



# R&D Newsletter

Indian Institute of Technology Kanpur

**FOCUS**

- **Air Sampling Device**
- AI for Sustainable Cities
- **Aircraft Simulator**
- Electronics & ICT Academy
- **Integrated Inspection Framework**
- JET Flame Characterization
- **Point of Care Medical Devices**

# Collaborations

## MoU with NSI



IIT Kanpur and **National Sugar Institute (NSI)** Kanpur signed an MoU to create a Centre of Excellence for Biofuels at NSI Kanpur to boost biofuel production from biomass, focusing on Ethanol, Methanol, Bio-CNG, Aviation Fuel, and Green Hydrogen, supporting India's renewable energy goals.

## MoU with Central Command Army



IIT Kanpur and **Central Command Headquarters, Lucknow**, signed a MoU to establish a strategic partnership in the niche field of cyber security.

## MoU with SAIL

Under the guidance of Ministry of Steel, **Steel Authority of India (SAIL)** and IIT Kanpur entered into an MoU to work in the areas of iron and steel making processes as well as allied fields like digitalisation, sustainability and reduction of carbon footprint.



## MoU with NPTI

An MoU was signed between **National Power Training Institute (NPTI)** and IIT Kanpur to initiate the preparation of DPR for establishment of Cyber Physical Lab at NPTI.



## MoU with CMPDI

**Central Mine Planning & Design Institute (CMPDI)** and IIT Kanpur sign an MoU to collaborate on just transition issues in mining. They aim to develop socio-economic indicators, social impact assessments, and mine closure frameworks. This partnership seeks to enhance CMPDI's business opportunities through joint R&D on Rehabilitation & Resettlement, Environment Impact Assessment, and more.



## MoU with FXE Ltd



**FusionX Asia Pacific Private Limited (FXE)** and IIT Kanpur entered into an MoU to work in the areas of Renewable energy generation and storage.

## MoU with DMIHER

**Datta Meghe Institute of Higher Education and Research (DMIHER)** and IIT Kanpur signed an MoU to collaborate on Biomedical Materials, Implants, and Medical Technologies.



## MoU with AVPL



IIT Kanpur and **AVPL International** entered into an MoU for co-developing cutting-edge drones equipped with advanced technology, designed to address the challenges faced

by large-scale landholders in India, Australia, Austria, & multiple European nations.

## MoU with EIL

**Engineers India Limited (EIL)** and IIT Kanpur signed an MoU to exchange scientific knowledge and collaborate on research in hydrocarbons, petrochemicals, and energy technology. The agreement aims to commercialize jointly developed technologies.



### IIT Kanpur Launches Air Sampling Device, Leading the Way in Air Quality Management Innovation



On March 11, 2024 IIT Kanpur officially launched its Air Sampling Device, titled the '**Multiple Slit Nozzle-based High Volume PM2.5 Impactor Assembly**,' developed by Prof. Tarun Gupta, Dept. of Civil Engineering. In 2020, Institute signed a technology transfer agreement with Airshed Planning Professionals Pvt. Ltd., an incubatee at Startup Innovation & Incubation Centre (SIIC), IIT Kanpur. The aim was to license the developed technology for local manufacturing, with the goal of replacing expensive imported air samplers and impactors.

The inauguration ceremony witnessed the presence of distinguished guests: Prof. Tarun Gupta, Dean of Research and Development, IIT Kanpur, Prof. Ankush Sharma, former Professor In-charge, Start-up Incubation and Innovation Centre, IIT Kanpur; Prof. Mukesh Sharma, Dept. of CE & Mr.

Dhirendra Singh, Director, Airshed Planning Professionals Private Limited.

The device is designed for sampling to evaluate a range of air parameters, encompassing respirable air quality, ambient air monitoring, and quantitative assessments of air pollutants. It offers quantitative estimations of diverse microbial colonies found in ambient air.



