textbook of Ordinary Differential Equations. V Raghavendra, Professor of the Department of Mathematics and Statistics. McGraw Hill (Education), 2009.
8. Gas Dynamics Work Book. E. Rathakrishnan, Professor, Department of Aerospace Engineering. Praise Worthy Prize, 2010.
9. Macroporous Polymers: Production Properties and Biotechnological/Biomedical Applications. Ashok Kumar, Associate Professor, Department of Biological Sciences and Bioengineering. CRC Press-Taylor & Francis group, 2010.
10. Advanced Biomaterials: Fundamentals, Processing, and Applications. Bikramjit Basu, Associate Professor, Department of Materials and Metallurgical Engineering. Dhirendra S. Katti, Associate Professor, Department of Biological Sciences and Bioengineering. John Wiley & Sons, Inc., USA, 2009.
11. Fluid Mechanics and Its Applications. S. K. Gupta, Professor in the Department of Chemical Engineering. Wiley Eastern/New Age Intl. Publishers, New Delhi, 1984, Second Edition, 2010.
12. Profile of Engineering Education in India: Status, Concerns and Recommendations. G. Biswas, Editor, Professor in the Department of Mechanical Engineering. Narosa Publishers, 2010.
13. Conduction and Radiation. K. Muralidhar, Professor in the Department of Mechanical Engineering. Narosa Publishers, 2010.
14. Sintering Fundamentals. G. S. Upadhyay, Professor in the Department of Materials and Metallurgical Engineering. Trans Tech. Publications Inc., 2009.
15. CI Engine Performance for Use with Alternative Fuels. A.K. Agarwal, Associate Professor in the Department of Mechanical Engineering. SAE International, USA, 2009.

16. Modeling of Steelmaking Processes, D. Mazumdar, Professor Department of Materials and Metallurgical Engineering. CRC Press, Boca Raton, Florida, USA, 2009.
17. Controlled Atomization: Needs and Challenges. Combustion Science and Technology: Recent Advances, Abhijit Kushari, Department of Aerospace Engineering, Narosa Publications, New Delhi, 2009.
18. Design of supermacroporous biomaterials via gelation at sub-zero temperatures-Cryogelation. Advanced Biomaterials: Fundamentals, Processing and Applications, Ashok Kumar, Department of Biological Sciences and Bioengineering, John Wiley and sons Inc. (Hoboken, NJ), 2009.
19. Molecular Modeling and Simulation: Can it help in the development of micro and nano devices, in Microfluidics and Microfabrication, Department of Chemical Engineering, Springer (USA), 2009.
20. Multi-objective Genetic Algorithm and Simulated Annealing with the Jumping Gene Adaptations in Multi-Objective Optimization: Techniques and Applications in Chemical Engineering, S. K. Gupta, Department of Chemical Engineering, World Scientific, Singapore, 2009.
21. Nano PTFE polymer films as organic insulating barrier in Nanomaterials and devices: Processing and applications for tunneling magneto-resistive Fe/PTFE/Fe., S. S. Manoharan, Department of Chemistry, Trans. Tech Publications, 2009.
22. Estimation of flood affected areas using classification of satellite images of a major Indian River in Natural and Manmade Disasters: Vulnerability, Preparedness, and Mitigation, O. Dikshit, Department of Civil Engineering, MD Publications Pvt. Ltd., New Delhi, 2009.
23. A multizone doped high breakdown voltage lateral bipolar transistor on buried oxide thick step, Springer's Lecture Notes on Electrical Engineering, S.S.K. Iyer, Department of Electrical Engineering, Springer's Lecture Notes, 2009.
24. Understanding Transformational Change Using 'Competing Value' Framework, in Integrating Spirituality and Organizational Leadership, R.R.K. Sharma, Department of Industrial Management and Engineering, Macmillan India Advance Research Series, New Delhi, 2009.
25. Civics Curriculum and Textbooks, Social Science Learning in Schools: Perspective and Challenges, Amman Madan, Department of Humanities and Social Sciences, Sage, New Delhi, 2010.
26. Sabbath's Complaint: Philip Roth's Black Comedy in Sabbath's Theater in Playful and Serious: Philip Roth as a Comic Writer, G. Neelakantan, Department of Humanities and Social Sciences, University of Delaware Press, Newark, 2009.

A total of **46** book chapters were published last year.

Books and technology and software developed during last 6 years



➤ **Summary of projects**

The number of sponsored (research), consultancy projects, conferences and courses conducted through the R&D office in the last 5 years are given in the table below.

