

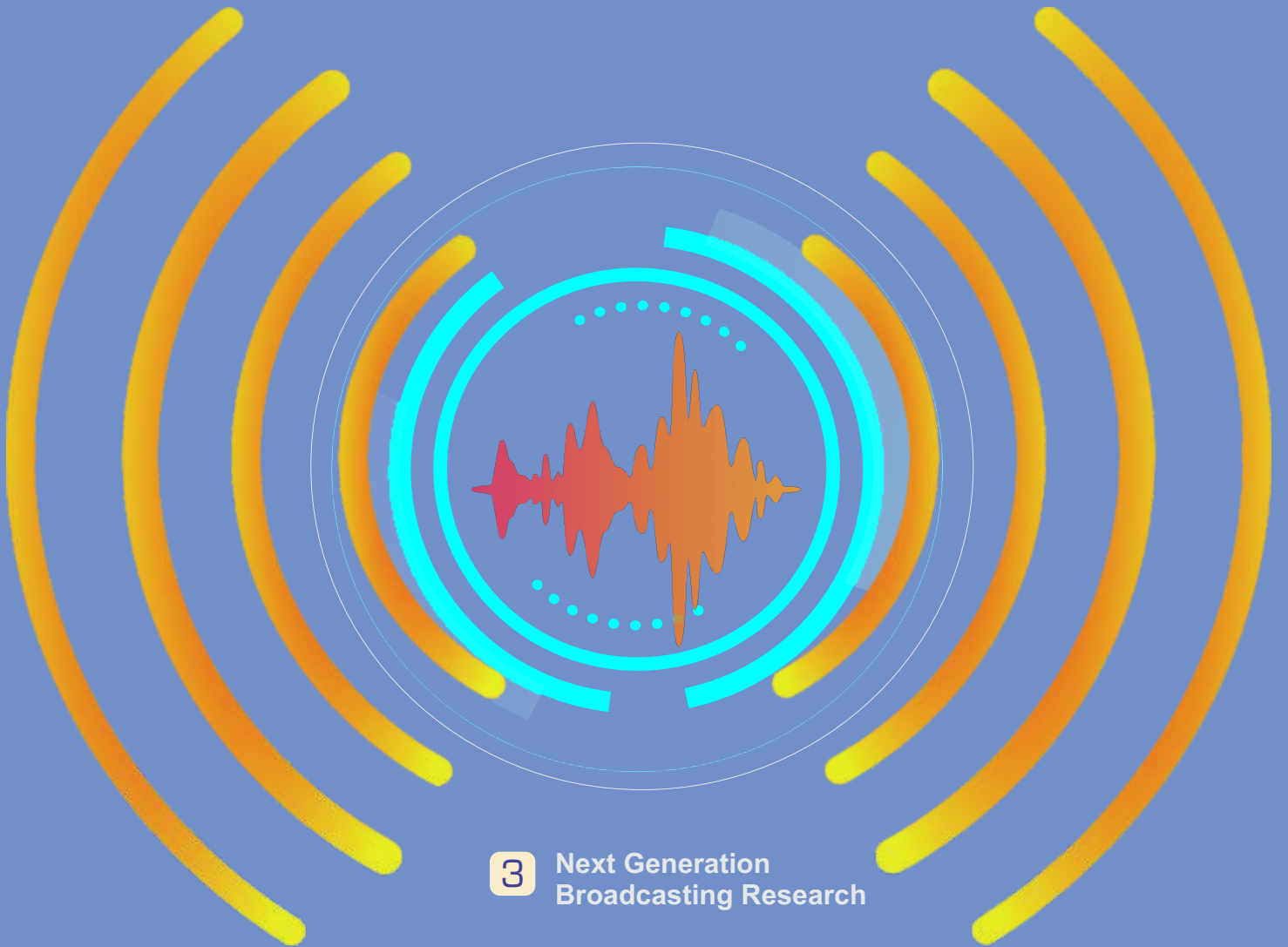
Volume 9, Issue 2

October 2021



# R&D Newsletter

Indian Institute of Technology Kanpur



**3** Next Generation  
Broadcasting Research

## More Highlights

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R&D News  
Major Projects  
SIIC Corner  
Technopark & C3iHub Corner

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## CNR Rao Endowed Lecture 2021



On June 11, 2021 Prof. Vinod K Singh, Department of Chemistry delivered a lecture under CNR Rao Endowed lecture series. The title of his talk was 'Chirality in Organic Synthesis'. This lecture series was made possible by a generous donation by Prof. C.N.R. Rao, Linus Pauling Professor at JNCASR, Bangalore. The objective is to give one faculty member of the IIT Kanpur, each year, the honor of delivering a lecture to the institute's community, sharing the excitement of his/her research with them.

