R & D at IIT Bombay

Academic units: 27; Research centres: 21
Faculty: ~620
Students: ~10,000 (2941 PhD)
Postdoctoral fellows: ~130
Degrees awarded in 2016: 2515
R&D funding for (April-Dec 2016): ₹285 Cr.
Publications in 2016: 1785 (Journals: 1274; Conference: 511)
Indian patents filed (2016): 81
Technology transfers/deployment so far: ~150
Total companies incubated: 99

Knowhow
Knowledge generation
R & D Outputs
Solution to society
Society
Outreach
Technology development
Research and Development

Period 1.1.1997 to 1.1.2017
- Indian patent applications: 659
- Foreign patent applications: 123
- PCT applications: 102
- Patents granted (Indian + Foreign): 124 + 54
- Others under process

Patents

IIT Bombay at a Glance

Industrial Research and Consultancy Centre (IRCC)
Nodal unit for coordinating and managing activities related to R&D

Dean (R&D)
IIT Bombay
Powai, Mumbai 400076
+91-22-2576 7039
dean.rnd.office@iitb.ac.in
www.ircc.iitb.ac.in

Roadmap to rural connectivity

Industry friendly
Facilitating Innovation
Cost for protection of IITB IP
In-house incubator
Inventor friendly policies
Simple processes
Generous revenue sharing
Hollow Fibre Membrane Technology for Kidney Dialysis

Prof. J. Bellare
Dept. of Chemical Engineering
jb@iitb.ac.in

Prof. M. V. Rane
Dept. of Mechanical Engineering
ranemv@me.iitb.ac.in

Users
- Manufacturers of haemodialysers
- Patients, nephrologists, industry, dialysis centres and hospitals

Features & Advantages
- High performance compared to commercial haemodialysers
- Superior biocompatibility for renal patients
- Low cost indigenous technology
- Shorter dialysis time

Status:
- Preparation of hollow fibre cartridges, Animal and clinical trials under initiation; patent pending
- Available for licensing

Tube tube heat exchanger
- Low cost double vented wall heat exchanger
- Compact and cost effective

Multi-utility heat pump
- Integrated, low cost compact, easy to operate
- On-demand supply of hot / cold water

Diabetic contacting device
- Air humidifier
- Indirect evaporative cooler
- Evaporative condenser/de-superheater/sub-cooler
- Fresh air dehumidifier
- Hybrid air conditioning system

Imported lifesaving haemodialysers are very expensive and unaffordable
Economically viable Hollow Fibre Membrane (HFM) technology for haemodialysers developed
Greater biocompatibility and superior separation performance
Dark Colored Cool Roof Coatings Technology

- Designed to reflect Near Infra Red (NIR) waves of solar radiation, on roof
- Lowers roof / room temperature by 10-14°C
- More effective than conventional insulation coating
- Available in wide range of colors
- Highly affordable
- Excellent surface finish
- Good waterproofing / weatherability
- Easy application

Acknowledgments:
Meity, IISc, Semi-Conductor Laboratory, Dept. of Space, Govt. of India

Status:
Patents pending, ‘SoilSenS’ under process of incubation

Low Cost Soil Monitoring System For Irrigation Control

- Soil moisture / temperature sensor, ambient humidity / temperature sensor
- Sensors and systems for agricultural and civil engineering applications
- Effective use of water in agriculture, sustainability
- Make it profitable to farmers

Acknowledgments:
Prof. M. S. Baghini
Dept. of Electrical Engineering
maryam@ee.iitb.ac.in

Status:
Available for licensing

Low Cost Soil Monitoring System For Irrigation Control

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- Easy application

Acknowledgments:
Prof. A.S. Khanna
Dept. of Metallurgical Engineering and Materials Science
khanna@iitb.ac.in

Status:
Available for licensing

Low Cost Soil Monitoring System For Irrigation Control

- Soil moisture / temperature sensor, ambient humidity / temperature sensor
- Sensors and systems for agricultural and civil engineering applications
- Effective use of water in agriculture, sustainability
- Make it profitable to farmers

Acknowledgments:
Prof. M. S. Baghini
Dept. of Electrical Engineering
maryam@ee.iitb.ac.in

Status:
Available for licensing

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Acknowledgments:
Prof. A.S. Khanna
Dept. of Metallurgical Engineering and Materials Science
khanna@iitb.ac.in

Status:
Available for licensing
Rapid Tooling and Manufacturing of Metallic Components

- Uses combined additive and subtractive Hybrid Layered Manufacturing (HLM) process
- Near-net shape manufactured in layers by depositing metal through MIG welding
- Faster and cheaper than laser and electron beam based deposition systems
- Can be adopted as a retro-fitment to existing CNCs
- Complex features possible

SüChek
A cost-effective glucometer
- High accuracy: compliant with ISO 15197
- Uses low cost colour changing reagent strips
- Mobile connectivity: effective analysis
- Small, portable and lightweight (<100 gms)

uChek
A mobile based low-cost, efficient and error proof urine analysis system
- ≥ 95% accuracy; registered with USFDA
- Affordable, simple to use, results in <5 seconds
- < 500 gms; bedside testing possible
- Integrated data organiser

Case study

Prof. K. P. Karunakaran
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karuna@me.iitb.ac.in

Prof. R. Srivastava
Dept. of Biosciences & Bioengineering
rsrivasta@iitb.ac.in

Status:
Produced and marketed by Biosense Technologies Pvt Ltd.

