



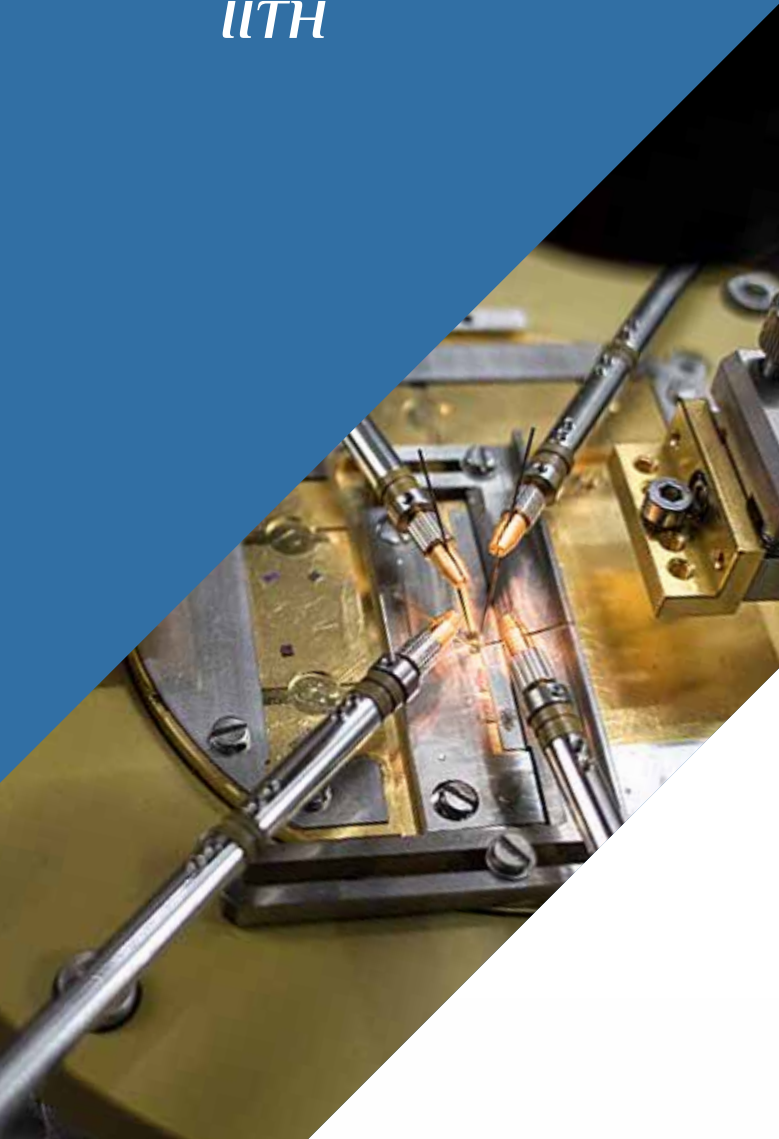
భారతీయ సాంకేతిక విజ్ఞాన సంస్థ హైదరాబాద్  
भारतीय प्रौद्योगिकी संस्थान हैदराबाद  
Indian Institute of Technology Hyderabad

*Annual Report 2020-21*

# *Inventing and Innovating in Technology for Humanity*

»»» 8<sup>th</sup> rank among the engineering institutes  
in the country. (NIRF Rankings 2021)

IITH





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2020-21 Annual Report

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Education is the most powerful weapon which you can use to change the world.

– Nelson Mandela



# Board of Governors



## Chairman

Dr BVR Mohan Reddy  
**Executive Chairman**  
Cyient Limited



## Member

Sh Rakesh Ranjan, IAS  
**Additional Secretary (TE)**  
Ministry of Education



## Ex-Officio

Prof BS Murty  
**Director**  
IIT Hyderabad



## Member

Smt Chitra Ramachandran, IAS  
**Special Chief Secretary**  
Higher Education, Government of  
Telangana State



## Member

Prof Vinod Krishan  
**Senior Professor & Dean**  
Indian Institute of  
Astrophysics



## Senate Nominee

Prof Ch Subrahmanyam  
**Department of Chemistry**  
IIT Hyderabad



## Member

Dr Prema  
Ramachandran  
**Director**  
Nutrition Foundation of  
India



## Senate Nominee

Prof C Krishna Mohan  
**Dept. of Computer Science &  
Engineering**  
IIT Hyderabad



## Member

Prof M Lakshmi Kantam  
**Department of Chemical  
Engineering**  
Institute of Chemical  
Technology



## Secretary

Commodore Manohar  
Nambiar (Retd)  
**Registrar**  
IIT Hyderabad



A good education is the foundation for a better future. – Elizabeth Warren





## Deans



**Prof Saptarshi Majumdar**  
*Dean (Academic)*



**Prof Pinaki Prasad Bhattacharjee**  
*Dean (International and Alumni Relations)*



**Prof Raja Banerjee**  
*Dean (Administration)*



**Prof K V L Subramaniam**  
*Dean (Planning)*



**Prof M Deepa**  
*Dean (Faculty)*



**Prof Kiran Kumar Kuchi**  
*Dean (Research and Development)*



**Prof P Rajalakshmi**  
*Dean (Students)*



**Prof C Krishna Mohan**  
*Dean (Public & Corporate Relations)*



You must do the things you think you cannot do. – Eleanor Roosevelt



# Distinguished Professors



**Bayya Yegnanarayana**

PhD – IIIT Hyderabad

***Distinguished Professor***

*Research Areas:* Signal Processing, Speech Signal Processing, Computer Vision and Neural Networks.



**Mathukumalli Vidyasagar FRS**

National Science Chair

***Distinguished Professor***

*Research Areas:* System and Control Theory



**Pulickel M Ajayan**

PhD – Northwestern University

***Distinguished Professor***

*Research Areas:* Carbon Based Materials, Nanostructured Materials, 2-D layered Materials, Multifunctional Nanocomposite Materials, Additive Manufacturing.



**V K Saraswat**

PhD – Osmania University

***Distinguished Professor***

*[Former secretary, Dept. of Defence R&D (GoI), Scientific Advisor to Raksha Mantri, Director General of DRDO & ADA]*

## Director's Message



Prof BS Murty

**“ Intelligence is the ability  
to adapt to change. ”**

*– Stephen Hawking*



IIT Hyderabad has again demonstrated in FY 2020-2021 that it is the leading engineering institute in the country with NIRF Ranking #8 and QS World Ranking [India] #8 & QS #10 in the country. We stand ahead in our league because of dedicated faculty, brilliant students, and committed staff. We define IITH as Invent and Innovate in Technology for Humanity. This commitment and our strong team have made IITH sail through the difficult times when COVID-19 hit the whole world.

In line with the IITH's Vision 2024, we could include new industry-oriented masters programs, strong collaborative projects with industry, joint doctoral programs with global universities, bringing experts and students from other parts of the globe through exchange programs, industry lectures, industry-defined MTech projects, semester-long internships for BTech and programs in Entrepreneurship. We are immensely glad that we could be able to fulfil most of our Vision 2024 outlines even amidst the COVID-19 Pandemic.

Strong research foundation at IITH has resulted in an exhibition of extraordinary work to combat COVID-19 like Test Kits, Masks, Ventilators, Mathematical Models, psychological Models, apps, sanitizing solutions, and technology for social good, which includes creating awareness and supporting neighboring villages adopted by IITH under Unnat Bharat Abhiyan. With the increase in the number of COVID 19 infected persons, it became the utmost priority to develop a faster and effective test kit. Our faculty Prof Shiv Govind Singh has developed a rapid test kit to diagnose COVID 19 in an economic way and he is in the process to complete the required certification so that it can be mass-produced for wider reach. The Jeevan Lite ventilator from Aerobiosys an incubator from the Centre for Health Care Entrepreneurship of IITH is another example of the relentless fight of IITH with Covid 19. The latest in this series of developments is the Usafe Health Care reusable respirator mask, which is a high-quality affordable mask that came out of IITH with the support of Dr Surya Kumar and Prof Renu John.

IITH has also continued to excel in the other fields of research such as Supercapacitors, Batteries, Neem-oil based storage bags for seed storage, Novel Molecules to treat ALS, and Combination Therapy for Cancer, etc. It is a matter of immense pride that one of our PhD scholars along with his colleagues has developed an Air Sterilizer 'Swatchh Air' to treat COVID-19 Virus and has been awarded as Top-10 Start-up Products in the recent HYSEA 2020, nurtured under an IITH in-house student research support program called BUILD [Bold and Unique Ideas Leading to Development]. IITH has also started supporting interdisciplinary projects and rural

development projects of its faculty through internal funding. Many path-breaking kinds of research have taken place like the prediction of the SAR COV 2 droplet by an interdisciplinary team of Dr Saravanan Balusamy and Dr Sayak Banerjee, led by Prof Kirti Chandra Sahu. We are very proud that IIT Hyderabad Researchers joins India,s global hunt for Einstein's waves from monster black holes.

Continuing to excel on the Research facade with about 237 faculty members, the institute has published about 1218 Scopus publications, secured about 70 sponsored research projects with about Rs. 36 Crores and filed 18 patents. The seed grant for new faculty increased from Rs.3 lakhs to up to Rs. 25 lakhs. About 27 new faculty members have been supported with total funding of over Rs. 5 Cr. this year. Several MoUs have been signed to strengthen the academic & research capabilities within the institute. IITHDRDO Research Cell has been established. IITHNIMS Research Centre has been established to have an exchange of PhD students, faculty, and scientists between the two institutions. Research Excellence Awards have been initiated for faculty members. Interdisciplinary Research Projects worth Rs.1 Cr. and Rural Development Projects to the tune of 50 lakhs have been provided to the faculty. Research culture among students has been nurtured with financial support through Build [Bold and Unique Ideas Leading to Development] projects. Alumni came forward and supported this new initiative partially. DST has funded Rs.135 Cr. under the NM ICPS, for TiHAN set up by Prof. P. Rajalakshmi of Electrical Engineering. The honorable Education Minister has obliged us by laying the Foundation Stone for the TiHAN. ICMR has funded Rs.15 Cr. to set up a CoE under Prof. Renu John, Biomedical Engineering. DBT has sanctioned an Indo-UK project [AMRflows] worth Rs. 11 Cr to Prof. Shashidhar, Civil Engineering. IITH also received global recognition for the contributions made to the development of 5G standards that is recently approved by ITU [International Telecommunication Union].