### IIT Kanpur bags STEM Impact Awards 2024



IIT Kanpur has been honoured with the prestigious **STEM Impact Awards 2024** for engaging in impactful technology transfer activities, during the annual STEM Summit - 2024, held in Bengaluru on February 01, 2024. On behalf of IIT Kanpur, Prof. Ankush Sharma, former Professor In-charge, Start-up Incubation and Innovation Centre, IIT Kanpur and Prof. Siddhartha Panda, Department of Chemical Engineering, and Coordinator of the National Centre of Flexible Electronics, (NCFlexE), IIT Kanpur jointly received the award from Mr. Alwin Wong, Chairman, Association of Technology Transfer Professional.

**STEM (Society for Technology Management)** is a non-profit organization providing a facilitative environment for Technology Transfer Processes and professional development of technology management professionals in Life Sciences, Material Sciences, IT, Engineering, Law, and others.

The institute is proud to be the winner for impactful technology transfer of the invention titled "**Haptic Smart Watch for Blind & Visually Impaired**", creating a socio-economic impact. The above technology was developed by Prof. Siddhartha Panda, Dept. of Chemical Engineering & National Centre for Flexible Electronics & Mr. Vishwaraj Srivastava (SCDT) at IIT Kanpur, addressing the major lag in assistive ecosystem and expected to bring a revolutionary change in the society. This technology has been licensed to Ambrane India Pvt. Ltd for mass manufacturing and sales. This invention was also honoured with the prestigious Best Assisted Technology Initiatives by Educational Institutes' Award at the ATF (Assistive Technology Foundation) Awards 2023.

## Recent Projects

### Point-of-Care Devices in Healthcare Technologies

PI: Prof. Sandeep Verma

Dept. of Chemistry

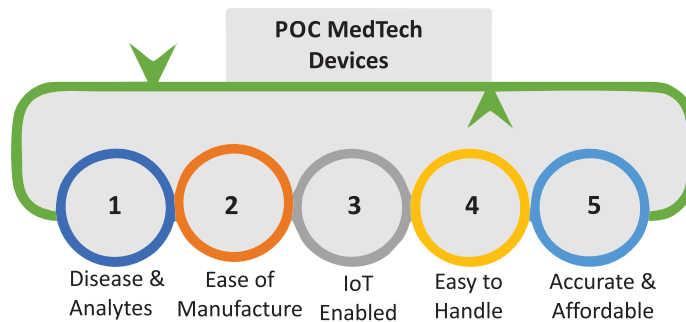
Professor In-Charge, Gangwal School of Medical Sciences and Technology (GSMST)

Sponsor: Ministry of Education

under Scheme for Promotion of Academic and Research Collaboration (SPARC) programme



Constant innovation and technological advancements in the field of MedTech devices is crucial to ensure the goal of effective universal healthcare. Diagnostics play a crucial role in supporting the healthcare system by rapid and accurate screening, prognosis and patient monitoring. Point-of-Care (POC) devices are particularly helpful in giving verifiable data to clinicians in order to source good treatment, avoid adverse health outcomes and offer integrated healthcare.



The following objectives will be pursued in the Ministry of Education supported SPARC project at GSMST, IIT Kanpur, with collaborative efforts from Faculty of Medicine, Dentistry, and Health Sciences, University of Melbourne, Australia, and Amrita Vishwa Vidyapeetham, Coimbatore, India.

- IoT Enabled Clinical/Physiological Analyzers
- Biosensing Modules for Patient Care
- AI Powered Handheld MedTech Devices: Sepsis, Cancer, Neurodegeneration
- Compilation of a monograph on POC devices in Healthcare

## Science Day 2024

IIT Kanpur celebrated National Science Day on March 02, 2024. The theme for National Science Day 2024 was "**Science for a Sustainable Future**". This theme emphasized the crucial role that science and technology play in addressing global challenges and fostering a more sustainable future for all.