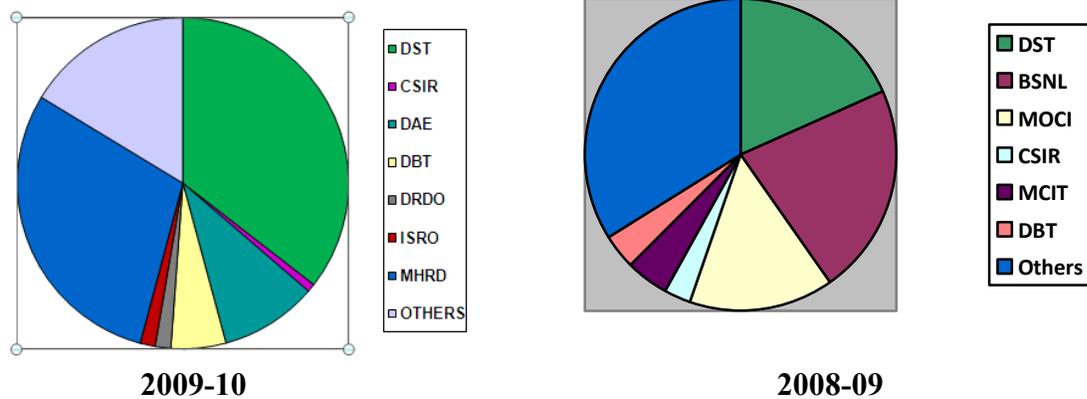
| | [Sponsored] (Rs. in crores) | [Consultancy] (Rs. in crores) | Conferences, Courses |
|----------------|-----------------------------|-------------------------------|----------------------|
| 2010-till date | [87] (81) | [62] (6) | 30 |
| 2009-10: | [133] (69.5) | [100] (7.5) | 56 |
| 2008-09: | [140] (66) | [122] (9) | 37 |
| 2007-08: | [111] (41.8) | [109] (6.6) | 36 |
| 2006-07: | [138] (65.6) | [96] (5.6) | 41 |
| 2005-06: | [121] (55.6) | [94] (4) | 43 |

Investments from R&D funds as of 31st March 2010: Rs. 38 crores

Investments from A/c II as of 31st March 2010: Rs. 75 crores

Investments from R&D earnings in the endowment account as of 31st March 2010: Rs. 42 crores

Pie chart of grants from sponsored projects



➤ 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.

Based on the available information on active tectonics in the Himalayan region, the project will undertake detailed mapping, paleo-seismic investigation and GPS measurements in three transects across the fault zone between NW and Central Himalayas. The generated data will reconstruct co-seismic deformations and active tectonic processes in the Himalayan region. It is proposed to develop an Optically Stimulated Luminescence (OSL) dating facility at IIT Kanpur to define the timings of earthquakes, and rates of crustal deformation for seismic and tectonic history of the Himalayan front.

- Another major project that has recently been sanctioned by DST is in the area of smart grids. This project will enable the procurement of the largest **Real time Digital Simulator – RTDS** in the country that will also be the largest among Asian Universities.

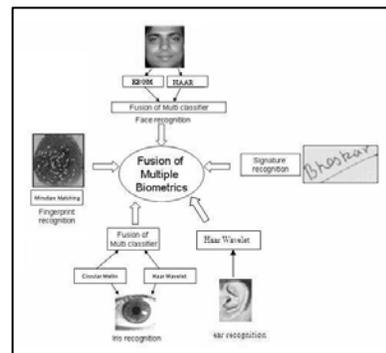
It would help in enhanced capabilities for developing and testing high fidelity models of power systems, power electronics and control equipments; improved system understanding and validation of controllers through real time Hardware-in-the-loop (HITL) tests; providing advance research capabilities and training platform to the students and utility engineers, in real-time environment on emerging issues in power and control systems.

- Syndicate Bank has approved an **Entrepreneurship Research and Education** as an activity of the SIDBI Innovation and Incubation Center (SIIC) at IITK. The *Syndicate Bank Entrepreneurship Research and Education Centre (SBEREC)* aims to promote and support research in entrepreneurship, develop and teach courses, impart skills to successfully manage new ventures, and help new entrepreneurs succeed. In simple terms, we envision this as a *finishing school* for entrepreneurship.
- 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 challenges in the initiative would be environmental concerns such as noise reduction and low emissions, while maintaining low fuel consumption and high efficiency. For military applications the objectives shift towards unmanned vehicles, whereas for manned vehicles one would like to enhance reconnaissance and strike capabilities. A second initiative on unmanned autonomous vehicle is being supported by ADA Bangalore.

➤ **Major ongoing projects**

- The Institute has been awarded a highly competitive and major international collaborative research project jointly funded by Research Council UK (RCUK) and the Department of Science and Technology, (DST) India under the auspices of a newly launched *UK-India Science Bridge Program* entitled *BioPharm 2020: Entrepreneurial Opportunities* for Indian and UK scientists in the pharmaceutical and biotechnology industries.

- The Biometric group is engaged with a DIT funded project titled *Biometric System Development* to build upon the existing system by minimizing its limitations and by incorporating some new traits.



- *Center for Development of Metal-Ceramic Composites through microwave processing* has been established under the Indo-US Public-Private Networked Joint Center Program funded by the Indo-US Science and Technology Forum (IUSSTF).
- Recent developments in the field testify to a significant progress in our attempts to develop new biomaterials. In this regard, we have received a grant for establishment of *Indo-US joint center on Biomaterials for health care*.