Amid this COVID 19 situation, we have ensured academic excellence too IITH has announced a number of new industry-oriented M Tech programs in collaboration with the industry experts, effective from September 2020. These include Additive Manufacturing, Energy Science and Technology, E-Waste Resource Engineering and Management, Integrated Sensor systems, Network and Information Security, Polymer and Biosystems Engineering, Smart Mobility. We have commenced BTech in Biomedical Engineering effective from this year with decent starting ranks of IIT-JEE Advanced along with several new industry-oriented MTech programs, such as Additive Manufacturing, Energy Science and Technology, E-Waste Resource Engineering and Management, Integrated Sensor Systems, Networks and Information Security, Polymers and Bio-Systems Engineering and Smart Mobility.

IITH has taken number of novel initiatives like BTech in Biomedical Engineering, 7 Industry-oriented MTech Program, and a new Department of Entrepreneurship with PhD Program. For the first time, 14 Foreign national students have enrolled at IIT Hyderabad for MTech and PhD programs. A special drive has been taken up to admit students who have been affected by Pandemic for PhD. The number of PhD student intake has been increased from 60 to 120. In addition, about 20 PhD students have been admitted exclusively to work on problems defined by DRDO labs. A Centre for Continuing Education started, and a Rural Development Centre was established. On the academic front too, this dreadful disease could not slow us down. While we continued our regular MTech PhD Admission for 2021 we have also taken some novel initiatives this year like FIRST (Fellowship for International Research Scholars in Technology) a PhD fellowship for foreign students to study at IITH, Interdisciplinary PhD Joint Doctoral Program with two top Australian Universities [Deakin Swinburne].

Taking our relations with Japan a step ahead, we have signed an MoU with Japanese financial firm New Frontier Capital Management (to create a global network of Venture Ecosystem and to establish 'Joint Innovation Centers' in Tokyo, Japan, and Telangana State. To strengthen our alliances with the Industry, IITH has also partnered with the Confederation of Indian Industry (and launched CII IITH IWN power talks. Every Saturday we have a talk from either an Industry expert or an IITH's academican Total of 4 Power talks has been successfully organized in the last quarter. IITH has an excellent entrepreneurship base with a strong incubation activity. The entrepreneurship ecosystem at IITH had many success stories in the past. Ventilators, Masks, and Face shields are a few of the works done by our start-ups during these tough and testing times of COVID-19.

Our international relations have crossed an important milestone with the first Joint PhD student between Swinburne and IITH successfully defending his thesis recently. We had a phenomenal year with remarkable academic and industry collaboration with top-notch institutes like the University of Hyderabad in India and Hiroshima University in Japan and many organizations like OPPO, IBM, CDAC, NHAI in India, and DENSO & NFCM in Japan. I am sure this will enable us to establish newer benchmarks in research and technology and be the dream destination for students, faculty, researchers, and industrialists. The Dept. of Entrepreneurship Management in collaboration with Business Design Lab has launched a unique Certificate program on Business Model Innovation for Business Leaders, Entrepreneurs, Intrapreneurs, Sr Design, and Strategy Professionals. FabCI Incubator at IITH Joins hand with NXP India MeitY to launch Semiconductor Incubation and Acceleration Program, a first-of-its-kind program for start-ups innovators working in the field of semiconductors.



Our students have proven that nothing can stop or slow them down. They have demonstrated a mammoth of motivation and management skills by conducting their flagship event, ELAN ηVision 2021, online with the theme Fables of a Moppet, an event focused on mental well-being stress management especially of the students. Given COVID 19 circumstances, even E summit 2 k 21 has been organized virtually with the help of IT Collaborators. It was a great success with more than 1500 registration and 300 participants for the panel discussion. With the message "It's time to stop playing safe" Let's play Unsafe" TEDx IIT Hyderabad too went online this year with the same or even better partaking. I am hopeful that we will soon be able to enjoy our in-person communications.

While the Phase-2 construction in the campus is going on in full swing, to make the campus green, we decided to identify the first Saturday of every month as Plantation Day, which resulted in planting more than 10000 plants with more than 100 varieties of species. To take care of the campus residents, a 24x7 Clinic has been established and a Specialty Clinic has been started with medical consultants from Apollo. A comprehensive Solid Waste Management scheme has been established on the campus. A Sub Post office has been set up on campus with an exclusive PIN for IIT Hyderabad. To encourage excellence among staff, Staff Excellence awards and Employee of the month awards have been initiated. Annual Alumni Awards have been initiated.

IITH is a dynamically evolving institution. The overall goal is to become the dream destination of students, academicians, and researchers.

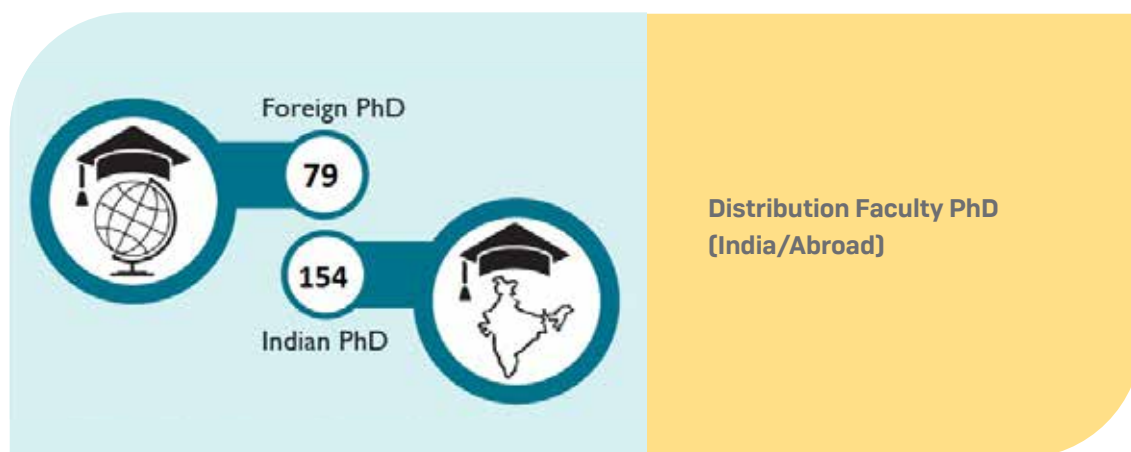
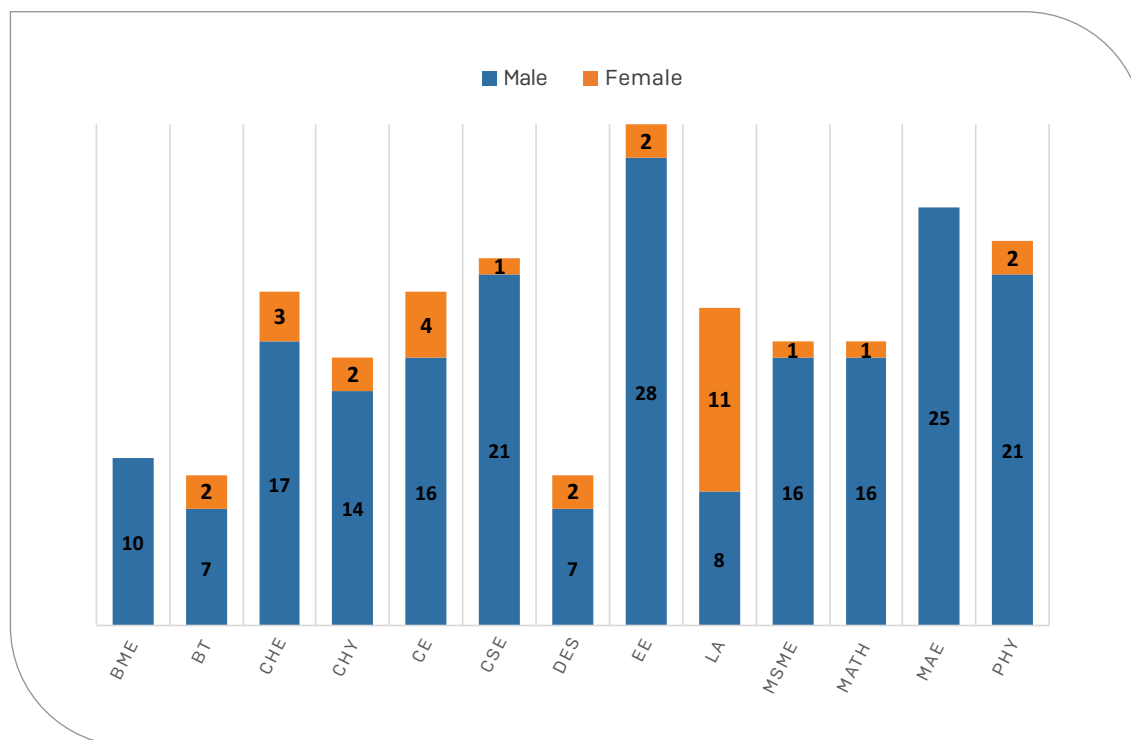
I would like to take this opportunity to thank our Board of Governors, and particularly our Chairman, Dr B V R Mohan Reddy, for their constant support and advise. I also take this opportunity to thank all the students, staff, and faculty for all the great work they are doing to keep the flag of IITH high.



Stay safe & stay healthy. Wishing you a wonderful year ahead.

**Prof BS Murty**

# Faculty Statistics

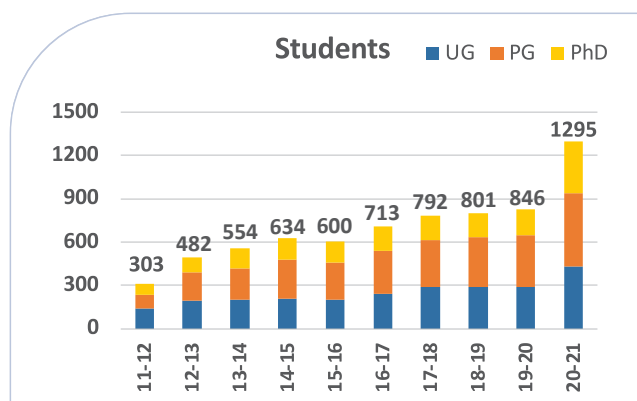
As on 31 March 2021, IITH is having 237 faculty members on-roll. ~13% of the total faculty are women.