The event was inaugurated by Prof. S. Ganesh, former officiating director, IIT Kanpur in the presence of Prof. Tarun Gupta, Dean Research and Development, Prof. J. G. Rao, Associate Dean Research and Development and other esteemed faculty members.

Prof. A. K. Chaturvedi delivered an insightful lecture on '*The Fascinating Science and Technology Behind Mobile Phones*' and Prof. Y. N. Mohapatra gave an intriguing talk titled '*From Quantum Dots, Nanostructures to Printable Electronics: Stories of Innovations*'.

Further, Prof. Aditya Kelkar and Prof. Adhip Agarwala demonstrated fascinating Science Experiments for school children.



## Recent Projects

### Centre of Excellence in Artificial Intelligence for Sustainable Cities

PI: Prof. S.N. Tripathi

Dept. of Civil Engineering, Dept. of Sustainable Engineering

Co-PI: Prof. Nisheeth Srivastava

Dept. of Computer Science & Engineering

Sponsor: Ministry of Education



IIT Kanpur led consortium - with partners from academia, industry, non-profit and government organisations - was awarded **Center of Excellence for Artificial Intelligence on Sustainable Cities (Phase-1)** by Ministry of Education in March 2024.

The Center's objective is 'Forecasting and Modelling for Urban Sustainability' with interventions focusing on 5 major tracks viz. air quality, energy, mobility, water and middleware for municipal functions, aligning with India's commitment in Paris agreement. Digital twins coupled with AI analytics models in the Phase-1 will forecast and optimize parameters specific to each domain. These interventions not only enhance economic growth and public health but also showcase a holistic approach to societal impact, aligning with national priorities and reinforcing India dedication to combat climate change.

### PoC (Proof of Concept)



#### Digital twin for PNG distribution

Gas data from Adani Gas  
Mobility data from IISc & IIIT Hyderabad  
Modelling by IISc & IIT Kanpur



#### Air quality-based Identification of Intervention opportunities

Data from IIT Kanpur's ongoing Clean Air project  
Source apportionment and modelling by IIT Kanpur



#### Digital twin for multi-scale urban mobility planning

Air quality data from IIT Kanpur  
Mobility data from IISc & IIIT Hyderabad  
Modelling by IISc



#### AI-augmented tech stack for ULB governance activities

Base platform DIGIT from eGov foundation  
Models contributed by all academic teams

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## Institute Lecture Series (March 2024 - July 2024)



**Dr. Vinod Mengle**  
Founder & CEO of Aero Insights

**Innovations in Jet Noise Reduction Technology**



**Prof. Ramesh Karri**  
New York University

**High-Level Approaches to Hardware and Embedded Security**



**Dr. Rajiv Desai**  
CEO, 3Di System

**Mars Pathfinder Mission - a Pivotal Moment in Robotic Exploration of Space**

## Recent Projects

### Electronics & ICT Academy Scheme - Phase II

PI: Prof. B.V.Phani

Dept. of Management Sciences

Sponsor: Ministry of Electronics & Information Technology (MeitY)  
under Capacity Building and Skill Development Scheme



**E&ICT Academy**

Indian Institute of Technology, Kanpur



Joint Initiative of Ministry of

Electronics & Information Technology & IIT Kanpur

**E**lectronics & ICT Academy (EICTA) Phase II is a joint initiative of Indian Institute of Technology Kanpur and Ministry of Electronics & Information Technology (MeitY) as a continuation of the earlier EICTA Phase I (2015-2024). EICTA II in continuation of its earlier mandate is tasked with designing, developing & delivering specialized highly subsidized Faculty Development

Programs (FDP) in emerging technologies/ niche areas/ specialized modules for specific research areas for Faculty in Higher Education Institutions (HEI).

