Indian Institute of Technology Bombay

R & D Highlights

About Us

Research and Development (R&D) at IIT Bombay has evolved and flourished over the decades since the Institute's inception in 1958. The synergy of academics and research has catapulted IIT Bombay into the illustrious circle of world-class institutions. Apart from offering sound science and technology solutions to various government sectors, the industry and to society, IIT Bombay pursues basic research leading to knowledge generation that lays the foundation for empowering us as a nation to be technologically confident and self-reliant.

IIT Bombay at a Glance

- **Academic units:** 15 Departments, 9 Centres, 4 Interdisciplinary Programmes and 1 School
- **Faculty:** 573 full time + 100 part time
- **Students:** 9000 (55% PG ; 2500 PhD)
- **Number of postdoctoral scholars:** 40
- **Degrees awarded in 2014:** 2256
- **PhD degrees awarded in 2014:** 216
- **Research publications in 2013:** 1500
- **Research project staff:** 750
- **R&D funding for FY 2013-14:** 35 million USD
- **Patents filed in 2014:** 39 (till August)
- **Technology transfers/deployment:** > 130
- **Total companies incubated:** 55

R & D Funding

IIT Bombay has seen significant growth in R&D funding in the last decade. During the last five years, R&D receipts grew at a compounded annual growth rate of over 24%.

Financial year	Research Funding (₹ in Crores)		
	National organizations	International organizations	Total Receipts
2008-09	66.4	6.4	72.8
2009-10	95.3	7	102.3
2010-11	170.3	9.5	179.8
2011-12	181.02	8.9	189.9
2012-13	277.8	15.7	293.5
2013-14	199.01	14.58	213.6
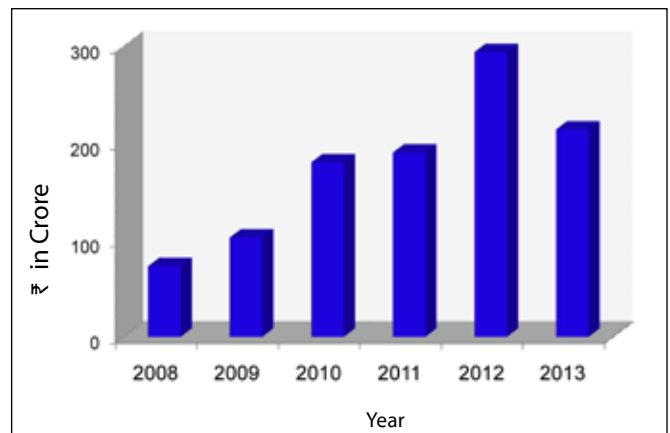
Research Facilities

The Institute provides high end infrastructure facilities and laboratories to support research activities. Facilities are augmented and upgraded regularly.

Sudarshan: The National Geotechnical Centrifuge Facility

Dielectric Broadband Spectrometer

Cryo Transmission Electron Microscope

NanoIndenter: a depth-sensor for thin films and small structures

Central Surface Analysis Facility


Cryo FEG Scanning Electron Microscope

Centres of Excellence / Consortia

- Biomedical Engineering and Technology (incubation) Centre
- Centre for Aerospace System Design & Engineering
- Centre of Excellence in Nanoelectronics and Indian Nano Users Programme
- Centre of Excellence in Steel Technology
- Centre for Formal Design and Verification of Software
- Geospatial Information Science and Engineering Laboratory
- Healthcare Consortium
- IIT Bombay-Indira Gandhi Centre for Atomic Research Cell
- ISRO-IIT Bombay Research Cell
- National Centre for Aerospace Innovation and Research
- National Centre for Photovoltaic Research and Education
- National Mission on Education through ICT
- National Solar Thermal Research, Testing and Simulation Facility
- PowerAnser Laboratory
- Tata Teleservices-IIT Bombay Centre of Excellence in Telecommunication
- VLSI Research Consortium

Glimpses of Research

In-house fabricated solar cells
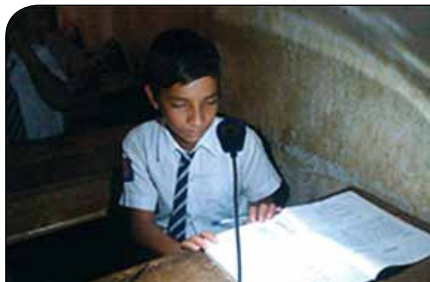
Solar Urja Lamp

1MWe solar thermal power plant at Gurgaon

IIT Bombay has been contributing to several national research programmes and addressing societal needs in diverse technology areas.