## Institute lecture



Dr. Parameswaran Iyer delivered an institute lecture on June 12, 2021. Dr. Iyer, former Secretary to the Government of India, is best known for leading the implementation of the Swachh Bharat Mission (SBM) – Prime Minister Narendra Modi's flagship programme, which became the world's largest sanitation revolution. The title of his talk was 'Implementing large scale transformations in India: Lessons for young professionals'.

## Collaborations



IIT Kanpur signed an MoU with JK Cement for setting up Super-speciality hospital on the campus as part of the initiative to establish School of Medical Research and Technology (SMRT) at IIT Kanpur.



A Memorandum of Agreement was signed with the REC Foundation to support the upcoming School of Medical Research and Technology (SMRT) at IIT Kanpur.



An MoU has been signed to share the strategic partnership that embraces the importance of technology in healthcare innovation between IIT Kanpur and SGPGI Lucknow.



An MoU was signed with the Indian Air Force (IAF) to establish the Air Vice Marshal Harjinder Singh Chair of Excellence and Research Scholars' Program at IIT Kanpur.



An MoU was signed with Albot Technologies Pvt. Ltd. for the commercialisation of an advanced low-cost oxygen concentrator based on the Pressure Swing Adsorption (PSA) technology.



With a generous support from IITK alumnus, Mr Sudhakar Kesavan, the institute is establishing the Chandrakanta Kesavan Centre for Energy Policy and Climate Solutions to assist policy makers with practical solutions to the problems of climate change.

### Next Generation Broadcasting Research

**Faculties involved:** Prof. Adrish Banerjee (adrish@iitk.ac.in),  
Prof. Vipul Arora (vipular@iitk.ac.in),  
Prof. Rajesh Hedge (rhegde@iitk.ac.in)



Department of Electrical Engineering

Sponsor: Prasar Bharati

Prasar Bharati, India's Public Service Broadcaster, in its endeavor to deploy the latest broadcasting technologies in service of the nation, has funded a proposal for three Research & Development projects from IIT Kanpur to showcase:

#### Next-generation broadcast technology trial in an urban area using a Low Power Low Tower & Single Frequency Network (LPLT-SFN):

The next generation software-defined radio-based broadcast technology will be demonstrated using the Advanced Television Systems Committee (ATSC) 3.0, Direct to Mobile (DTM) technology for

- video content delivery without the use of Broadband/WIFI,
- audio-only content delivery using News On Air without Broadband/WIFI,
- flexible use of network capacity based on live Target Rating Point (TRP) using return channel and artificial intelligence (AI)/Machine Learning (ML) models, and
- enhanced indoor and outdoor coverage.

A new LPLT-SFN using Next Generation Broadcast technologies that are spectrum-efficient, and gives much higher, uniform coverage throughout the chosen area will help incubate next-generation broadcast use cases like Advanced Emergency Alerting and Convergence of Broadcast & Broadband.

#### Automatic speech recognition for speech subtitling:

Prasar Bharati is India's largest broadcasting agency, broadcasting audio and video content via All India Radio, and Doordarshan has a humungous wealth of audio and video content. In this age of digitization and AI, machine learning technologies have opened vast opportunities. Proper content analysis can help in the efficient search, recommendation, accessibility, and translation. This project will develop and deploy automatic speech recognition (ASR) technologies for certain languages for Prasar Bharati's multimedia content.