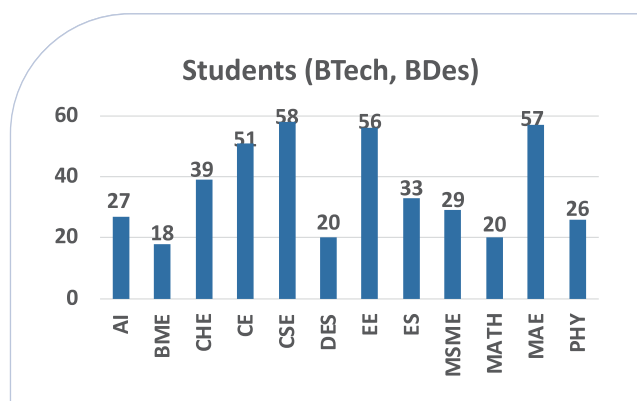
 Education is the most powerful weapon which you can use to change the world. 

# Students Statistics

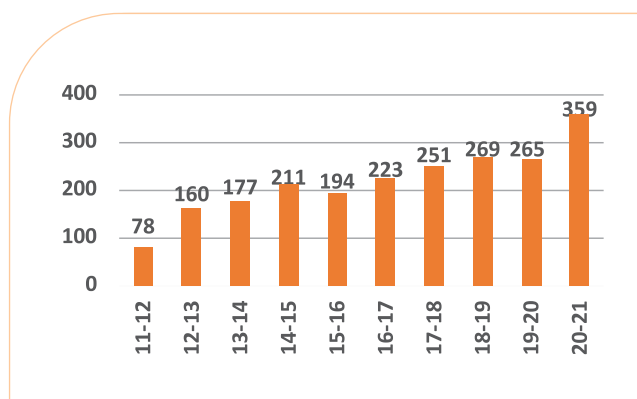
IIT Hyderabad has seen a major surge in overall admission with an increase of ~52% in the year 2020-2021. There is an increase of 35%, 38% & 124% intake for UG, PG and PhD in 2020-21 compared to 2019-2020.



The summary of annual intake for various courses



Department-wise Distribution of Undergraduate Students for 2020-2021



MTech  
(Yearly Intake of MTech Students)

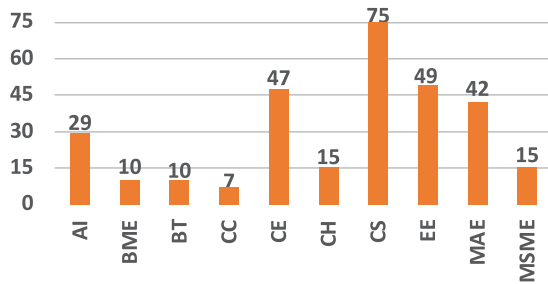


“Education is the passport to the future, for tomorrow belongs to those who prepare for it today.” – *Malcolm X*



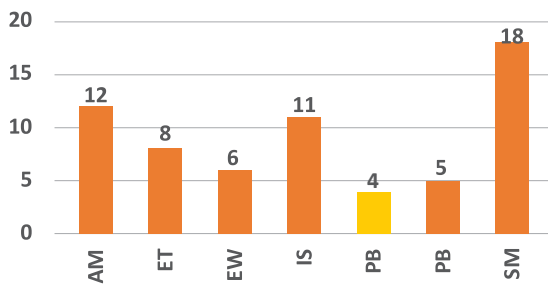


**Students (Departments)**



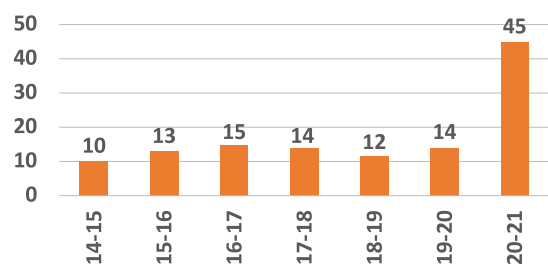
**Department-wise  
Distribution of MTech  
Students for 2020-2021**

**Students (MTech - ID)**



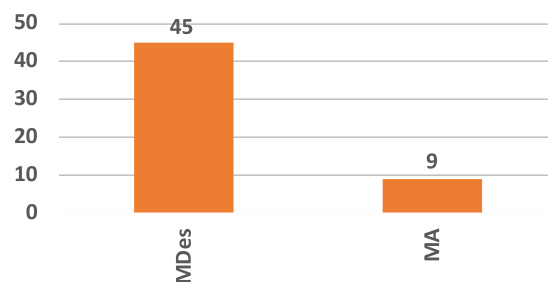
**Department-wise  
Distribution of MTech  
(Interdisciplinary) Students  
for 2020-2021**

**Students (MDes)**



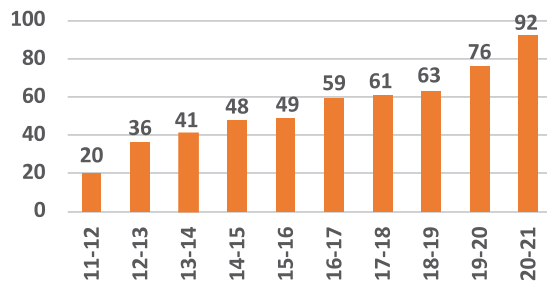
**Yearly Intake of MDes  
Students**

**Students (MDes, MA)**



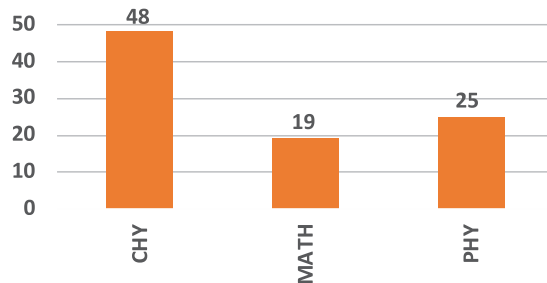
**Department-wise  
Distribution of MDes, MA  
Students for 2020-2021**

**Students (MSc)**



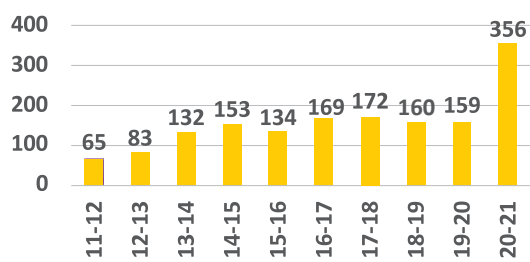
**Yearly Intake of MSc Students**

**Students (MSc)**



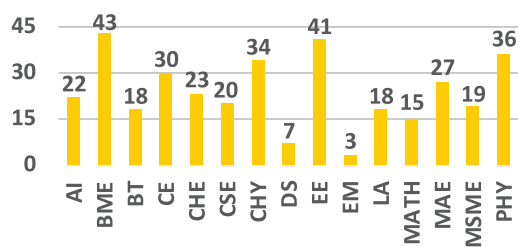
**Department-wise Distribution of MSc Students for 2020-21**

**Students (PhD)**



**Yearly Intake of PhD Students**

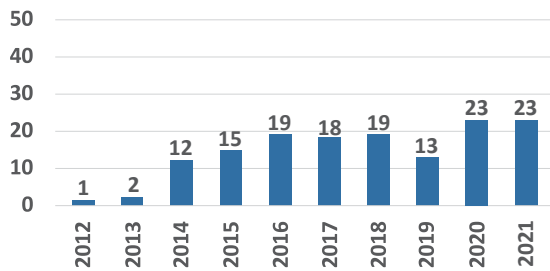
**Students (PhD)**



**Department-wise Distribution of PhD Students for 2020-21**

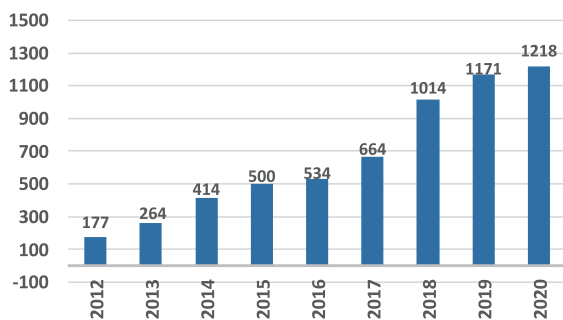
# Patents, Publications & PhD Graduates

## Patents Applied



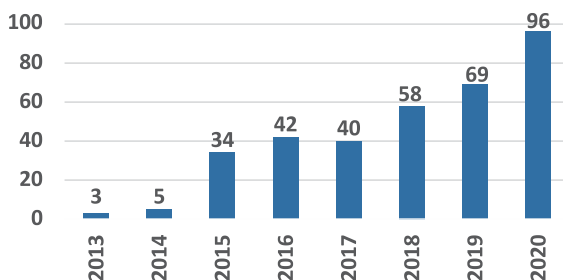
Year-wise Distribution  
of Patents filed