Energy

■ The National Centre for Photovoltaic Research and Education (NCPRE): part of the Jawaharlal Nehru National Solar Mission of the Government of India and supported by the Ministry of New & Renewable Energy (MNRE) to promote solar voltaics R&D. http://www.ncpre.iitb.ac.in/

■ The 1 Million Solar Urja Lamps (SoUL) Initiative through the National Clean Energy Fund to reach out to students in remote rural areas and conduct training workshops. http://www.millionsoul.iitb.ac.in/

■ The National Solar Thermal Power Testing, Research and Simulation Facility: a grid-connected 1MWe solar thermal power plant designed, installed and commissioned at Gurgaon, New Delhi.
Consortium members: Tata Power, Tata Consulting Engineers, Larsen & Toubro, KIE Solartherm, Clique, Solar Energy Centre and the KGDS Renewable Energy. http://www.ese.iitb.ac.in/~NSTPP/

■ Unit developed at the Cummins Engine Research Facility to support sustainable development and electrify villages. Project awarded 'Most Innovative Energy Saving Product' under the CII National Awards for Excellence in Energy Management in 2010.

Information & Communication Technologies

TICET – Unlicensed Band Radio

Inauguration of ECR 1000 Series Router

■ The TTSL-IIT Bombay Centre of Excellence in Telecommunication (TICET): a joint initiative of IIT Bombay, Tata Teleservices Ltd & the Department of Telecommunication, Government of India for capacity building, design and fabrication, and offering advisory support to the telecom sector; various technologies developed including cost-optimization tool to reduce fuel consumption at telecom towers; supports entrepreneurship. http://ticet.iitb.ac.in/ticet/home.html

■ Low cost, power-efficient high speed ethernet switch routers deployed at different sites by the Mahanagar Telephone Nigam Ltd, Mumbai, RailTel and National Knowledge Networks.

Outreach

- Several projects funded by the Ministry of Human Resource Development, Government of India including 'Integration Tools for Teacher-Student Empowerment' to train about 1,50,000 teachers through workshops and projects.
- The National Mission on Education through ICT (NME-ICT) initiative:
  - *Teach 10,000 Teachers* programme
  - Interactive web portal for open source e-content
  - ProxyMITY—a multimedia lecture integration tool
  - Clicker—a student response system for classrooms
  - Aakash Tablet—a convenient educational tool

http://www.it.iitb.ac.in/nmeict/home

- Sandhan—a search engine for Indian languages developed in consortium with many institutions; intended for the tourism domain. http://clia.iitb.ac.in:8080/sandhan

Aerospace & Security

- The ISRO-IITB Space Technology Cell: promotes advanced research related to space technology. http://www.csre.iitb.ac.in/isro_cell/

- The National Centre for Aerospace Innovation and Research: a joint initiative of IIT Bombay, Boeing, Department of Science and Technology, Government of India and Hindustan Aeronautics Ltd to provide economically viable and sustainable solutions to Indian aerospace manufacturers. http://www.ncair.in/

- Cryocooler technologies: having applications in defence, space, surgical techniques, medical imaging and MagLev trains

Cantilever based e-Nose

- Cantilever based e-Nose for explosive detection: low cost, sensitive device; detects RDX and TNT in parts per billion; has integrated wireless transmission capability

- RoVer: the remotely operated vehicle for handling and disposing Improvised Explosive Devices (IEDs)