#### Archival Content Retrieval Through Audio and Text Query.

Generally, all audio-visual content is tagged by keywords relevant to them. Humans could supply these keywords, or they could be extracted from the surrounding text in the form of captions, written material, or metadata. If such text is not available along with the content; manual tagging of audio-visual content is not only insufficient but also inefficient. This project focuses on audio-based content retrieval. Audio is ubiquitous - in radio as well as television broadcasts. State-of-the-art technologies will be developed using deep learning methods. The overarching goal of this project is audio-based content retrieval. Two kinds of retrieval methods will be developed: extracting text labels from audio (audio tagging) and direct audio matching (audio fingerprinting).



## A Synthetic Antibody Technology Platform to Generate Novel Probes and Potential Therapeutics Targeting the Human GPCRome

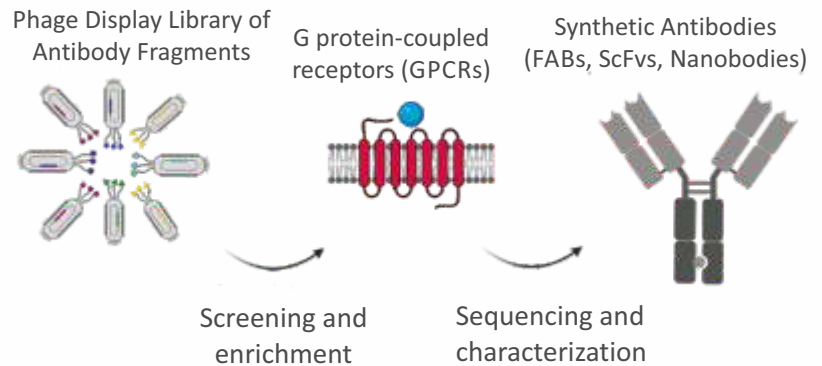
PI: Prof. Arun K. Shukla (arshukla@iitk.ac.in)

Department of Biological Sciences & Bioengineering

Sponsor: Department of Science & Technology



About half of the currently prescribed medicines including those prescribed for heart failure, hypertension and mental disorders work by targeting a class of cell surface receptors known as G protein-coupled receptors (GPCRs). These receptors are involved in every physiological process in our body including memory, behavior, immune response, cardiovascular regulation and metabolism. Therefore, understanding the structure and function of GPCRs is of utmost importance to decipher the regulatory paradigms of human physiology and design novel therapeutics with minimized side-effects.



In this project, it is proposed to generate synthetic antibody fragments using the Phage Display Technology Platform for targeting a broad set of GPCRs not only to visualize the structural basis of their activation and signaling but also to develop some of these antibody fragments as novel modulators of selected GPCRs for potential therapeutic applications in multiple human diseases.

## Just Transition Research Centre

PI: Prof. Pradip Swarnakar (spradip@iitk.ac.in)

Department of Humanities & Social Sciences

Sponsor: Stichting SED Fund Netherland



Coal, as the backbone of our economy, has weaved an intricate and complex web of socio-economic relations that stand threatened as India transitions towards a more sustainable energy system. This project is a step forward towards taking a stock of these threats and vulnerabilities in the form of lost livelihoods and imperilled social security. Through rigorous grassroots level engagement, it aims to bring the trade unions and the coal communities to the forefront by tapping into their perceptions on how to make this transition just for them.

Simultaneously, as the foundational research activity of the **Just Transition Research Centre (JTRC)**, the project plans to bring diverse actors together to promote a just and democratic discussion in order to arrive at a policy-relevant and community-centric just transition framework for India at the national, state and regional level.

### Specific objectives

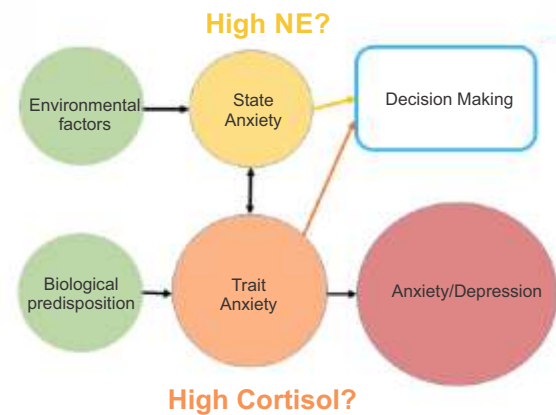
- ❑ To collect and analyze the perceptions of the trade unions & mine workers on justice in transition process
- ❑ To evaluate the current & proposed policies against these perceptions and analyse the extent to which they converge and diverge
- ❑ To promote knowledge sharing and outreach
- ❑ To arrive at a policy relevant and public-oriented just transition framework.