In addition to this FDPs on multi-disciplinary areas connected with ICT tools and technologies and other digital hybrid domains, covering a wider spectrum of engineering and non-engineering colleges, polytechnics, ITIs, and PGTs educators are to be conducted. The mode of delivery specific to IITK's EICTA set by the ministry is in synchronous, asynchronous and hybrid mode.

The above is in addition to its Phase I mandate of enhancing the technical skill of faculty, students, researchers and professionals working in all domains of Sciences, Engineering, Humanities and Management in state of the art Electronics & ICT skill domains.

### Experimental Characterization of Flame Stabilization in a Jet Engine after Burner

PI: Prof. Santanu De

Dept. of Mechanical Engineering

Co-PI: Prof. Alakesh Chandra Mandal

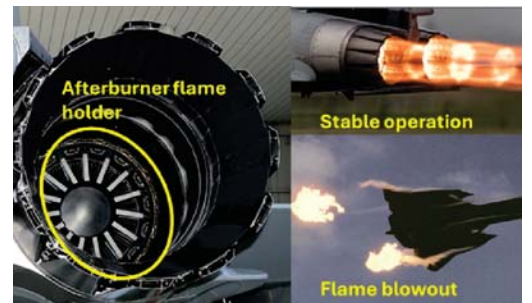
Dept. of Aerospace Engineering

Sponsor: Aeronautics Research and Development Board (ARDB)



**I**ndigenous development of Advanced Medium Combat Aircraft (AMCA) class, all-weather, fifth-generation, twin-engine, multirole combat aircraft for the Indian Air Force and the Indian Navy relies heavily on the successful operation of the afterburner.

During the project, a test rig will be realized to mimic actual operating conditions of a jet engine afterburner, and high-speed laser-based optical diagnostics will be employed to unravel spray, flame, and flow features. The stability map of the afterburner and the experimental database generated during this project will be instrumental in realizing the indigenous development of the jet engine afterburners for future large aero-engine configurations.



## Recent Projects

### Establishment of an Aircraft Simulation Facility

PI: Prof. G.M. Kamath

Co-PI: Prof. Raghavendra P. Kukillaya

Dept. of Aerospace Engineering

Sponsor: Aeronautics Research and Development Board (ARDB)



**F**light simulators are typically used to train pilots. However, other significant roles for flight simulators are to support aircraft R&D and aerospace engineering education.

This project aims to set up an Aircraft Simulation Facility in the Flight Laboratory of the Dept. of Aerospace Engineering, IIT Kanpur. The flight simulation facility will comprise different levels of simulation fidelity: Advanced, Intermediate and Basic levels. The Advanced flight simulator will simulate the Cessna aircraft currently under operation. The Intermediate and Basic level simulators will have multiple simulator stations that can be used by faculty and students for developing and validating methods, models, and algorithms related to flight vehicle research. They can also be used to enhance the learning outcomes in topics such as aircraft design, dynamics, performance, and control.



*A representational view of an advanced flight simulator (Picture Courtesy: redbirdflight.com)*

### Design and Development of an Integrated Inspection Framework Comprising of UGVs (Unmanned Ground Vehicle) with Deployable UAVs (Unmanned Aerial Vehicle) for Critical Power Infrastructure Inspection