RoVer

Healthcare

- SüChek: a low cost diabetes testing kit
- Biomedical Engineering and Technology (incubation) Centre (BETiC): a multidisciplinary, multi-institutional translational initiative funded by the Rajiv Gandhi Science and Technology Commission of the Government of Maharashtra and the Department of Science and Technology, Government of India
  - Integrated facilities for design, analysis, prototyping and testing
  - Facilitation of clinical trials, IPR and technology transfers in collaboration with medical and industrial partners

SüChek

Novel design for prosthesis

Final prosthesis

Surgery plan

Novel surgical instruments
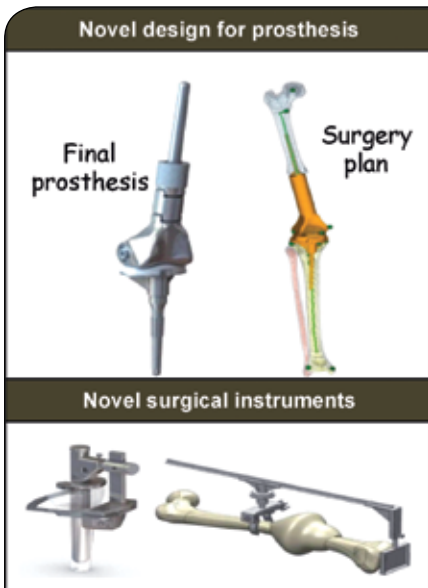
- Polysensor based portable device to monitor water quality
- Low cost, high quality knee mega-prosthesis to circumvent amputations in bone tumor cases
- Carbogen gas inhaling apparatus for stress relief for people working in high-noise environments
- Drishti: auto-tunable lens for universal eye glasses; winner in product design category in Samsung Innovation Awards 2012

Urban Development

The Centre for Urban Science and Engineering(C-USE): an interdisciplinary centre working to improve the quality of urban life. Member of the New York based international consortium, Centre for Urban Science and Progress (CUSP). http://cuse.iitb.ac.in/

Frontier Areas

The Centre of Excellence in Nanoelectronics (CEN) established in 2006: collaborative project between IIT Bombay and Indian Institute of Science (IISc), Bangalore; funded by the Department of Electronics & Information Technology (DeitY), Government of India:

- State-of-the-art nanofabrication facilities
- Research projects with social relevance leading to prototype development
- Successful Indian National User Program (INUP) for access to users across the country
- More than 200 journal and conference papers
http://www.cen.iitb.ac.in/ and http://www.inup.iitb.ac.in/

State-of-the-art nanofabrication facility

R & D for Society

Includes tools and technologies for the village industry and craft sector; educational and communication aids; products for alleviating problems of those with disabilities; devices for extending benefits of computer technologies to rural communities and other useful innovations for the common person.

Dry sanitation system

K-Yan: the compact media centre

aAQUA web portal for Indian farmers

IIT Bombay and Industry

Collaboration with IIT Bombay

- Access to fresh ideas, innovation & talented student base
- Partner in knowledge creation, technology development and human resource development
- Complementary skills and capabilities upgradation
- Access to new technologies
- Access to high end equipment and other resources
- Multidisciplinary research pool
- Facilitating processes and systems for collaboration
- Leverage public funding
- Access to qualified personnel for recruitment

Modes of Interaction: Examples

R & D Projects:

Student Sponsorship:

Labs & Facilities:

Chair Professorship:

Licensing:

Consortia:
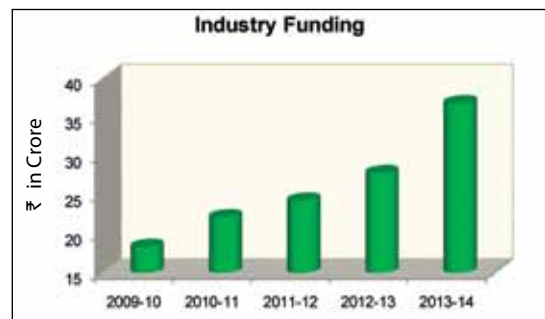
Endura equipment for PVD

Yahoo! Hadoop Cluster Laboratory inauguration

- The **Applied Materials Manufacturing Laboratory:** to promote research in nanoelectronics, nano-manufacturing and solar photovoltaic technology

- The **PowerAnser Lab:** an IIT Bombay, Tata Consultancy Services (TCS) and Tata Consulting Engineers (TCE) partnership to bring the benefits of IT to the power sector; deployed webSTLF technology and webNETUSE to stakeholders

- The **Yahoo! Hadoop Cluster Lab:** to help conduct research on search-based technologies

- The **TCS-IITB Research Cell:** for long term collaboration with TCS in multiple areas of research and development

- **Healthcare Consortium:** multiple partners including leading hospitals, cancer research centres, medical technology companies and NGOs.