## Publications



Year-wise Distribution  
of Publications

## PhD (Awarded) over years



Year-wise Distribution of  
PhD awardees

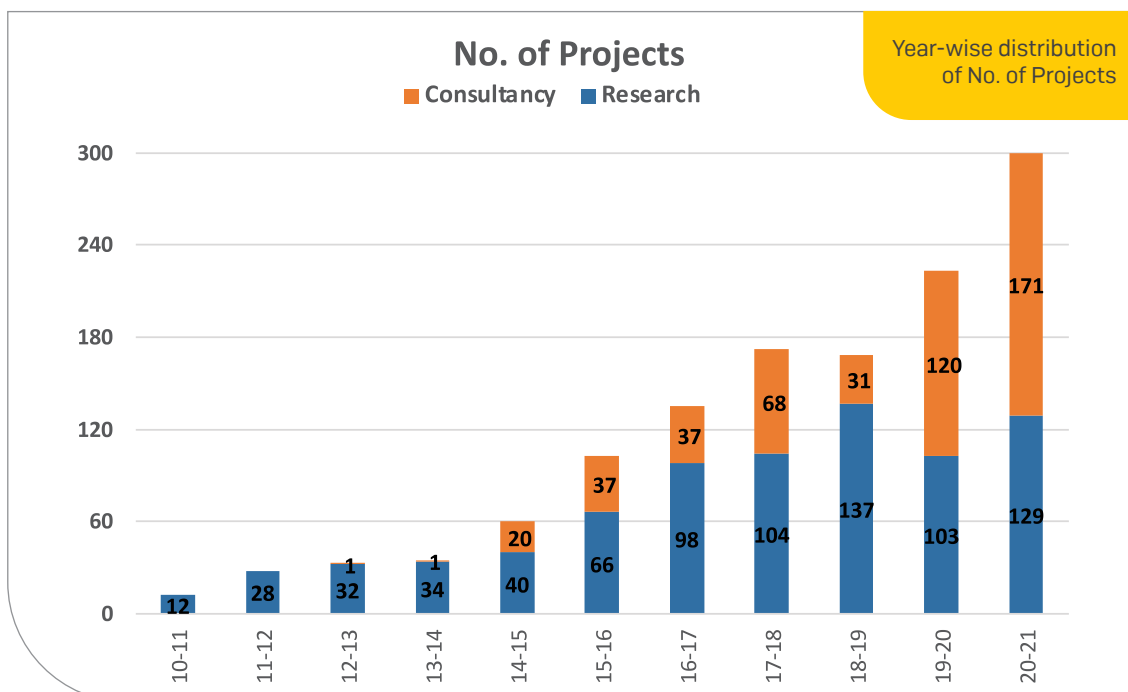
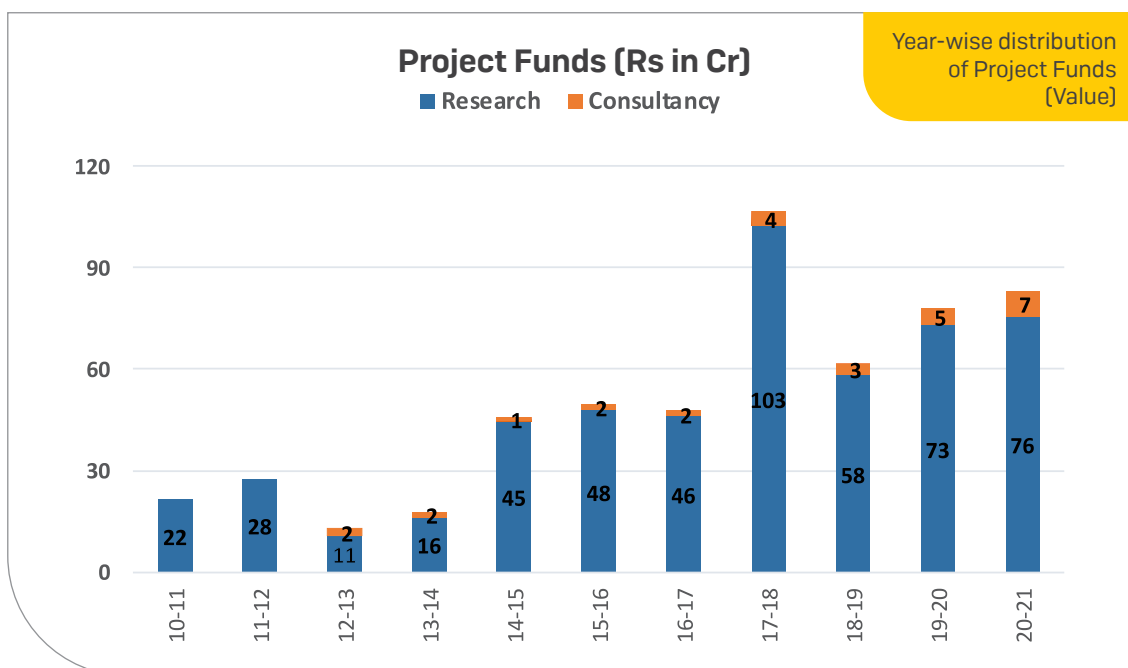


Anyone who has never made a mistake has never tried anything new.  
– Albert Einstein





# Research & Development



“What is now proved was once only imagined.” – William Blake



# Placement & Internship

## PLACEMENTS Key highlights for the year 2020-21

Number of Companies Registered: **184**

Total number of students: **601**

Number of Students Registered for Placements: **537**

Total Placement offers: **312**










Number of Companies hired: **96**

Highest Package: ₹ **60 LPA**

Average Package: ₹ **21 LPA**

Number of International offers: **31**

### Top 10 Companies (Package Offered)

- |                    |   |
|--------------------|---|
| 1. MTX             |    |
| 2. Yokogawa        |    |
| 3. Rakuten         |    |
| 4. Microsoft       |    |
| 5. TSMC            |    |
| 6. Accenture Japan |    |
| 7. NTT-AT          |    |
| 8. Alphonso Inc    |    |
| 9. Amazon          |   |
| 10. DG Takano      |  |

*In spite of the COVID pandemic, the Placement process for AY 2020-21 went smoothly.*

A good number of students from UG and PG opted for higher education in India and abroad. Mentioned below are the few universities opted by the students for higher education:

California Institute of Technology

Carnegie Mellon University

Columbia University

Georgetown University

Georgia Institute of Technology

Harvard Business School

New York University

Purdue University

University of Illinois

University of Pennsylvania

University of Texas

ISI

IISc Bangalore

IIT Delhi

IIT Madras

IIM Ahmedabad

IIT Bombay

Karlsruhe Institute of Technology

University of Minnesota Twin Cities

University of Munster

University of Southern California

## INTERNSHIPS Key highlights for the year 2020-21

Number of Companies Registered: **124**

Companies hired: **59**

Total Internship Offers: **218**

Summer Internship offers: **206**











Semester Internship offers: **12**

Highest monthly stipend: ₹ **2 Lakhs**

Average monthly stipend: ₹ **45,000/-**

Internship offers of 2019-20 converted to PPOs: **49**

### Top 10 Companies (Stipend Offered)

- |                  |  |
|------------------|--|
| 1. Adobe         |   |
| 2. Amazon        |   |
| 3. Arcesium      |   |
| 4. BNY Mellon    |   |
| 5. Goldman Sachs |   |
| 6. KLA Tencor    |   |
| 7. Microsoft     |   |
| 8. Oracle        |   |
| 9. Salesforce    |   |
| 10. Sprinklr     |  |

IT Hyderabad witnessed a significant increase in the no. of national and international internship offers for the AY 2020-21. A total of 218 offers were received from 59 companies, out of which 26 are international from 6 Japanese Companies. The participated companies are from diversified sectors such as IT, Financial Services, E-Commerce, Manufacturing, Construction, Healthcare Services, Auto Retails, R&D, etc.

IITH introduced for the first time in the AY 2020-21, a semester-long internship for its BTech students in their 6<sup>th</sup> Semester.

 The true purpose of education is to make minds not careers. – William Deresiewicz 

# TEQIP-KITE Center@IITH

The Technical Education Quality Improvement Programme (TEQIP) was conceptualized in 2003 by the Government of India and the World Bank jointly. The Knowledge Incubation in Technical education (KITE) Center was created in IIT Hyderabad in 2013 and since then IIT Hyderabad is actively participating in all TEQIP activities. The TEQIP (Phase III) is started in 2017 for three years of time and has been extended till end-September 2021 due to the global pandemic. As per MHRD-NPIU's statement, TEQIP-III is fully integrated with the twelfth five-year plan objectives for Technical Education as a key component for improving the quality of Engineering Education in existing institutions (around 200) with the Special Category Status (SCS) and support to strengthen few affiliated technical universities to improve their policy, academic, and management practices. The major objectives of TEQIP-III are to increase student participation in technical examinations, to increase enrolment of students from a traditionally disadvantaged group like SC/ST and Women, to increase the number of Trained Faculty, to increase the percentage of NBA accredited UG&PG programs, and to gain UGC autonomous status. TEQIP-III through IITs pledged for a combined Students, Staffs, Faculty, and Institutes development in Engineering Education through various activities like Workshops, Joint Research Projects, Internships, GATE sensitization for the Engineering Students and Lab development through staff training, minor civil works and purchase of equipment, furniture, books, and software. Handholding of these Institutes needing support is performed through mentoring them by IITs.

Despite the last Academic Year (2020-21) as a global pandemic year, the TEQIP-KITE center has successfully carried out the maximum number of Faculty-based Workshops and Students' Online Summer Internships ever performed in any earlier years. TEQIP-KITE Center of IIT Hyderabad has carried out 14 Online Faculty-oriented Workshops engaging 133 Faculty participants from all parts of India, performing 1055 Faculty Days of Training and a 30-day Online Summer Internship program provided to 102 Students from different parts of India with 3,060 Student Days of Internship.

TEQIP-KITE Centre of IIT Hyderabad would like to thank from the heart the two of its hardworking Staff Members, Ms. Imrana Begum, and Mr. B. Nagaraju, who finished with their TEQIP jobs in March 2021. Without their sincere efforts, it would not have been possible to perform any of the TEQIP activities successfully. Currently, the TEQIP activities are seen over by Ms. P. Priyanka (Executive Assistant, Center for Continued Education Office).