- *Ganga management plan* - a Pan IIT project involving the faculty of seven IITs is sponsored by the Ministry of Environment and Forests. The project is for development of a Ganga River Basin Management Plan (GRBMP) under National Ganga River Basin Authority (NGRBA).



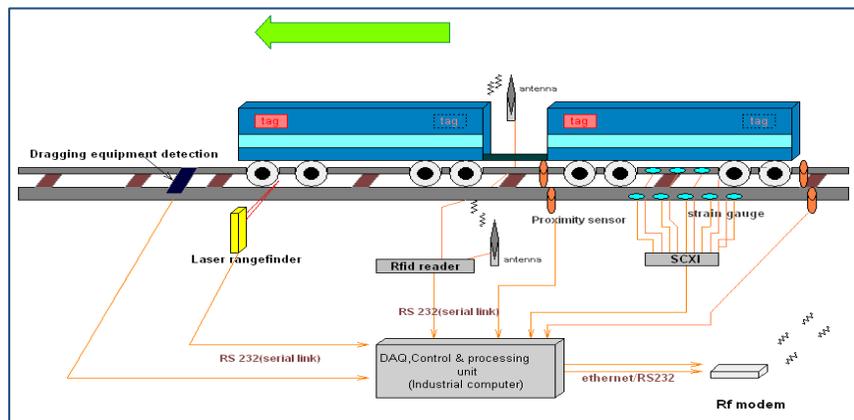
- The project *India-UK Advanced Technology Center (IU-ATC) of Excellence* in Next generation network Systems and Services seeks to study the feasibility of transmitting high data-rates through frequency selective fading channels.
- The project titled *Engineering Articular Cartilage: a Novel Interdisciplinary Approach* is funded by DBT. It is related to Osteoarthritis (OA) is the most prevalent disease in India affecting more than 65% of the elderly (60 years and above) population and has no cure.
- The project on River dynamics and flood risk evaluation of the Kosi river (North Bihar plains), 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.

- The Institute has undertaken a major initiative in particle acceleration with the inauguration of the *Tandetron Ion Beam facility*. The accelerator operates energies at 1.7 MeV and will facilitate research in the areas of microfabrication, micromachining (MEMS/NEMS), ion beam synthesis of nano phases and surface engineering, surface and interface studies by RBS/ERDA/PIXE/ channeling, defect and damage studies in materials, bio-materials, 3D mapping and process optimization and system automation.



- The *IGCAR-IITK initiative* on futuristic mechanics and materials. The initiative devotes its energies to the conduct of research in areas of relevance of the fast breeder reactor. The specific areas of research that are identified include Mechanics and Materials, Thermal Hydraulics, Multiscale modeling, Instrumentation, mechanisms, and machine vision.
- BRNS Mumbai has approved the creation of a *National Fire Facility* for understanding fire propagation and associated thermal hydraulic aspects in multiple compartments. The project is approved at a total cost of Rs 5 crores.

- The attractive feature of the DBT funded project Investigation on developing *Ultra-high Molecular Weight Polyethylene- Hydroxyapatite – Carbon Nanotube Biocomposite for Biomedical Applications* lies in applying a synergistic combination of (i) Hydroxyapatite (HA, $\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$), (ii) aluminum oxide (Al_2O_3) and (iii) carbon nanotubes via compression molding and achieving enhanced mechanical and tribological properties of the biocomposite without deteriorating its cytocompatibility.
- The DST Unit of Nanosciences has been established as a joint venture with *Indo-US Science and Technology Forum*. The unit costing Rs. 15 crores has several fabrication and characterization facilities such as e-beam patterning, spin coating, nano-imprint, lithography, maskless lithography, laser ablation, small and wide angle X-ray.
- Recently, the Institute completed a major project for **Indian Railways**. As a result of a research project, several technology developments related to rail safety have taken place. These include (i) development of an automated system which can be installed along the track for detecting faults in bogies of rolling stock, (ii) measurement of lateral and vertical rail forces in components of the rolling stock which may cause derailment, (iii) development of an indigenous electronic derailment detection device for the coach and a mechanical device for the freight, (iv) development of an on-board diagnostics panel for diesel and electric locomotives through microprocessor based controls, (v) a new chemical composition of wheels, axles both for forging and casting without altering the design parameters, (vi) development of corrosion prevention methods of the existing rails and the liner location, (vii) design and development of an instrumented wheel set for wagon, carriage and locomotive, (viii) indigenous flaw detection and testing equipment for rails and rail weld joints at a speeds of about 40-50 kmph, (ix) design and development of an environmental friendly railway coach toilet system for Indian Railways, (x) SIMRAN, a real time train tracking system, and (xi) improvement in the visibility under foggy conditions by developing a proper fog vision system.