Student Initiatives

Biosynth

Matsya

Solar powered house

Pratham

- **Project Biosynth:** a self-sustaining biodiesel producing plant; won award for 'Outstanding Research in the Field of Green Chemistry and Engineering' at the Industrial Green Chemistry Workshop held in Mumbai in 2009. http://www.che.iitb.ac.in/chea/biosynth/index.php

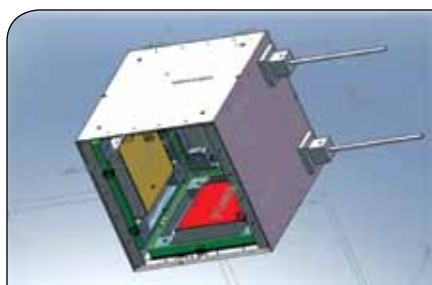- **Matsya:** an autonomous underwater vehicle; won 'Best Autonomous Machine and Most Innovative Design Award' in 2011 at ROBOCON, the Robotic Contest. http://www.auv-iitb.org/
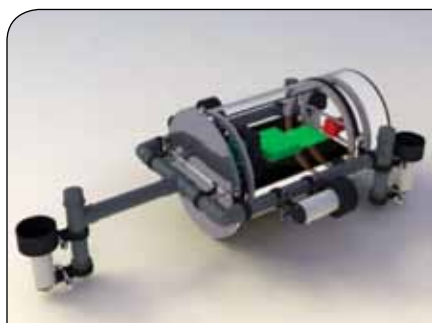
- **Solar Decathlon** (Versailles, France, July 2014): Students of IIT Bombay and the Rachna Academy of Architecture, Mumbai designed and constructed a 700 sq m house powered entirely by solar energy. http://teamshunya.in/

- **IIT Bombay Racing:** the team competed in three international competitions in the design and engineering of amateur high performance race cars; endurance run completion at Formula Student UK'14; judged as one of the best in design documentation. http://www.iitbracing.org

- **Pratham:** design of satellite to orbit at an altitude of 817 kms; four months mission life; two downlinks and weight of 10 kgs; more than 40 students from various departments involved. http://www.aero.iitb.ac.in/pratham/

Endurance run completion at Formula Student UK'14

Technologies Transferred / Licensed

Zero Sum: an educational game based on mathematics

Fuel additives

Direct licensing

- Board games design
- Ethernet switch routers
- WebNC for product design and process planning for CNC machining
- V-trough concentrated module
- Soil biotechnology for waste management
- Software for bid matching in day-ahead spot electricity market
- Multi-utility heat pump technology
- Hybrid cooling system technology

Licensing through collaborative development

- Amplified fluorescence polymers as TNT sensors
- Asymmetric device applications in advanced CMOS technologies
- Design of ATM enclosure - ASAN
- Fuel additives for improving efficiency
- Laminated Object Manufacturing - rapid prototyping process
- Short term load forecasting
- Silicon locket for cardiac monitoring
- Steer-by-wire system for vehicles
- Supercritical fluid extraction technology