**TEQIP-KITE CENTRE ACTIVITIES** *April 2020-March 2021*

| S. No.                    | Program Title   | Program held on                           | Course Coordinator                           | No. of participants Attended | No. of faculty days | No. of Student days |
|---------------------------|---|---|--|------------------------------|---------------------|---------------------|
| 1                         | Student Summer Internship   | June 1 - 30, 2020                         | Prof. Suhash R. Dey                          | 102                          | -                   | 3060                |
| 2                         | Analog IC design using free Software Tools  | October 2nd - 6th, 2020                   | Dr Abhishek Kumar                            | 21                           | 105                 | -                   |
| 3                         | Advanced Pedagogies: Active Learning & Digital Tools                                | October, 5th - 09th 2020                  | Dr Abhinav Kumar                             | 40                           | 200                 | -                   |
| 4                         | The aid of Demo Experiments in Teaching Solid Mechanics                             | October 26th - 30th, 2020                 | Dr Ramji M.                                  | 20                           | 100                 | -                   |
| 5                         | Magnetic Materials for MEMS-based Devices   | October 29 - November 1, 2020             | Dr Arabinda Halder                           | 12                           | 48                  | -                   |
| 6                         | Matrix Analysis using Python  | November 3rd - 08th, 2020                 | Dr G. V. V. Sharma                           | 12                           | 60                  | -                   |
| 7                         | Visual Tools and Techniques for Effective Communication                             | November 16th - 18th, 2020                | Dr Mohammad Shahid                           | 16                           | 48                  | -                   |
| 8                         | Probability using Python  | November 17th - 22nd, 2020                | Dr G. V. V. Sharma                           | 7                            | 35                  | -                   |
| 9                         | Active Learning and Digital Pedagogy for Chemical Science and Engineering Education | November 20th - 22nd, 2020                | Dr Sharada D.S.                              | 7                            | 21                  | -                   |
| 10                        | Advanced Algorithms   | November 28, 29, December 5, 6 & 12, 2020 | Dr Subramanyam Kalyanasundaram               | 13                           | 65                  | -                   |
| 11                        | 3D Printing & Design  | 28 Nov - 2 December 2020                  | Dr Prasad Onkar                              | 37                           | 155                 | -                   |
| 12                        | Teaching Effectiveness  | December 07-09, 2020                      | Dr Mudrika Khandelwal<br>Dr Ranjit Ramadurai | 12                           | 60                  | -                   |
| 13                        | Advanced Pedagogies: Active Learning & Digital Tools                                | December 14-18, 2020                      | Dr Abhinav Kumar                             | 16                           | 80                  | -                   |
| 14                        | Internet-of-Things_Industry, Academia, and Start-ups                                | December 21-23, 2020                      | Dr Abhinav Kumar                             | 16                           | 48                  | -                   |
| 15                        | Cleaner Technologies for Sustainable Environment                                    | December 21-25, 2021                      | Dr Ambika S.                                 | 6                            | 30                  | -                   |
| <b>Total Participants</b> |   |   |  | <b>235</b>                   | <b>1055</b>         | <b>3060</b>         |

**T**LC activities of IITH are mainly focused on faculty development programs (FDPs) aiming at advanced pedagogy and teaching effectiveness. TLC-IITH conducted a four-day workshop on Teaching effectiveness including advanced pedagogy techniques. The topics discussed in the workshop include academic integrity, best practices for online teaching, information and communication technologies (ICT) for teaching, active learning instruction strategies (ALIS), merits and demerits of online education, methods and practices for laboratory courses in virtual mode, etc. Faculty participants from various geographic locations including, Jammu, Odisha, Chattisgarh, Maharashtra, Tamil Nadu, Andhra Pradesh, Karnataka, and Uttar Pradesh actively participated in the workshop. In addition to the faculty development program for other colleges and institutions around the country, TLC also organized a one-day event on “Teaching Effectiveness and Instruction Strategies (TEIS)” for both the newly joined faculty of IIT Hyderabad and outsiders.

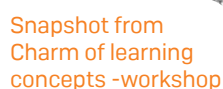
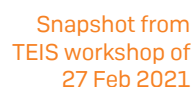
“Teaching Effectiveness and Instruction Strategies (TEIS)”: TEIS was the first among the series of workshops under this theme and was inaugurated by Prof. B.S. Murty, the director of IITH. Renowned educational researchers and faculty like Prof. Sahana Murthy from IIT Bombay and Prof. Pratap Haridoss from IIT Madras were among the invited speakers. The workshop also had a group discussion among the IITH faculty on various challenges and opportunities of online teaching, including a way forward discussion. Participants from outside IIT Hyderabad were also part of the workshop and benefited from the program.

“Charm of Learning Concepts”: TLC-IITH also began a new workshop series under the theme of “Charm of Learning Concepts” aiming at mainly senior secondary and higher secondary school students. The workshop was mainly focused on the importance and joy of learning concepts for school children. Demonstrations and interactive virtual experiments were part of the content of the workshop. The workshop was conducted free of cost for government and government-aided school participants. The workshop involved invited speakers from IIT Bombay and the faculty of IIT Hyderabad. More than 150 students registered for the workshop with more than 50% of them from government and government-aided schools. The students were enthusiastic and have already requested more workshops of this kind in their feedback. Thus TLC-IITH is aiming to explore various fronts in which it can be involved and is also aiming at the creation of innovative content that could be used for pedagogy.

TLC-IITH conducted a four-day workshop on Teaching effectiveness including advanced pedagogy techniques - This was between 6 - 9 Dec 2020



The charm of Learning Concepts”: TLC-IITH also began a new workshop series under the theme of “Charm of Learning Concepts” - 10th July 2021



"

## DRDO@IITH

An MOU has been signed between the HQs, DRDO, and the Director, IITH on 3 July 2020 and established the DRDO-IIT Hyderabad research cell at the IIT Hyderabad campus. This Cell is an extension wing of the Research and Innovation Centre Chennai which is a self-accounting unit of DRDO. The vision of this cell is to emerge as a center of excellence in conducting scientific and applied research in directed areas of advanced technologies for defense and achieve recognition as one of the best research centers in the world. The objective of this cell is to facilitate collaborative efforts in the areas that are of interest to DRDO. This cell will work as an enabler to tap the knowledge of the collaborative directed basic research and multi-institute collaborative research in the basic and applied areas of engaging faculty and researchers at the academic institutions and technology centers and other renowned institutes in India through defined research programs and activities. An interactive engagement model will be adopted to facilitate the research community for sharing knowledge for developing technologies for emerging and future needs of defense and security. Currently, the thrust areas of this cell are the following - Advanced materials and processing, sensors, Hardware and Softwares of Artificial Intelligence-based missile applications, Technology for space applications, Adaptive optics and Image processing, UAVs, and Quantum Computing to name a few. In the last financial year (FY 20-21), a total of 13 projects in these related areas were approved with a budget of 19 Crores INR and as of date 12 got sanctioned and work has commenced in collaboration with various DRDO Laboratories in India.

Snapshots from  
DRDO – IITH MoU  
Signing Ceremony



The difference between try and triumph is a little umph. – Marvin Phillips



# Rural Development Centre (RDC)

**R**ural Development Centre (RDC) at IIT Hyderabad was established in July 2020 with a vision to support rural development initiatives of the Government through innovative technologies being developed at IIT Hyderabad with Prof Prem Pal as Chair, RDC. The main objectives of RDC are as follows:

- To identify the problems and needs of the rural people through direct interaction or with the help of reputed institutions/organizations/NGOs working for rural sectors.
- To strengthen the UBA activities conducted in the villages adopted by IITH.
- To help the NSS team to conduct activities in nearby villages.
- To facilitate the faculty/staff/students who are passionate to develop technologies to be used in the field such as agriculture, sanitation, drinking water, etc. in rural areas.
- To collaborate with institutions/industries interested to contribute meaningfully to the development of the rural sector.
- To organize training/workshops on skills development to educate the villagers.
- To spread awareness among rural people about the importance of hygiene and cleanliness.
- To develop an academic framework for working on societal problems, their solution, and delivery.
- To involve and motivate the students to work for the welfare of society.

Institute granted 5 rural development projects in FY 2020-21 to develop kits/products for rural areas:

- Kitchen/Poultry waste for defluoridation of drinking water
- Utilization of waste corn cobs for the production of furfural.
- Improving Personal Health and Hygiene in Rural Schools through Interactive Installation
- IoT enabled an aquaculture monitoring system to assist the farmers.
- Development of a generic low-cost device for detection of heavy metals in groundwater sources.

Fluoride in drinking water is not good when its concentration exceeds 1.5 ppm. The groundwater in many parts of Telangana State has F-values higher than 6 ppm. Hence the development of low-cost adsorbents for defluoridation of drinking water is required. Kitchen/Poultry waste i.e., the eggshells, which are rich in Calcium carbonate, will be used for defluoridation of drinking water. A series of physical/chemical treatments will be proposed to develop the adsorbent for F-removal. The final objective is to develop a cartridge made up of activated carbon [which we have prepared and kept ready] and Calcium based adsorbent [started] for the removal of hardness and Fluoride.

Corn cobs are the abundant agricultural waste in India, especially in the united Andhra Pradesh and Karnataka. These agricultural wastes will be utilized to produce various value-added chemicals, such as furfural and 5-hydroxymethyl furfural. The successful implementation of this project will boost the economics of the people in rural areas by creating job opportunities.

IITH has adopted 5 villages under Unnat Bharat Abhiyan (UBA) program. In FY 2020-21, two more new villages viz. Kandi and Mamidapally are adopted by IITH. The UBA team organized several awareness programs for the Covid-19 pandemic and provided food packets to the needy people in the villages adopted under the UBA program. The UBA team conducted Gram Sabhas in the adopted villages as part of Republic Day activities. In addition, a sensitization workshop was conducted in the schools located at the adopted villages about National Education Policy 2020.

One of the Projects awarded under the Rural Development Centre is related to the *development of personal health and hygiene practices in rural school children*. The essence of the theme—hygiene—is such that it is better to learn through personal practice and application than through theoretical understanding. Designers, hygienists, healthcare workers, and educators have launched several successful projects



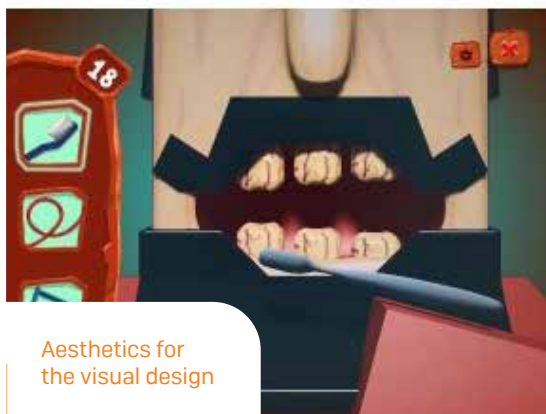
that effectively teach hygiene habits and their needs for different age groups. Games and environmental simulations provide a safe way to experience real-life situations—game skills due to the safety of space, cost-effectiveness, and time efficiency through roles. In this project, it is intended to develop an interactive kiosk-based game for rural children to enhance their hygiene practices, specifically in this case, dental hygiene.