➤ **Patents**

(A) Number of Indian patents

pre 2005 [2-3 per year]

2005-2006 [10]

2006-2007 [15]

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]

Many of the patents proposed by the faculty have been procured by *Intellectual Ventures Ltd.*, a Bangalore-based multinational company. A quote from Dr Ashok Mishra, CEO of IV is quite revealing: **In 2010, IIT Kanpur is the top source of inventions for IV India, both on invention volumes and filed patents...**

➤ **Institute level publications**

1. Directions, a scientific magazine of the Institute is published twice a year.



2. The academic and research profile is published once in three years.

3. NERD is a student-managed magazine on research and development.

➤ **REACH**

Research Challenges (REACH) symposia are being held since 2007. The structure of these symposia is multi-disciplinary with the idea that such meetings would foster the much needed cross talk from academicians belonging to different hues of research. It is hoped that such events would be fertile grounds for new ideas to germinate and take root.

Themes covered over the years are:

2007: Art of experiments, Living with and controlling vibrations, Materials of tomorrow

2008: Biomimetics, Future of energy, Forecasting

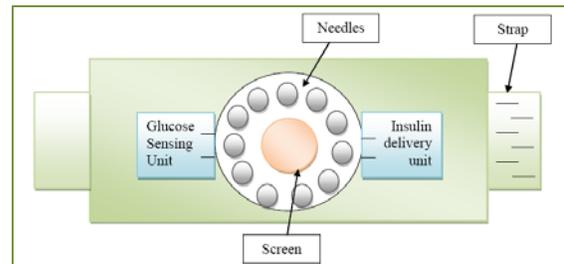
2010: High-performance computing: applications in science and engineering; Environment, health and life; Design and innovation; a research vision for IIT Kanpur.

➤ Undergraduate research

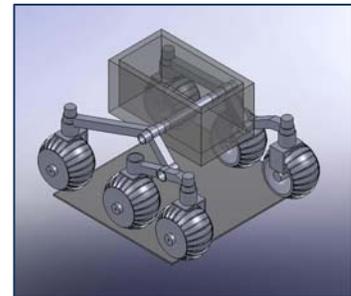
- **Autonomous vehicle** (with Boeing): *Abhyast* is a mobile robot device designed to be reliable and rugged for map interpretation, robotic navigation, and imaging. It navigates with the help of GPS (Global Positioning System), IMU and Digital Compass (direction). The robot communicates with the user through GSM network which brings in the added benefit of large areas of network coverage. The autonomous navigation system is enabled through self-localization and path planning capabilities.



- **Nanosatellite** (with ISRO): *Jugnu*, the first nanosatellite developed by students under the guidance of faculty of the Institute and scientists from ISRO has been handed over to ISRO for the final launch. *Jugnu* will image the earth's surface and transmit a *Beacon* – blinking signal, at all times – all over the earth.
- **Glucoband:** A group of students will develop a closed loop glucose sensing and insulin delivery system.



- **Lunar Rover:** is expected to navigate on very rough terrain, such as the lunar surface. The main focus of the two projects is on wheel traction control and accurate 3D map generation.



➤ Student initiatives in R&D

- NERD (Notes on Engineering Research and Development) is IITK students' publication celebrating the work done by students.
- GE3 (Group on Environment and Energy Engineering):
The group increases awareness about importance of energy efficiency
- PoWER (Promotion of Work Experience and Research): is a platform for interaction between students, faculty and industries for free flow of ideas, information and resources.

➤ **Institute level initiatives**

• **Solar Energy Project**

As a Golden Jubilee initiative, the Institute has undertaken an ambitious project to setup a 500 kW Solar Energy Research Experimental Station (SERES) on Shivli road at Kanpur. It will supply power to nearby villages at subsidized rates. The project is first of its kind, since it has technology as well as social dimensions.



Major features of the initiative include:

1. 500 KW solar power station/*modular* research test-grid.
2. Long term research and development in solar power generation, storage and distribution.
3. Involvement of students from graduate and undergraduate programs.



Solar Energy Enclave (*imagined*)

➤ **Other Institute-level initiatives**

- Futuristic Mechanics
- Digital connectivity for rural areas
- Translation development for Indian languages
- Smart card and radio frequency identification
- Cyber security
- Nanoscience and Nanotechnology

➤ **Awards**

The Institute has Wellcome trust awardees (4), Bhatnagar scholars (16), Fellowships of National academies (50), Humboldt (20), JSPS (12), and Bessel (3) Fellows on the faculty apart from editorship of leading journals.

Recent national and international awards gathered by the faculty are listed below:

1. Government of India has nominated Professor Sanjay Dhande to work in the *National Innovation Council* set up by the Honorable Prime Minister of India. The Council will prepare a roadmap for the Decade of innovation 2010-2020 and will also promote the setting up of State and Sector Innovation Councils to help implement strategies for innovation in States and for specific sectors.
2. Dr. Manindra Agrawal, Department of Computer Science and Engineering has been awarded Humboldt Research Award for the year 2011.
3. Professor Ashutosh Sharma, Department of Chemical Engineering has been given the Infosys Prize 2010 in the category of Engineering and Computer Science.
4. Dr. Kantesh Balani, Department of Material Science and Engineering has been awarded the 2010 Young Metallurgist of the Year.
5. Professor Manindra Agrawal, Department of Computer Science and Engineering has been awarded the prize of the Third World Academy of Sciences (TWAS) in Mathematics, for the year 2010.
6. Professor Ashutosh Sharma, Department of Chemical Engineering has been elected as a fellow to the TWAS.
7. Professor Ashutosh Sharma, Department of Chemical Engineering, has been awarded the Life Time Achievement Award, 2010-11 of the Indian Science Congress Association and also has been selected for the 'MRSI Distinguished Lecturership' award for the period 2011-2012 by the President, Materials Research Society of India.
8. Dr. Bikramjit Basu, Department of Material Science and Engineering has been selected for the Ministry of Steel funded Best metallurgist of the year award.
9. Dr. Anindita Chakrabarti, Department of Humanities and Social Sciences has received the prestigious Professor M. N. Srinivas Memorial Prize 2010 awarded by the Indian Sociological Society.
10. Dr. Krishanu Biswas, Department of Materials Science and Engineering, has been selected for the IEI Young Engineers Award 2010-2011 in Materials Science and Engineering discipline.
11. Dr. Anupam Pal, Department of Biological Sciences and Bioengineering was conferred the Young Investigator Award by Asian Neurogastroenterology and Motility Association, 2009.

12. Dr. Balaji Prakash, Department of Biological Sciences and Bioengineering has been awarded the DBT-National Bioscience Award for 2009.
13. Dr. Ashu Jain, Department of Civil Engineering has been awarded Endeavour Executive Award 2009 by the Ministry of Education, Australia.
14. Dr. Tarun Gupta, Department of Civil Engineering received the INAE Young Engineer Award (2009).
15. Dr. Tarun Gupta, Department of Civil Engineering received the INDO-US Frontiers of Science Symposium Joint Research Award (2009).
16. Professor Rajiv Sinha, Department of Civil Engineering has received the best paper award from the Indian Society of Remote Sensing (2009).
17. Dr. S. N. Tripathi, Department of Civil Engineering has been given the NASI-Scopus Young Scientist 2009 Award instituted by the National Academy of Sciences India and Elsevier Pvt. Ltd. Asia-Pacific.
18. Professor Ashutosh Sharma, Department of Chemical Engineering received the Homi J. Bhabha Award for Applied Sciences, University Grants Commission (UGC) and National Hari Om Ashram Trust Award for the year 2007 [received in 2010].
19. Dr. Y. M. Joshi, Department of Chemical Engineering received the Amar Dye Chem Award, Indian Institute of Chemical Engineers (IChE).
20. Dr. J. K. Singh, Department of Chemical Engineering received the Indian National Academy of Engineering (INAE) Young Engineer Award, 2009.
21. Professor V. Chandrasekhar, Department of Chemistry has been elected to the Academy of the Developing World, FTWAS, Trieste, Italy.
22. Professor J. N. Moorthy, Department of Chemistry received the bronze medal awarded by the Chemical Research Society of India (CRSI).
23. Dr. S. S. Manoharan, Department of Chemistry was conferred the Gold Medal of the DST - Lockheed Martin Innovation Growth Program for developing nanocoated coronary stent.
24. Professor S. Verma, Department of Chemistry was conferred the CDRI Award for Excellence in Drug Research.
25. Professor S. Verma, Department of Chemistry received the Rajib Goyal Young Scientist Prize in Chemistry.
26. Professor Manindra Agrawal, Department of Computer Science and Engineering received the G D Birla Award for Scientific Research, Birla Foundation.
27. Professor Manindra Agrawal, Department of Computer Science and Engineering received the P C Mahanalobis Birth Centenary Award, Indian Science Congress.
28. Professor Manindra Agrawal, Department of Computer Science and Engineering received the Rajib Goyal Prize, Kurukshetra University.