http://www.iitb.ac.in/licensing

Ethernet switch router

Sewage treatment plant set up at BMC, Mumbai

Steer-by-wire system for vehicles

Multi utility heat pump

Carbogen breathing apparatus

Modular hybrid air conditioner

Technology Business Incubation

The Society for Innovation and Entrepreneurship (SINE) established in 2004 actively supports entrepreneurship among faculty and students by enabling commercialisation of research activities. Incubated companies cover a diverse spectrum of technology areas including Computational Fluid Dynamics Technologies, Artificial Intelligence based Consumer Analytics, Geographical Information Systems and Image Processing, and Intelligent Audio Applications among many others.
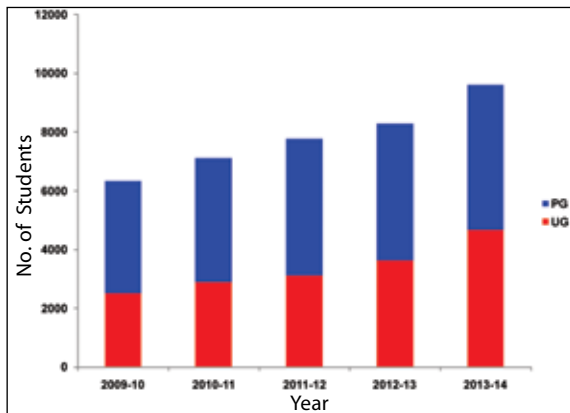
SensiBOL
Audio Technologies

243RMT
Anytime Anywhere

@ agrocom

iKen
SOLUTIONS

SEDEMAC

vegayan

ZEUSNUMERIX

kWatt Solutions Pvt. Ltd.
economising renewables

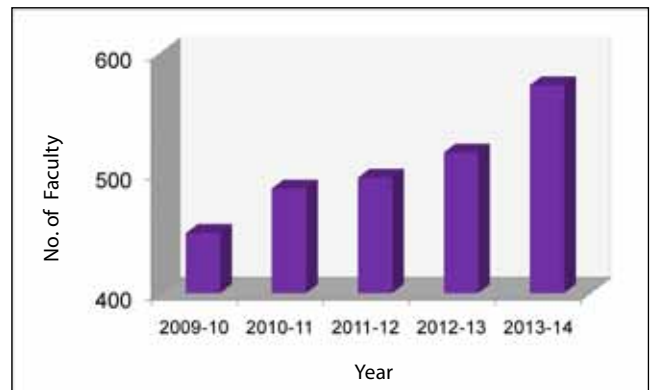| Companies incubated in SINE	55
Companies graduated	29
Jobs created through entrepreneurship / start-ups	1100-1200

www.sineiitb.org/

Faculty & Students

Student strength


Faculty Strength

Awards
- Padma Shri Award: 2
- Shanti Swarup Bhatnagar Prize for Science and Technology: 13
- Infosys Prize: 1
- Swarnajayanti Fellowship Award: 10
- J C Bose National Fellowship: 4
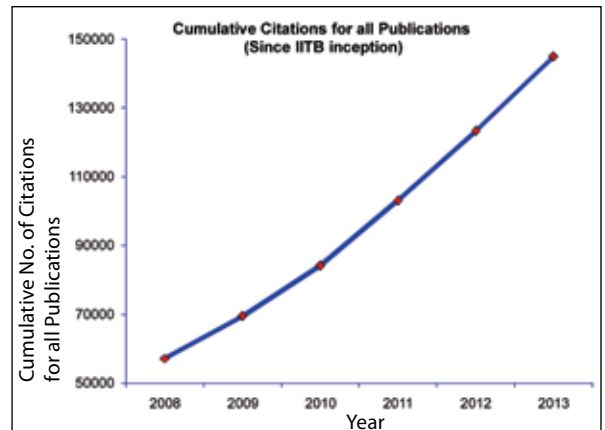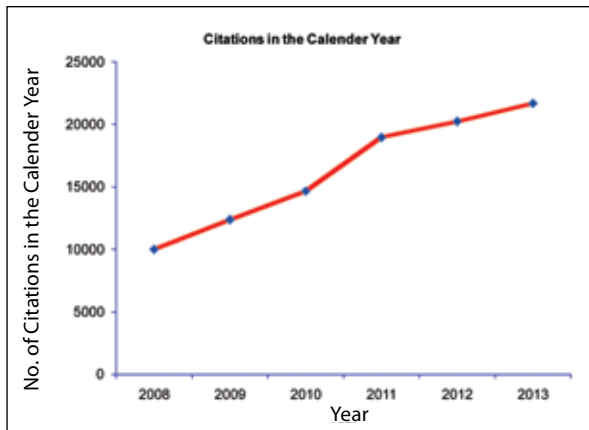- DAE-SRC Outstanding Research Investigator Award: 4