- Planar deposition in 3-axis HLM for small undercuts and after blinding them
- Non-planar and variable axis deposition
- Multiple welding torches based deposition
Pulse Tube Cryocoolers
- Vibration and maintenance free
- Can attain & maintain temp. < 80K
- Single Stage PTC–U-type: 50-60K in 30-40 mins
- Two-Stage PTC–U-type: 20-25K attainable in 1 hr

Status:
- Customisation possible
- Ready for commercialisation

Mixed Refrigerant Joule-Thomson Cryocooler
- low cost, efficient, reliable
- 70–120K in <1 hour

Status:
- Imaging equipment for night vision and heat-seeking missile guidance
- Cooling electronic devices and sensors

Sustainable Landfills for Small Townships
- Economical method for disposing municipal solid waste (MSW)
- Decentralized sustainable engineered bioreactor landfills (SEBLF) developed
- Accelerates decomposition / energy recovery and value added products
- Aerobic and anaerobic field models developed
- Moisture content and temperature of MSW monitored / controlled
- Recirculation of leachate to accelerate decomposition
- Periodic analysis of recirculated leachate characteristics
- Good reduction in C, H and N content in the bioreactors

Status:
- Customisation possible
- Ready for commercialisation

Mixed Refrigerant Joule-Thomson Cryocooler
- Cooling of infrared sensors
- Gas cooling / liquefaction
- Cryo-preservation
- Laboratory equipment

Status:
- Imaging equipment for night vision and heat-seeking missile guidance
- Cooling electronic devices and sensors

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Status:
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- Cooling electronic devices and sensors
Beagle-Z: to empower homeland security
• Amplifying Fluorescent Polymer based handheld device
• Proprietary embedded software running on microcontroller
• RS-232 Serial Interface based communication
• 7.5V, 2200mAh (Li-ion battery pack), 12V DC adaptor
• Real-time detection
• No radioactive source

Status
Technology transferred to Bigtec Pvt. Ltd.

Low Cost Vein Tracer
• Convenient, light weight and affordable
• Ergonomic, user friendly
• LED light deflected by deoxygenated blood giving a clear silhouette of veins

Status:
Usability testing underway
Smart Ultrasonic Water Meter

- Low cost, accurate and reliable domestic water meter
- For both rural and urban water supply schemes
- Low maintenance
- No moving parts
- Long battery life >5yrs
- Alarms: misuse-tamper; reverse flow
- Tailor made billing software
- Highly accurate & reliable
- Automatic wireless data collection on centralized server

Status
- Field tested on IIT Bombay campus
- Ready and available for licensing

Novel Switched Reluctance Motor Drive for Ceiling Fan

- Singly excited motor
- No permanent magnets
- No coils on rotor
- High reliability
- Lower PE requirement
- DC grid compatibility
- Smart control

The market: 40 million/year

- Current market share of high efficiency fans: 0.2%
- 350 million existing Induction motor fans

- High efficiency
- Low cost
- High payback
- Up to 50% less power consumption
- Potential savings:
  - 19,162 GWhr/yr
  - 8,750 MW peak
Board Games
- Short games for entertainment
- Encourage spatial intelligence and mental imagery
- Allows foresight and planning capabilities

Status:
- Design registrations filed; Manufactured and marketed by the Funskool (India) Ltd.; “Zero Sum’ in Japanese market by Gakken

Diabetic Foot Screening Device
- Handy and compact design
- Sensitive sensor to measure force accurately
- Reduces cost burden
- 5 wire connection
- 5 Volts DC, 100Hz
- Operating force: 0-1.5lb
- Operating temperature: 0 to 70°C

Status:
- Primary trials being conducted
- Prototype to product underway

Product Designs

DigiSteth - Digital Stethoscope
- Transforming any stethoscope into a “Digital Stethoscope”
- Volume control
- Recording and playback option
- Bluetooth connectivity
- Detachable chest-piece
- Provision for simultaneous auscultation

Status:
- Patent filed
- Available for licensing

ByClip: Bicycle parking rack
User centric novel design for effective arrangement of large no. of bicycles

IIT Bombay
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www.betic.org

Dry sanitation system

Status:
- Patent filed
-Licensed to C Tech Pvt. Ltd.

Industrial Design Centre
www.idc.iitb.ac.in
Mobile microscopy platform to detect sickle cell disease
• Early stage diagnosis for faster management
• Easy, quick and affordable

Paperfluidic platform for rapid amplification of tuberculosis DNA
• One-step disinfection, lysis and amplification technique
• Less manual intervention

Home-based monitoring of oral health
• Fully printable paper-fluidic device
• Cheap, disposable, easy to manufacture
• Suitable for oral health monitoring and screening

Technologies to monitor ECG, EMG, EOG and SpO$_2$, for implantable and wearable applications

Compact prototypes with customised Application Specific Integrated Circuits (ASICs)

Oxi-Sense: Non-invasive, fast, accurate measurement of blood oxygen saturation level and heart rate using custom designed ASIC

Heart-Sense: Light weight portable device for continuous monitoring of ECG and heart rate

Bio-WiTel: Custom set of transmitter and receiver ASICs

Life-Sense: Real-time monitoring of ECG/PPG data on any Android mobile or desktop

Status: Patents pending; prototypes successfully tested in home and hospital environment
µSENS - Fiber Optic Based Detection System

- Low cost portable system for detecting *E. coli* bacteria
- Based on evanescent wave absorbance
- Able to perform real time, label-free detection of ~250 *E. coli* cells in 0.25 ml sample
- Modest detection limit obtained as trade-off between sensitivity and simplified design

**Instrumentation:**
- UV source: T9H28C (280nm)
- UV detector: SIC01M (280 – 400nm)
- Multimode optical fiber, core diameter of 200 – 400µm
- Microcontroller: MSP430F1611
- Display unit: 20 × 4 line Alphanumeric LCD display

The centre aims to develop solutions to challenges faced by resource constrained communities using an end to end innovation approach.