29. Dr. Surender Baswana, Department of Computer Science and Engineering received the Young Engineer Award for the year 2009 instituted by the Indian National Academy of Engineers for his contribution to the field of design and analysis of algorithms.
30. Dr. Adrish Banerjee, Department of Electrical Engineering received the Young Engineer Award, Institute of Engineers (IEI), India in the area of Electronics & Communications, 2009.
31. Dr. Adrish Banerjee, Department of Electrical Engineering received the Microsoft Research India Outstanding Young Faculty Award, 2009.
32. Dr. Jaleel Akhtar's Department of Electrical Engineering paper entitled Noninvasive Procedure for Measuring the Complex Permittivity of Resins, Catalysts, and Other Liquids Using a Partially Filled Rectangular Waveguide Structure (IEEE Transactions on Microwave Theory and Techniques) received the CST (<http://www.cst.com>) University Publication Award 2009.
33. Professor Ashok K. Mittal, Department of Industrial Management and Engineering has been honored with Life Time Achievement Award 2010.
34. Professor R. R. K. Sharma, Department of Industrial Management and Engineering has been judged the Outstanding Management Researcher, at AIMS-7 conference, at IIM Bangalore, India.
35. Professor R. Balasubramaniam, Department of Materials and Metallurgical Engineering has been elected to receive the inaugural IIM Distinguished Educator Award 2009.
36. Dr. Kantesh Balani, Department of Materials and Metallurgical Engineering has been selected for the Young Scientists Award.
37. Professor N. K. Sharma, Department of Industrial Management and Engineering and Manu Kanchan's paper Role of mentoring in enhancing self efficacy: The effect of some personality traits and learning goal orientation as antecedents has been judged the best paper at the Annual Global Conference on Entrepreneurship and Technology Innovation (AGCETI), 2010.
38. Dr. Kantesh Balani, Department of Materials and Metallurgical Engineering has been selected for Dr R L Thakur Memorial Award 2009.
39. Professor Dipak Mazumdar, Department of Materials and Metallurgical Engineering has been selected to receive the G D Birla Gold Medal-2009.
40. Dr. Anish Upadhyaya, Department of Materials and Metallurgical Engineering has been selected for the 2009 Metallurgist of the Year Award.
41. Dr. Sameer Khandekar, Department of Mechanical Engineering has been awarded the Professor K. N. Seetharamu Medal for Young Researchers by the Indian Society for Heat and Mass Transfer.
42. Dr. Shantanu Bhattacharya, Department of Mechanical Engineering has been chosen for the IEI Young Engineers Award 2009-10.

43. Dr. Shantanu Bhattacharya, Department of Mechanical Engineering was given the Certificate of Outstanding Leadership by Boeing Corporation for the year 2009.
44. Dr Sudeep Bhattacharjee, Department of Physics was conferred the Buti Foundation Award and the Endeavour Research Award of the Australian Government.
45. Dr. S. N. Tripathi, Department of Civil Engineering received the NASA Senior Fellowship, National Aeronautics and Space Administration, USA.
46. Professor Deepak Kunzru, Department of Chemical Engineering has been elected Fellow, The National Academy of Sciences, India.
47. Professor S. K. Gupta, Department of Chemical Engineering has been elected Fellow, Indian National Academy of Engineering, New Delhi.
48. Professor P. K. Bharadwaj, Department of Chemistry received the J. C. Bose National Fellowship, DST, New Delhi, India.
49. Professor J. N. Moorthy, Department of Chemistry has been elected Fellow of the Indian Academy of Sciences (FASc), Bangalore.
50. Professor S. Verma, Department of Chemistry has been elected Fellow of National Academy of Sciences, India.
51. Professor Y. D. Vankar, Department of Chemistry has been elected Fellow, Indian National Science Academy, New Delhi, 2009.
52. Dr. Braj Bhushan, Department of Humanities and Social Sciences received the Common Future Fellowship (2010), Volkswagen Stiftung, Germany.

➤ **Infrastructure**

Academic area has 100% wi-fi facility available to all students, staff and faculty. Internet bandwidth is 1 Gbps. Direct access is available. All hostel rooms, residential area have internet access through broadband.

P. K. Kelkar Library

It comprises of 3275 books, 1711 periodicals, 1523 international journals, 164 national journals and 15 international magazines. Our Library (<http://library.iitk.ac.in/>) has total 260232 books, 9 electronic databases. These acquisitions are about USD 20 million per year.

New RA hostel (under construction)

For increasing number of research associates, senior scientists and post-doctoral fellows, the construction of new seven storied RA hostel with 200 single and 36 double rooms is underway.



➤ **Facilities**

- Computers are available for students in the labs, departments, and in Computer Center. The Institute has recently procured a state-of-the-art facility *High Performance Computing* (HPC) system worth USD 15 million with the generous support from the Department of Science and Technology. 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 100 TB usable storage.

- **Major equipment funded by the Institute include:**

| |
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| X-Ray fluorescence (XRF) spectrometer |
| Laser-induced incandescence for particulate emissions measurement |
| Dynamic high-resolution laser confocal fluorescence microscopy |
| A probe station for measurements on thin films, devices and materials |
| Scanning electron microscope |
| Phased array diffuse optical tomography system |
| Dielectric probe kit for determination of electromagnetic properties |
| Equipment related to micro-fabrication facility |
| Fiber coupled microscope and detection system for Raman spectrometer |
| Laser Doppler anemometry for the unsteady velocity measurement |
| Establishment of a micro-analytical facility |
| Surface profilometer |
| Research goniometer for static and dynamic light scattering analyses |
| Inductively coupled plasma-optical emission spectrometer |
| Establishment of a gas chromatography and mass spectrometry |
| Establishing a cascaded dilatometer facility |
| Plasma sintering setup |
| Terrestrial laser scanner for high resolution surveying |
| Shielded anechoic chamber |
| Precision ion beam milling system |
| Density gradient separation cum fractionation facility |
| Encapsulation system for organic photovoltaic devices/panels |
| Cyclic triaxial testing system to evaluate liquefaction potential of noncohesive soil |
| Optical microscope for microfluidics and contact mechanics on soft materials |
| Tunable laser in the wavelength range of 1480-1640nm |
| Engine exhaust particle sizer (EEPS) spectrometer |
| Scanning mobility particle sizer for gas-borne nanoparticulate systems |
| Installation of reciprocating wear and friction tester facility |
| Augmentation of ESI-Q-ToF with atmospheric pressure chemical ionization (APCI) and photoionization (APPI) interfaces |
| Servo-hydraulic actuators for load application |