### Neural Mechanisms Underlying Impact of Stress Neuromodulators on Decision Making

PI: Prof. Arjun Ramakrishnan (arjunr@iitk.ac.in)  
Department of Biological Sciences & Bioengineering  
Sponsor: DBT Wellcome Trust India Alliance



Depression and anxiety are highly debilitating mental health conditions with more than 500 million cases worldwide. Trait vulnerability to stress and chronic, unmanaged stress can precipitate their onset. To understand the behavioral, physiological, and neural impact of stress, the project aims to examine the impact of primary stress neuromodulators, cortisol and norepinephrine, on decision making. An ecologically valid, virtual, patch foraging game in conjunction with a normative model will be used to detect subtle deviations from optimal behavior in both humans and nonhuman primates (Rhesus macaque). To gain insights on the neural mechanisms underlying decision making under stress during gameplay, source-localized neural signals using EEG in humans, will be gathered multichannel neurophysiological signals in nonhuman primates, along with gaze tracking and pupillometry will be gathered. Overall, the project merges ideas from ethology, economic theories of decision-making and neuroscience to determine the impact of acute stress on the brain.



A state-of-the-art neurophysiology laboratory will be set up to study decision making in humans and nonhuman primates. Establishing a viable nonhuman primate model for stress and anxiety will have several advantages and create new avenues for translational research. Furthermore, given the higher incidence of that stress-related mental health issues like depression and anxiety in young adults on college campuses, validating the practicality of the solutions derived from the research program at IIT Kanpur, in the long run, would be beneficial.

### Integrating UAV Technology with Thermal Infrared and Hyperspectral Imaging for Assessment of Water Quality of Large Water Bodies

PI: Prof. Rajiv Sinha (rsinha@iitk.ac.in)  
Department of Earth Sciences  
Sponsor: Science & Engineering Research Board



Large aquatic water bodies such as rivers, lakes and wetlands offer a unique challenge in terms of monitoring water quality due to spatial variability and several feeder channels. Rapid water quality monitoring of such aquatic systems is important for the protection and preservation of water and related terrestrial resources. However, ground-based monitoring stations are cumbersome and expensive to maintain and the data quality remains uncertain due to problems of sample collection and variance in laboratory results.

This project aims to use modern technology such as UAV based sensors to monitor water quality at a large scale. The novelty of this project is the integrated use of high-end technology such as UAVs and hyperspectral/thermal sensors. Airborne methods would not only provide a quick and instant assessment of water quality of large stretches of the rivers, lakes and wetlands but would also help in ascertaining the source of pollution and its downstream dispersal. This approach would help to monitor critical stretches by strategically designing the sampling sites and therefore maximizing the efforts.

## Engineering Fibers for Fog Harvesting and Interfacial Solar Water Purification

PI: Prof. Sameer Khandekar (samkhan@iitk.ac.in)

Co-PI: Prof. K. Muralidhar (kmurli@iitk.ac.in)

Department of Mechanical Engineering

Sponsor: Ministry of Textile, Govt of India

Laboratory Partner: Prof. Mukesh Kumar Singh, Department of Textile Technology, UPTTI Kanpur

Prof. Arun Kumar Patra, Department of Textile Chemistry, UPTTI Kanpur

Dr. Subhankar Maity, Department of Textile Technology, UPTTI Kanpur



Industrial wastewater treatment is critical for any sustainable development model. The development of effective and low-cost techniques to purify textile wastewater has received quite some attention in the contemporary times. With the availability of solar thermal energy utilization strategies, solar energy driven interfacial water evaporation is a highly promising method for achieving purification of wastewater with non-conventional, yet effective technique. Suitable fiber surfaces / fabrics need to be developed which have robust optical absorption, light-to-thermal conversion, and water transport properties (Figure 1(a)). These fabrics can then be effectively coupled with wastewater sinks so as to achieve very high rates of interfacial evaporation, caused by the solar energy influx, on the large surface area created due to the wicking meniscus (Figure 1(b)).