To estimate the role of digital games, a survey was conducted with the school children in the adopted schools. All the COVID-19 protocols were followed in the process. It was observed that many school children play mobile-based games of different genres. It was also observed that Dental hygiene is one of the personal health issues which does not have any systemic interventions in school education. Thus, to facilitate this, a smartphone-based game was developed to enhance the dental hygiene practice of rural children. The aesthetics for the visual design were also derived from this survey. Some of the screens are shown in the figures below.



Don't decrease the goal. Increase the effort. – Tom Coleman





Aesthetics for  
the visual design

Doing the best at this moment puts you in the best place for the next moment.  
– Oprah Winfrey



# Incubators @ IITH

## FabCI@IITH Activities of FabCI: FY 2020-21

### 1. Cadence Live Virtual Booth 2020

FabCI had a virtual booth for the Cadence live event. We presented our current activities and our Incubator benefits through the virtual booth we had.

### 2. Chip-IN Bootcamp

Date: Dec 12 was the launch date  
A virtual Bootcamp for Idea stage chip design aspirants. It was a one-week program. Following were the topics for the session:

- Idea validation & execution
- Business plan & pitch
- Revision of presentation
- Final Demo

60 candidates registered, and we selected 8 eligible candidates for the program.



### 3. Launched Semiconductor startup Incubation & Acceleration program

NXP India Semiconductors & MEITY are the partners for the program. We got 35 applications and shortlisted 11 startups for the 2 weeks virtual Bootcamp.



### 4. Partnerships

We are in talks with multiple partners to assist startups with discounted/free benefits from their potential partners.

Following are the partnerships in the pipeline:

- Mathworks
- Photonics Valley & Telangana Govt.
- MEDs technologies
- Tessolve
- Seimens
- AWS



## 5. Startups

We have 10 startups, and 6 startups are in the final stage of onboarding:

.....

- Silizium circuits
- Green PMU
- SemiIT Solutions
- NetraSemi
- Si-Hive
- TyreIQ

## 6. Startup success story:

FabCI startup Wisig launched India's first 5G SoC to drive NB-IoT applications.



## iTIC INCUBATOR@IITH

*iTIC is the Incubation unit of IITH for supporting the startup activities.*

All Deep tech domains are supported by iTIC, with some of the prominent domains being Healthcare, AI/ML, Quantum Computing, AR/VR, Cybersecurity, Robotics, IOT, Industry 4.0, Blockchain, Electronics, Advanced materials, Drones, Biotechnology, etc.

iTIC provides support to startups such as Mentoring, Financial Aid, IP Support, Networking, and access to Dedicated office/Coworking space, Softwares, IITH Technological Infrastructure, and Makerlab.



Surpassing my achievements feels incredible; I want to replicate that again and again. – Katherine Reutter-Adamek



Under the umbrella of iTIC, during 2020-21, various grants and programs support entrepreneurs in sector-specific areas, like

- Program for autonomous Navigation and UAVs supported by TiHAN
- NICE for sector agnostic Deep tech innovations
- IDEX DIO for Defense applications
- MeitY TIDE 2.0 for IT product-related innovations
- Nidhi PRAYAS for Hardware-based ideas
- BEL Seed Fund for Video Analytics applications
- AISEA for Social Impact based tech innovations

### Impact by iTIC

The primary objective of iTIC is to nurture entrepreneurial aspirations and help them become successful business entities. Despite the pandemic, 2020-21 saw a two-fold increase in the number of startups and the funding sanctioned to them. The impact on job creation and revenue generation by the startups has also been significant. This has been made possible by the sustained efforts of the startups to convert the pandemic challenges into opportunities and by the policy promotion of startups in the Atmanirbhar Bharat framework.

| Tenure  | Total Startups supported | Total funds sanctioned to startups | Total revenues generated by startups | Total jobs created by startups | Mentors associated |
|---------|--------------------------|------------------------------------|--------------------------------------|--------------------------------|--------------------|
| 2015-21 | > 70                     | > INR 5 Cr                         | > INR 100 Cr                         | >800                           | > 150 (Globally)   |
| 2020-21 | 54                       | > INR 2.5 Cr                       | > INR 60 Cr                          | >500                           | >120 onboarded     |

### AISEA [Accelerator Program]

In 2020-21, iTIC organized its first accelerator program AISEA in collaboration with Action For India [AFI]. AFI iTIC Social Entrepreneurship Accelerator [AISEA] conducted two cohorts of 4 months each, with 15 startups graduating in Cohort 1 and 14 startups graduating in Cohort 2. The engaged startups received mentorship from domain experts & serial entrepreneurs, global connections, investor connects, on-demand mentoring, ecosystem connects with government, policymakers, customers, researchers, thought leaders, etc., and partnership opportunities which helped them save time and efforts from making costly mistakes in their ventures and helped catapult their startups to the next level. The focus areas of the first and second cohorts were (a) Health-tech, Edu-tech & Agri-tech, and (b) Health-tech respectively.

### Few numbers of AISEA

| Startups accelerated | Mentors associated | Connections established | Mentoring hours | Investment raised | Increment in revenue |
|----------------------|--------------------|-------------------------|-----------------|-------------------|----------------------|
| 29                   | 116                | >350                    | >400            | >INR 40cr         | >3x                  |



## Center for Healthcare Entrepreneurship, IIT Hyderabad

### 1. Total number of fellows selected

For Batch 1 (Jan 2020) 8 fellows were selected out of which 4 have successfully completed the program. For the second Batch (September 2020) 18 fellows joined the program and 17 are currently in the process of prototyping their innovation as six different teams.

### 2. Diversity: professional, institutional, geographic

Selected fellows had previously attended Institutions like the All India Institute Of Medical Sciences, M. S. Ramaiah Medical College, Rajiv Gandhi University of Health Sciences, IIT Guwahati, NIT Raipur, NIT Calicut, IIM Ahmedabad, IIM Udaipur, University of London, CUSAT, to name a few. They were from different states of the country bringing cultural diversity to the program.

### 3. Digital platform for engagement

Moodle, a popular Learning Management system is being used to engage Fellows, both online and offline, in activities like medical device case studies, design thinking case studies, healthcare industry analysis. Timely formative and summative assessments could be performed and progress indicators could be shared with fellows, strengthening the quality of the program.

### 4. Grand pitch of 2020 batch

“Grand Pitch” of the fifth batch of the fellowship program of the Foundation for Center for Healthcare Entrepreneurship, IIT Hyderabad saw CfHEforaying into the domain of surgical healthcare devices. M/s InnovSurgical Pvt Ltd, founded by Mr. Rohit and Mr Vivek, is introducing a self-retaining retraction system that enables uniform retraction of the skin flap.

“Surgenie” by M/s. Megh, Thejas, and Vishnu is an “OT suite” that helps in preference list building, counting, restocking of supplies, pricing, and billing purposes and organizes the entire armamentarium within the reach of the surgery team with a uniquely compact design.

### 5. Companies in the process of incubation

**Company name:** InnovSurgical Pvt Ltd.

**Founders:** Dr G Rohith, Founder and CEO, G Vivek, Co-founder and CT

**Product Name:** SurgeGenie -An Intelligent Portable Operation Theatre Assistive Device

**Founders:** Dr Megh Mehta, Tejas Dhekane, Dr Vishnu Rajkumar

## 6. Awards for incubates:

1. Business Mint and Mercedes-Benz Silver Star India for recognizing our efforts and congratulate NeMo.Care on 7th Award ceremony of Nationwide Healthcare Conclave & Awards 2020.
2. Business Mint and Mercedes-Benz Silver Star India for recognizing our efforts and congratulate BeAblehealth on the 7th Award ceremony of Nationwide Healthcare Conclave & Awards 2020.
3. Team Aerobiosys: Adjudged as 2nd Runner in Tata Social Enterprise Challenge 2019-20 grand finale program organized on 4th January 2020 at the IIM Calcutta.
4. Heamachealth has received Healthcare Product Summit 2020. HealthCare Product Excellence Award. It's an honor to receive the award from Jayesh Ranjan, IAS, Secretary, Information Technology, Telangana-State. Minister for IT, Telangana Tamlisai Soundararajan
5. Heamachealth is extremely honored to receive the Top 5 startup award from Minister for IT, Telangana in BioAsia: The Global Biobusiness Forum.
6. VaccineonWheels organizes vaccination drives in selected cities across the country, with the support of local self-government.

## 7. Grants and funding: M/s JCB extending their CSR funding to CfHE for accelerating the ventilator design and development (A project of the incubate, M/s Aerobiosys)

Full Render



Usaid Render



*Team Aerobiosys: Adjudged as 2<sup>nd</sup> Runner in Tata Social Enterprise Challenge 2019-20 grand finale program organized on 4th January 2020 at the IIM Calcutta*



Flyer of FabCI startup Wisig that launched India's first 5G SoC to drive NB-IoT applications.



*Vaccine on Wheels* organizes vaccination drives in selected cities across the country, with the support of local self-government.



If it is important to you, you will find a way. If not, you'll find an excuse.  
– Josie Bisset





# IITH Technology Research Park

IITH Technology Research Park” is a Section 8 Company funded by the Ministry of Education (MoE, Govt. of India) and hosted by IIT Hyderabad, to the tune of Rs. 75 Crores towards capital expenses. The research park shall feature the latest facilities on par with world standards and strive to bring the academic and industry together. It provides the infrastructure and facilities for industry partners to co-locate Research and Development centers at Research Park. It is governed by a Board of distinguished academicians, faculty of IIT Hyderabad, and industry professionals, to inoculate the idea of innovative Entrepreneurship in collaboration with Research Development.



## Vision

To bring recognition for innovation, entrepreneurship & research excellence through industry-academia collaboration.



## Mission

- Establish a world-class innovation hub through industry-academia collaboration.
- Provide a strong and robust platform to foster innovations and entrepreneurship.

## Key highlights

- Building under construction of nearly 1.5 Lakhs square feet exclusively for Research Park and expended to be ready the beginning of 2022
- The expertise of around 250 Faculty
- 13 Departments
- 570 + Acres of Campus
- Mentoring Support
- Showcasing & Networking events
- Training Programs and Seminars

*\* TRP Building under Construction*





## Major Advantages @ IITH Technology Research Park

- Diversified Fields of Research
- Extensive Array of Faculty Expertise & Academic Researchers
- State-of-the-art Facilities
- Proximity to Industries



Currently, Plianto Technologies, Redpine Signals Inc., Qulabs Software India, Midwest Energy, Wisig Networks, Exawizards, and Vervesemi Microelectronics have established their R&D Centres in IITH TRP. A few other industries have expressed interest to open their R&D centers. Plianto Technologies and Wisig Networks are the startups that have graduated from the i-TIC Foundation IIT Hyderabad Technology Business Incubator.