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| Hot-isostatic pressing facility for processing advanced materials |
| Polarized confocal imaging of the cervical epithelial tissue |
| Stereoscopic PIV system for flow diagnostics in aeronautical & non-aeronautical applications |
| Ultrahigh vacuum molecular beam deposition system for organic thin films |
| Upgradation of the vibrating sample magnetometer (VSM) facility in ACMS |
| Optical spectrum analyzer |
| 3-D surface profilometer to characterize material surfaces |
| Closed cycle refrigeration system |
| HPTLC system |
| Drill core scanner for magnetic susceptibility & natural gamma ray measurements |
| Coincidence Doppler positron annihilation radiation system |
| Particle size analyzer |
| Laser scattering particle size analyzer |
| Modernization of Raman system and removal of obsolete data acquisition system |
| A thin film and multi-layer preparation unit using DC magnetron sputtering |
| Electro-chemical impedance measurement system |
| Thermal analyzer equipped with thermal-gravimetric analyzer, differential scanning calorimeter and dynamic mechanical analyzer |
| NOX and THC emission measure-ment system for internal combustion engines |
| X Ray diffraction System |
| Preparation, processing and characterization of nanoparticles |
| Virtually-instrumented polymerization reactor with on-line optimal control facility |
| Pico-second optimal source |
| Optical measurement facility for advanced flow and heat transfer applications |
| PCR thermocycler |
| Scanning probe and atomic force microscope |
| Multipurpose thin film deposition unit based on electron beam evaporation |
| Rheology of complex non-newton materials with constant temperature bath |
| Auto sampler for 400 MHz. high resolution NMR machine |
| Power supply for varian 15” electro-magnet |
| Enhancement of the cyclic testing facility |

- The Institute has procured Ultra High Speed Camera, Time-resolved fluorescence, Thermal analysis equipment, Atomic Force Microscopy, Resonance Raman and Mass spectroscopic facilities through the FIST program of DST New Delhi. A pseudo-dynamic test facility has reached nearly the stage of completion.
- The Institute has procured 2 *motor gilders* which can fly up to an altitude of 10000 feet without any oxygen cylinder and further up to a maximum altitude of 29000 feet with external oxygen cylinders and can maintain a speed of 122 knots/hr.

- *4I laboratory* is a recent initiative at the Institute. It is an enabling laboratory with an objective to facilitate design evolution into complete products. The four Is stand for Innovation, Integration, Incubation and Implementation. The laboratory is envisaged as a central facility for concept design and product realization.

➤ **Office Automation (OA):**

The DORD - Online Portal is developed and maintained by the Office Automation Division, IIT Kanpur. It facilitates options such as project monitoring (agency information and sponsors), viewing details of project activity and expenditure, purchases, project-wise advances, adjustments, receipt, expenditure, ledger, and utilization certificates. In recent years, the portal capability has been greatly enhanced in terms of its utility. A snapshot of the **DORD Online** portal is shown below.

The screenshot shows the 'Office Automation Portal' for AVANTI YOGESH JOSHI, logged in as Dean-Incharge, DORD. The main content area displays a financial summary table with the following data:

| Budget Head | Grant Sanctioned (A) | Actual Funds Received (B) | Cash Refunds (C) | Expenditure | | | Balance | |
|--------------|----------------------|---------------------------|------------------|----------------------|-------------------------|-----------------|------------------------------------|---|
| | | | | Actual Expenses (D1) | Committed Expenses (D2) | Total (D) D1+D2 | Against Grant Sanctioned E=A-(D-C) | Against Actual Funds Received F=B-(D-C) |
| CONS | 0 | 0 | 0 | 64552 | 0 | 64552 | -64552 | -64552 |
| CONTG | 0 | 0 | 0 | 1653 | 0 | 1653 | -1653 | -1653 |
| EQUIP | 0 | 0 | 0 | 50500 | 0 | 50500 | -50500 | -50500 |
| SALARY | 0 | 0 | 0 | 12000 | 0 | 12000 | -12000 | -12000 |
| Total | **1000000 | 0 | 0 | 128705 | 0 | 128705 | 871295 | -128705 |

Summary statistics shown below the table:

- Net Expenditure (including committed) During The Year (D-C) (Rs.): 128705
- Overall Balance of The Funds Received Till Now (O+B+C-D) (Rs.): 288436

Additional text: ** Since the Budget Head Wise Sanctioned Amount is 0. Therefore The Total Sanctioned Amount of Project is