PI: Prof. Bishakh Bhattacharya

Dept. of Mechanical Engineering

Co-PI: Prof. J. Ramkumar

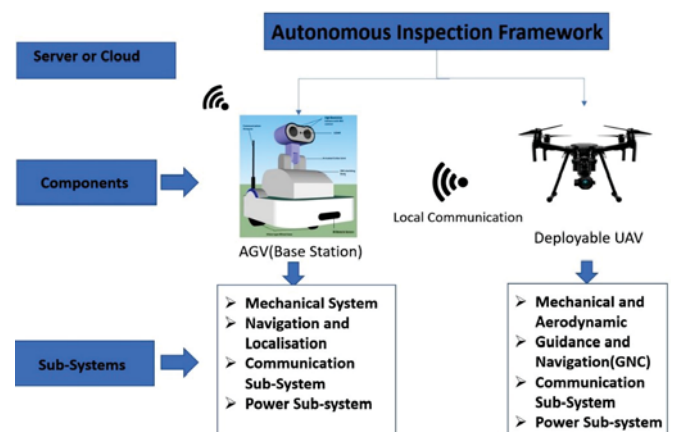
Dept. of Design

Sponsor: Central Power Research Institute



**O**perational efficiency and preventive maintenance are essential to ensure smooth and uninterrupted functioning of components of the power infrastructure. In order to achieve this, an effective autonomous inspection framework that inculcates state-of-art autonomous robots (UGVs + UAVs) which can continuously monitor the environment and inspect the components for failure is essential. AI based algorithms can detect the faults occurring in the critical infrastructure (such as hotspots, mechanical failure, splice failure etc.) using the sensory data obtained by the robots and can also predict failures. In this process, operational down-time could be reduced and thereby consequent losses.

The proposed system in this project consists of two essential collaborative robots that form the backbone of the integrated framework of the Non-destructive inspection of critical infrastructure. These are an autonomously guided vehicle (AGV/UGV) acting as a base station from where an Unmanned Aerial Vehicle (UAV) can be deployed as the task demands. Further, there will be two such sets of collaborative robots to create a swarm-like environment and distribute the inspection work in case of urgent failure.



*Inspection framework with its components and sub-systems*

# Featured Technologies

## System for Early Detection and Termination of Ransomware and Method Thereof

**Invented by:** Prof. Sandeep K. Shukla, Mr. Putrevu Mohan Anand, Mr. Putrevu Venkata Sai Charan, Mr. Chunduri Naga Venkata Hrushikesh

Dept. of Computer Science & Engineering

*Patent Granted (501011)*

- Powerful combination of Windows registry monitoring and trap file monitoring to detect on ransom in early stage.
- Prevents data loss at early stages of ransomware execution.
- Minimizes the impact of attack by isolating the infected systems.
- Allows for swift incident response, minimizing operational disruption, reputation damage & duration of downtime.

## An Optimized AAV Vector for Gene Therapy of Muscular Dystrophy

**Invented by:** Prof. Jayandharan Giridhara Rao, Mr. Navneet Srinivasan, Ms. Anila Varghese, Ms. Pratiksha Sarangi, Ms. Vijayata Singh

Dept. of Biological Sciences & Bioengineering

*Patent Granted (531321)*

- The Invention focuses on Duchenne Muscular Dystrophy (DMD) which is a severe genetic disorder that causes muscles to gradually weaken.
- Technology Validation – These Vectors have been tested for their therapeutic utility by intramuscular (TA Muscle) administration in muscular dystrophy (mdx) mice.

## Process for Ruthenium Doping of a Sodium-Superionic-Conductor Ceramic based electrolyte in Sodium-Ion Batteries

**Invented by:** Prof. Raju Kumar Gupta,  
Dept. of Chemical Engineering

**Prof. Kanwar Singh Nalwa (late)**  
Dept. of Sustainable Engineering

*Indian Patent Application no. 202311043231*

- Enable ultra-fast charging of batteries in consumer electronics and electric vehicles.
- Improved safety rating of the solid-state electrolyte over the conventional flammable liquid electrolyte.
- Low cost of Na-ion battery.
- No degradation at high charge-discharge rates.

## Design and Fabrication of Biomimetic Scaffold for Ligament Tissue Engineering

**Invented by:** Prof. Dharendra S. Katti, Mr. Sriram M.

Dept. of Biological Sciences & Bioengineering

*Indian Patent Application no. 202411003111*

- Directs cells to organize in two directions, like in ligaments.
- Possesses zone-specific anisotropic (Different characteristics in different areas) features.
- Supports stem cells turning into fibroblasts with the right growth factors.

### Contact

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### Feedback/Suggestions

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