This research explores two novel applications of functionally engineered fibers. The final aim is to develop two distinct products, through fundamental studies on fiber level, and translational research to achieve system level integration of (i) Potable water production from natural fog on engineered fabrics (Figure 2(a)) and, (ii) Solar water purification system with interfacial evaporation on the developed fabric (Figure 2(b)). Surface modification and treatment of fibers is aimed at controlling its wettability, solar energy absorption capability and wicking dynamics so that such engineered fibers can be harnessed to maximize the rate of evaporation as well as condensation/water droplet capture efficacy. System level improvement of ~50% (for fog harvesting) and ~100% for solar evaporative water purification is targeted, as compared to the existing/contemporary technologies.

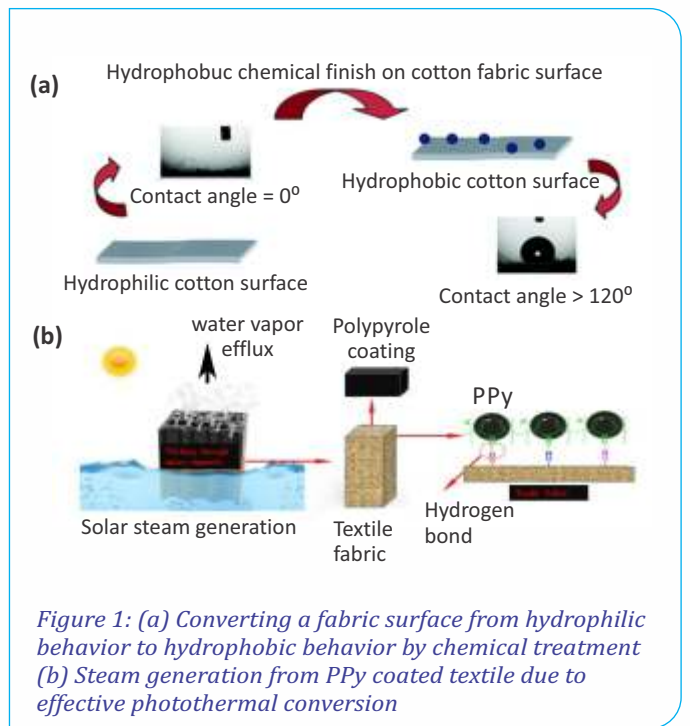


Figure 1: (a) Converting a fabric surface from hydrophilic behavior to hydrophobic behavior by chemical treatment (b) Steam generation from PPy coated textile due to effective photothermal conversion

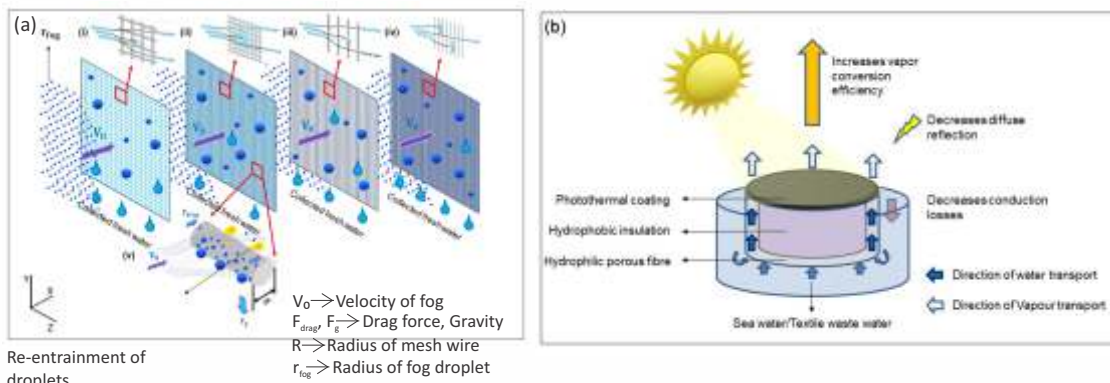


Figure 2: (a) Schematic of different fog harvesting mechanisms, (i) Large-scale meshes (ii) Fine scale meshes (iii) Large-scale harps (iv) Small-scale harps (v) Enlarged picture focusing on the interaction between incoming fog droplets and a horizontal mesh element (b) Schematic representation of the concept of heat localization in solar thermal desalination/ or wastewater purification.