Fellowships
- Fellow, Indian National Science Academy, New Delhi: 10
- Fellow, Indian Academy of Sciences, Bangalore: 19
- Fellow, Indian National Academy of Engineering, New Delhi: 25
- Fellow, The National Academy of Sciences, India (Allahabad): 28
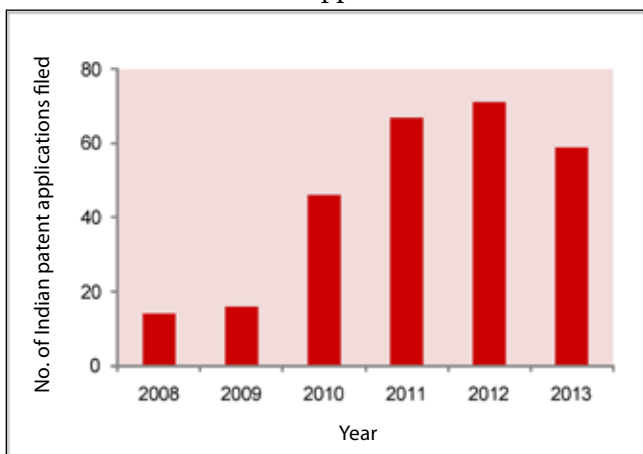
Publications & Patents

Papers
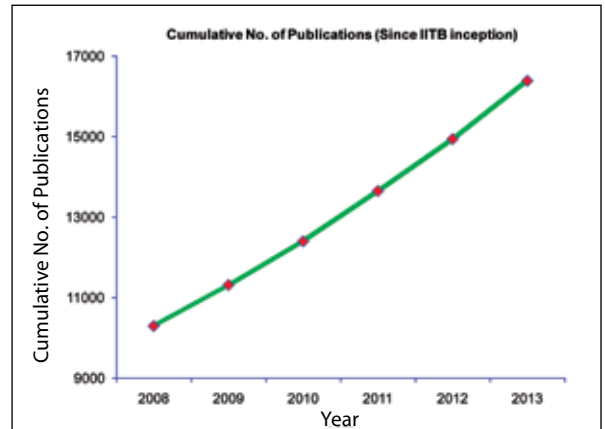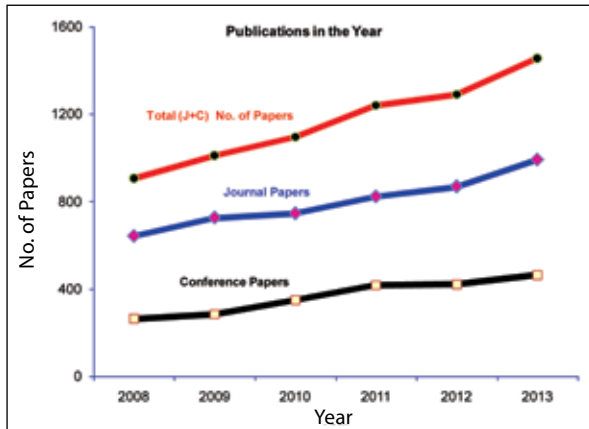
Citations

(Source: Scopus)

Patent applications filed

Patent applications filed during 2013-2014

Indian	61
PCT	1
US	11
EU & Brazil	4
Trademarks (Indian)	4
Copyrights (Indian)	1

I am pleased to share with you that the Institute continues to be ranked as one of the top universities of the country and among the best in the world. IIT Bombay attracts the brightest students from the country for its Bachelors, Masters and Doctoral programmes; and in the 56 years of its existence, more than 46,000 students have graduated from IIT Bombay. The alumni of the Institute have made their alma mater proud through their achievements and contributions in diverse fields and our engagements with them are steadily growing.

Prof Devang V Khakhar
Director, IIT Bombay

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