In the Financial Year 2020-21, two companies namely Exawizards LLC & Midwest Energy who have focused interest in AI and EV Battery respectively have opened their R&D Centers. Due to COVID -19 pandemic, no events were held during the same period.



You can't use up creativity. The more you use, the more you have.  
– Maya Angelou



**T**iHAN Foundation is a Section 8 company founded under the DST NM-ICPS Technology Innovation Hub on Autonomous Navigation and Data Acquisition Systems (UAVs, ROVs, etc.) at IIT Hyderabad. The main focus of TiHAN is on the research, design, and development of Autonomous Navigation Technology for next-generation Smart Mobility Solutions. The primary focus includes Research & Technology Development, Industry Collaborations, Human resource & Skill development, Innovation Entrepreneurship & Start-up ecosystems, and International Collaborations. The broad application sectors of the hub include Autonomous Transportation Systems – Ground Vehicles, Aerial Vehicles, Surface Vehicles, Agriculture, Infrastructure, Surveillance, and Environmental.

## » Research & Technology development

TiHAN has identified 8 Core Research and workgroups as shown in Figure 1.



*Fig. 1 TiHAN Core Research Groups*

Around 41 faculty of IIT Hyderabad from different departments like Artificial Intelligence, Electrical Engineering, Computer Science Engineering, Civil Engineering, Mechanical & Aerospace Engineering, Mathematics and Design is part of TiHAN Foundation and is working in these core areas.

TiHAN is working on technology development for autonomous navigation in different modes of transport including ground, aerial, and surface vehicles.

In addition to these, around 14 publications in prominent journals and conferences have been published from the TiHAN fraternity till now, including 1 patent and 1 copyright.

## TiHAN Testbed on Autonomous Navigations (Aerial/Terrestrial)

TiHAN at IIT Hyderabad has taken up a magnanimous effort in building a unified and state-of-the-art testbed for the development of autonomous navigation technology for ground and aerial vehicles. Some of the facilities include – Proving Grounds, Test tracks/circuits for Autonomous Vehicles, Mechanical integration facilities like Hangers, Ground control stations, State of the art Simulation tools [SIL, MIL, HIL, VIL], Road Infra – Smart Poles, Intersections, Environment Emulators like Rainfall Simulators, V2X Communications, Drone Runways & Landing area, Control Test centers Fig. 3 and Fig. 4.

The Foundation stone for the TiHAN Testbed for Autonomous Navigations was laid on December 29, 2020, by Shri Ramesh Pokhriyal 'Nishank', Honorable Minister of Education, Govt. of India, in the presence of Shri Sanjay Dhotre, Honorable Minister of State for Education, Dr K R Murali Mohan, Mission Director, NMICPS, DST, Dr B.V.R Mohan Reddy, Chairman, BoG, IITH and Prof. B. S Murty, Director, IITH & TiHAN Foundations, as in Fig. 2



Fig. 2 TiHAN Testbed Foundation Stone Laying



Fig. 3. Hanger facility  
for UAV testing  
including control room



Fig. 4. Test-tracks for  
Autonomous Vehicles

**TiHAN** Testbed on Autonomous Navigations is envisaged to be the platform for collaborative research between academia, industry, and R&D labs in the area of Autonomous Navigations.

### » Human Resource & Skill development

TiHAN in collaboration with IIT Hyderabad has established a New Interdisciplinary 2 year M. Tech program on *Smart mobility* from Aug 2020. 17 students from different departments like Artificial Intelligence, Civil Engineering, Computer Science and Engineering, Design, Electrical Engineering, Mathematics, Mechanical, and Aerospace Engineering were admitted.

Also, 13 Doctoral fellows have joined from multiple departments including EE, CSE, CIVIL, AI, MAE, and are working in the area of Autonomous Navigation and Data Acquisition. 2 Post-Doctoral Fellows are working under TiHAN in this field. 8 staff members have been recruited to take care of the administrative works of TiHAN.

For enhancing the Autonomous Navigation Ecosystem in the country, TiHAN is on a mission to train eligible candidates to build a talent pool who can become researchers, entrepreneurs, corporate employees, etc. Keeping this in view, TiHAN has started skill development workshops for all the categories like students, working professionals, researchers, faculty, etc.

### » Research Collaborations with Industry, Academia, and R&D labs:

TiHAN has initiated research collaborations with various industries both at the national and international level like Suzuki Motor Corporation, Maruti, ANRA, ARAI, ALTRAN, and many more. Through these collaborations, the parties intend to enhance consultation and discussions for exploring business opportunities in the area of Autonomous Navigation. R&D collaborators from reputed institutions like IITs, IIITs, Government labs like CDAC, in the area of Autonomous Navigation have been identified through a call for proposals. With a synergistic industry and academic collaborations, the hub aims at realizing the utilization of autonomous navigation and data acquisition systems.

### » Innovation, Entrepreneurship & Start-up Ecosystem:

TiHAN Foundations, to promote Innovation and Entrepreneurship ecosystem in Autonomous Navigations, is launching various schemes like seed funding for Start-ups & Spin-off companies, GCC - Grand Challenges & Competitions, Promotion, and Acceleration of Young and Aspiring technology entrepreneurs (PRAYAS), CPS-Entrepreneur In Residence (EIR), Dedicated Innovation Accelerator (DIAL), CPS-Seed Support System (CPS- SSS). In this regard, TiHAN is collaborating with the i-TIC Technology Business Incubator of IIT Hyderabad.

# Centre for Continued Education

## Overview

The Centre for Continuing Education (CCE) aims to conduct training programs for students, academicians, and working professionals across the country. The young and energetic faculty of IIT Hyderabad is dedicated towards providing learning opportunities for the professional growth of interested participants. With a rapid rise in E-learning programs, CCE @ IIT Hyderabad is keeping abreast with the online programs that can facilitate learning of working professionals by meeting their work schedules.

## Scope and functions

- To conduct all academic outreach activities like Conferences, Workshops, Certificate Courses, Symposia, Short-term courses, Training programs, and other similar activities of the Institute under the umbrella of the CCE.
- To organize teacher training programs for faculty of engineering colleges.
- To provide necessary logistics, and administrative support to run such programs.
- To evolve a mechanism for self-sustainability in the future.

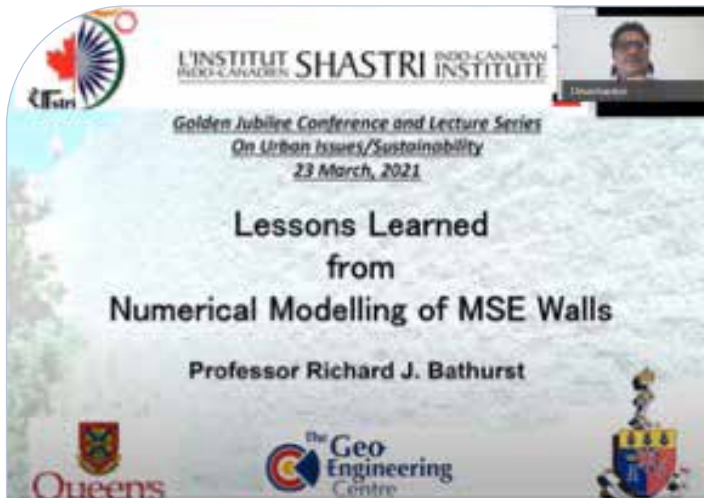
***CCE Activities - April 2020-March 2021 (TLC, TEQIP, and GIAN activities also comes under CCE from October 2020)***

| S. No. | Program Title  | Program held on | Course Coordinator | No. of participants Attended |
|--------|--|-----------------|--------------------|------------------------------|
| 1      | Golden Jubilee Conference and Lecture Series Grant- Indo Canadian Conference | 23-03-2021      | Prof B Umashankar  | 200                          |

## Golden Jubilee Conference and Lecture Series Grant- Indo Canadian Conference

The proposed Lecture on 'Lessons learned from numerical modeling of MSE walls' by Prof Richard Bathurst was conducted. The inaugural session was attended by Mrs Prachi Kaul, Director, SICI, and the speaker was introduced by Prof B Umashankar. The speaker had a detailed overview on the numerical modeling of MSE structures based on his research work conducted over the last few decades. Finally, the event was concluded with a discussion session with questions from the participants being answered by the speaker.





Screenshot with the coordinator, **Prof B Umashankar**, introducing the speaker



Screenshot with the speaker, **Prof Richard Bathurst**, during the talk

This invited lecture from a very distinguished scholar, Prof Richard Bathurst, was aimed at presenting his learnings from research on Mechanically stabilized earth (MSE) walls. This talk was very well received by participants that included research scholars, academia, and practicing engineers working in this area.