## Tech for Tribal

**F**oundation for Innovation & Research in Science & Technology IIT Kanpur won the **Van Dhan Annual Awards** for the Best Entrepreneurial Skill Training Project organized by The Tribal Cooperative Marketing Development Federation of India (TRIFED) on its foundation day.

IIT Kanpur's technology business incubator FIRST, has set up PMUs in Chhattisgarh under the TRIFED-supported Tech for Tribal Project.



Tech for Tribals initiative has expanded its PMU in Wayanad after a stellar performance in Chhattisgarh over the last year. Within its first month of physical training, the T4T team has impacted 300+ beneficiaries across 6 Van Dhan Vikas Kendras (VDVKs) across Wayanad, Kerala.

## Recent Success of SIIC

- SIIC has crossed the milestone of incubating 100 next-generation startups across multidisciplinary domains of healthcare, agri-tech, clean-tech, artificial intelligence, machine learning, and waste to value.
- SIIC gained recognition under the UP Startup Policy, 2020 by the Uttar Pradesh Government, a step forward towards their goal of being among the top 3 “States' Startup Ranking” across India.
- SIIC is now in association with leading AI Med organization Novartis in the endeavour to share insights on the current and future applications of AI in healthcare mediated through interesting webinars.

## Mission Bharat O<sub>2</sub>

- SIIC launched Mission Bharat O<sub>2</sub> during the second wave of Covid-19 to enable large-scale manufacturing of oxygen concentrators and oxygen plants to strengthen India's healthcare ecosystem.
- The mission was huge success and turned into a reality due to the unwavering support from CSR partners: ICICI Securities, Ansys, and NTT Data Services.
- Ten O<sub>2</sub> plants were set up across the country under MBO<sub>2</sub>
- SIIC under mission MBO<sub>2</sub> donated oxygen concentrators to hospitals of seven states across the country, namely, Uttar Pradesh, Kerala, Himachal Pradesh, Gujarat, Tamil Nadu, Maharashtra, and Mizoram.



**Technovation with IIT Kanpur:** On 9th July, Technopark@iitk in collaboration with the Indian Industries Association, Kanpur Chapter hosted a webinar focussing on the crucial role research and development plays in the economic growth of the country and the opportunities of collaborations that exist for industries to work together with IIT Kanpur. Mr. Sunil Vaish, CEC Member & Ex-National President, IIA inaugurated the event with his welcome address. Dr. Gopal Kamath, Professor-In-charge, Technopark@iitk was the main speaker of the event.



**Technithon International Pte Ltd**, a Singapore-based company with specialization in cutting-edge sulf(on)ation processes, surfactants, and environmental technologies, joins Technopark@iitk to engage with IIT Kanpur on R&D collaborations, starting with the Department of Chemical Engineering. The company plans to expand its collaborative work with IIT Kanpur in near future and has expressed interest in setting up a R&D laboratory and pilot plant facility in the upcoming Technopark@iitk Phase I building.

**Transchain Technologies** sets up its R&D office in Technopark@iitk. The company offers customised, end-to-end logistics services and solutions. With technology at its foundation, Transchain is transforming supply chain from low transparency, manual documentation, low visibility to a digitized platform which lets you understand, analyse, control your supply chain and collaborate with all the partners involved.

**BPL Medical Technologies** collaborates with Technopark@iitk to engage with IITK expert pool to indigenously design and develop medical devices. Headquartered in Bengaluru, Karnataka, the company is one of the fastest growing medical devices company in the country and is engaged in manufacturing of indigenously designed products since August 2013.

The other companies to join Technopark@iitk include GE Oil and Gas India, Logic Fruit Technologies, Superhouse Group, and Standard Surfactants.

**C3iHub** launches First Cohort of Cyber Security Start-Ups which will develop services & products across the critical cyber security domains of UAV Security, Blockchain, Intrusion Detection, and Cyber Physical Systems.



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### R&D Profile at a glance

<http://www.iitk.ac.in/dord/data/R&D-profile-flyer-2019-16-08-19.pdf>