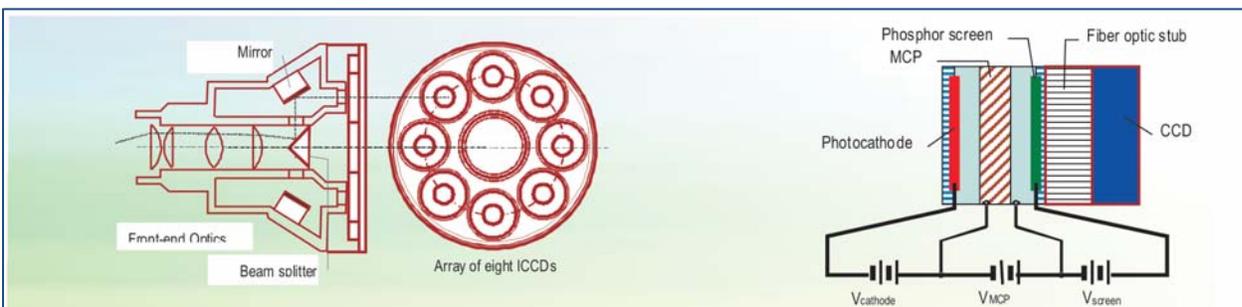
Developed by: Office Automation Division, Computer Centre 228,227 (Contact No. : 7352/7467/7747) Indian Institute of Technology Kanpur, India-208016.
Co-Ordinator: Dr. R.K. Thareja (Deputy Director) | [Team Members](#)
© 2010. All Rights Reserved. Best View on IE6+, Firefox 2.0+ at 1024 X 768

Additional modules related to online submission of advance requests, project registration, employment on work assignment, and ad hoc appointment have been introduced in the R&D website.

➤ **Institute Research and Development Committee (IRDC)**

The main objectives of IRDC are to a) provide impetus to the Institute research and development activities and b) support, advice and assist the Dean in as many ways as possible. The membership of IRDC includes the Departments, Centers, project employees, senior research staff, and doctoral students. IRDC meetings are well-attended and the committee has provided valuable input to the Institute over the years in creating a healthy ambience on campus.

IRDC discussions have considered matters of importance such as thrust areas that should be preferentially be supported, functioning of research centers, broad usage of high-value equipment, and a new RA hostel to meet increasing demand for accommodation of the research staff, to name a few. A proposal for a comprehensive Research Complex where well-endowed laboratory space can be given on demand for conducting inter-disciplinary research was conceived, debated, and submitted to the Institute. Feedback from the members of IRDC has resulted in administrative changes in the R&D office leading to improved efficiency as well as accuracy of the financial transactions.



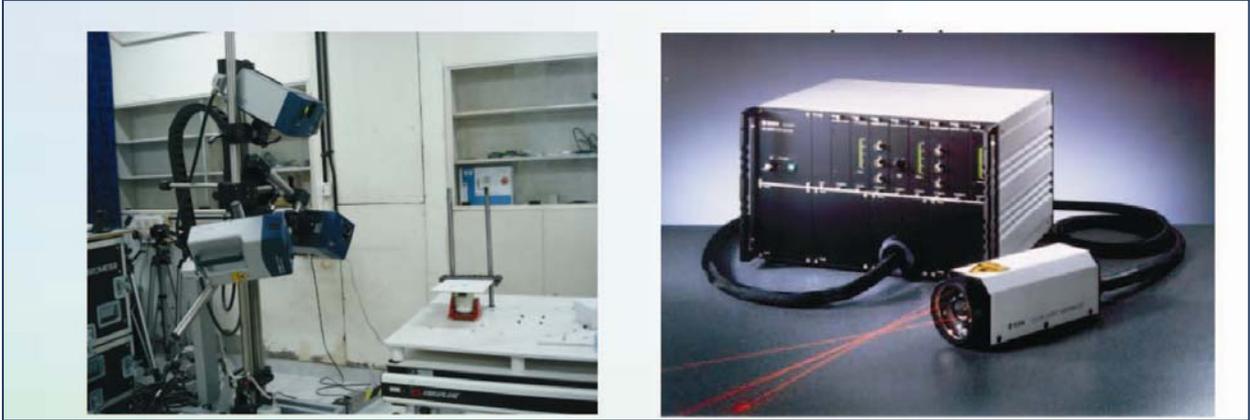
Configuration of various components of ultrahigh speed camera



Engine Exhaust Particle Sizer Spectrum



1.7 MV Accelerator



Entire assembly 3-D Laser Doppler Vibrometer

One of the laser heads, attached to 3D-LDV

➤ **Glimpse at the future**

We are certainly on a growth trajectory with all the productivity indices on the rise. The importance of funding from private sources, innovation and IPR, creation of research facilities, collaborative ventures in the form of Centers are felt across the Institute. Certain directions, for example, high performance computing, energy and environment, communications, mechanics, and health are getting concretized and may emerge as thrust areas. Research as a theme spans the entire Institute and the involvement of undergraduates can now be seen.

Yet, we are nowhere close to international levels. Funding continues to be government-dependent and international activities are limited. The future will see us create centralized research facilities, hire professional manpower, fix quantitative benchmarks and plan for reaching them in strategic manner.

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