### Contact Information

**Center for Continued Education, IIT Hyderabad**

Academic Block C, Office No. 422

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Email: [office.cce@iith.ac.in](mailto:office.cce@iith.ac.in)

### Our Team

Prof. B Umashankar  
**Chair, CCE**

Ms. P Priyanka  
**Executive Assistant, CCE Staff**

Mr. Rajasekhar, **CCE Attendant**



# Celebrations

## Celebrations/National Events



International Yoga Day



Independence Day

*IIT Hyderabad celebrated 74<sup>th</sup> Independence Day. Event is being broadcasted live with minimum possible gathering in view of COVID-19.*



### Gandhi Jayanthi

*NSS Club, IIT Hyderabad & IIIT Raichur pay tribute to a great leader, the Father Of The Nation, Symbol of Peace 'Shri Mahatma Gandhi'; on his 150<sup>th</sup> Birth Anniversary.*



### Vigilance Awareness Week

*IIT Hyderabad & IIIT Raichur observed Vigilance Awareness Week 2020 on 27 Oct 2020. Integrity Pledge has been taken by Faculty, Staff & Students in Person & Virtual Mode.*



You can never be overdressed or overeducated. – Oscar Wilde







## Republic Day

*Social Distancing and Mask up, IIT Hyderabad and IIIT Raichur celebrated 72<sup>nd</sup> Republic Day in new normal with flag hosting followed by Cultural events.*



## Rashtirya Ekta Diwas

*IIT Hyderabad & IIIT Raichur observed Rashtirya Ekta Diwas 2020 with a Pledge taken by faculty and staff.*



## International Women's Day

*For better networking & well-being of Women & Children at IIT Hyderabad, a women association had an inaugural event on International Women's Day. Smt. Sujata has taken over as 1<sup>st</sup> President of the Association & delivered the presidential address.*



**You educate a man; you educate a man. You educate a woman; you educate a generation.” – Brigham Young**





# Departments



## »» Department of Biomedical Engineering

**D**epartment of Biomedical Engineering at IIT Hyderabad is a highly interdisciplinary department that is working on various aspects to address the grand healthcare challenges being faced by humanity. The department offers engaging and dynamic undergraduate, post-graduate and doctoral programs in various focus areas to invigorate passionate minds. We are a department with 10 faculty, 6 staff members, 16 Undergraduate, 16 Postgraduate, and 100+ PhD students. The department has 10 research labs, where high-quality research work is going on. Additionally, the department has 2 teaching labs to cater to the needs of undergraduate and postgraduate teaching. The research areas of the department are Biomedical Imaging, Biomicrofluidics, Biomechanics, Regenerative Medicine, Nano Medicine, Computational Neurosciences, Biofabrication, Neurotechnology, Neuroscience, Computational Systems Biology, and Ultrasound Imaging & Therapeutics.

The department started a BTech Program in Biomedical Engineering in 2020, which is the first among the IITs. This program started with the aim to fulfill the requirement of industry needs of a biomedical engineer having sound knowledge of both engineering and human biology. The department also streamlined the MTech Program into two major streams in 2020, namely, Medical Sensing, Analytics & Simulation (MedSAS) and Nanomedicine & Biomaterials (NBM) with the intention to train the student in the relevant area and to develop the skillset that will make them ready for the industry. The department also promotes MTech students to conduct high-class research so that they can take up research as their career option. The department secured 3 externally funded projects in the year 2020-21.

### Highlights

- ▶▶ Started BTech Program in Biomedical Engineering in July 2020 which is the first in IITs.
- ▶▶ 2 PhD students received the prestigious PMRF in 2020-21.
- ▶▶ Dr Jyostnendu Giri, started a spin-off, Keabiotech, and launched a range of sanitary products to fight COVID.
- ▶▶ Dr Mohan Raghavan and Dr Kousik Sarathy Sridharan developed a computational model for monitoring and predicting the ongoing COVID pandemic, the study was published in Nature Scientific Reports journal in 2020.

## Faculty



**Renu John**

PhD – IIT Delhi

**Professor & HoD**

*Research Areas:* Biomedical Optical Imaging; Quantitative Phase Microscopy; Biosensors



**Harikrishnan Narayanan Unni**

PhD – NTU, Singapore

**Associate Professor**

*Research Areas:* Lab on Chip Micro Fluidics and Nanofluidics; Biophysics; Biomechanics



**Subha Narayan Rath**

PhD – NUS, Singapore

**Associate Professor**

*Research Areas:* Biomimicking; 3D Bioprinting; Angiogenesis; Osteogenesis; Nature-Inspired Biomaterials; Decellularized Tissues; Organ-On-Chip; Cell Therapy Biosensors



**Falguni Pati**

PhD – IIT Kharagpur

**Associate Professor**

*Research Areas:* Biomaterials; Tissue Engineering; 3D Bioprinting; In Vitro Tissue / Organ Models



**Jyotsnendu Giri**

PhD – IIT Bombay

**Associate Professor**

*Research Areas:* Nanomedicine; Regenerative Medicine; Drug Delivery; Therapeutics and Diagnostics



**Aravind Kumar Rengan**

PhD – IIT Bombay

**Assistant Professor**

*Research Areas:* Nanomedicine; Bio-Nanotechnology; Photothermal Therapy; Nanotoxicology; Cancer Theranostics



**Kousik Sarathy Sridharan**

PhD – Aarhus University

**Assistant Professor**

*Research Areas:* Neuromodulation; Neuroimaging; Intra-operative Neuromonitoring; Healthcare Data Analytics



**Mohammed Suhail Rizvi**

PhD – IIT Kanpur

**Assistant Professor**

*Research Areas:* Biomechanics; Biophysics; Systems Biology



**Mohan Raghavan**

PhD – IISC Bangalore

**Assistant Professor**

*Research Areas:*  
Computational Neuroscience;  
Motor System; Spinal Cord;  
Bionics; Assistive Devices;  
Rehabilitation



**Avinash Eranki**

PhD – Utrecht University

**Assistant Professor**

*Research Areas:* Therapeutic  
Ultrasound (HIFU/FUS), Diagnostic  
Ultrasound, Ultrasound-based  
Drug Delivery, Acoustics, Cancer  
Therapy, Rehabilitation & Sports  
Medicine, Point-of-Care Ultrasound,  
Translational (Bench-to-Bedside)  
Device Development, Clinical Trials.



**Sikandar Shaik**

MBBS, DMRD DNB

**Adjunct Faculty**

*Research Areas:* CT; PET  
Affiliation: Dept. of Radiology,  
Yashoda Hospitals



**Ramana Vinjamuri**

PhD – Stevens Institute of  
Technology, New York

**Visiting Assistant Professor**

*Research Areas:* Brain-Machine  
Interface

### Patents Filed/Granted

1. Dr Jyotsnendu Giri, Protein-based hydrogel and process for preparing the same. Application No: 202041039188.
2. Dr Jyotsnendu Giri, An adhesive nanogel composition and method of preparation thereof. Application No: 202041055925.
3. Dr Jyotsnendu Giri, Instant nanogel composition and process of preparation thereof, Application No: 202041041760.
4. Mr Vijayasankar K N and Dr Falguni Pati, A footwear and a method of manufacturing thereof, Indian Patent Application no. 202041047879, filed on 3rd November 2020.
5. Mr Shibu Chameettachal and Dr Falguni Pati, Decellularized corneal matrix-based hydrogel, bioink formulation and methods thereof, USA Patent Application No. 16/981,957, filed on 16th September 2020.
4. Ramachandran, S., Strisciuglio, N., Vinekar, A., John, R., & Azzopardi, G. [2020]. U-COSFIRE filters for vessel tortuosity quantification with application to automated diagnosis of retinopathy of prematurity. *Neural Computing and Applications*, 32(16), 12453–12468. <https://doi.org/10.1007/s00521-019-04697-6>
5. Singh, N., Ali, M. A., Rai, P., Ghor, I., Sharma, A., Malhotra, B. D., & John, R. [2020]. Dual-modality microfluidic biosensor based on nanoengineered mesoporous graphene hydrogels. *Lab on a Chip*, 20(4), 760–777. <https://doi.org/10.1039/C9LC00751B>.
6. Ramachandran, S., Kochitty, S., Vinekar, A., & John, R. [2020]. A fully convolutional neural network approach for the localization of optic disc in retinopathy of prematurity diagnosis. *Journal of Intelligent & Fuzzy Systems*, 38(5), 6269–6278. <https://doi.org/10.3233/JIFS-179708>.

### Publications (Journal)

1. Ghor, I., Roy, D., John, R., & Chalavadi, K. M. [2020]. Echocardiogram Analysis Using Motion Profile Modeling. *IEEE Transactions on Medical Imaging*, 39(5), 1767–1774. <https://doi.org/10.1109/TMI.2019.2957290>.
2. Gurram, H. P. R., Galande, A. S., & John, R. [2020]. Nanometric depth phase imaging using low-cost on-chip lensless inline holographic microscopy. *Optical Engineering*, 59(10), 104105. <https://doi.org/10.1117/1.OE.59.10.104105>.
3. Gurram, H. P. R., Panta, P., Pandiyan, V. P., Ghor, I., & John, R. [2020]. Digital holographic microscopy for quantitative and label-free oral cytology evaluation. *Optical Engineering*, 59(2), 024105. <https://doi.org/10.1117/1.OE.59.2.024105>.
7. Bhatt, A., Sakai, K., Madhyastha, R., Murayama, M., Madhyastha, H., & Rath, S. N. [2020]. Biosynthesis and characterization of nano magnetic hydroxyapatite [nMHAp]: An accelerated approach using simulated body fluid for biomedical applications. *Ceramics International*, 46(17), 27866–27876. <https://doi.org/10.1016/j.ceramint.2020.07.285>
8. Kumari, N., Bhargava, A., & Rath, S. N. [2020]. T-type calcium channel antagonist, TTA-A2 exhibits anti-cancer properties in 3D spheroids of A549, a lung adenocarcinoma cell line. *Life Sciences*, 260, 118291. <https://doi.org/10.1016/j.lfs.2020.118291>.

9. Dhiman, N., Shagaghi, N., Bhawe, M., Sumer, H., Kingshott, P., & Rath, S. N. [2020]. Selective Cytotoxicity of a Novel Trp-Rich Peptide against Lung Tumor Spheroids Encapsulated inside a 3D Microfluidic Device. *Advanced Biosystems*, 4[4], 1900285. <https://doi.org/10.1002/adbi.201900285>
10. Kumari, N., Dalal, V., Kumar, P., & Rath, S. N. [2020]. Antagonistic interaction between TTA-A2 and paclitaxel for anti-cancer effects by complex formation with T-type calcium channel. *Journal of Biomolecular Structure and Dynamics*, 0[0], 1-12. <https://doi.org/10.1080/07391102.2020.1839558>.
11. Kasoju, A., Shahdeo, D., Khan, A. A., Shrikrishna, N. S., Mahari, S., Alanazi, A. M., Bhat, M. A., Giri, J., & Gandhi, S. [2020]. Fabrication of microfluidic device for Aflatoxin M1 detection in milk samples with specific aptamers. *Scientific Reports*, 10[1], 4627. <https://doi.org/10.1038/s41598-020-60926-2>.
12. Yadava, S. K., Basu, S. M., Valsalakumari, R., Chauhan, M., Singhanian, M., & Giri, J. [2020]. Curcumin-Loaded Nanostructure Hybrid Lipid Capsules for Co-eradication of Breast Cancer and Cancer Stem Cells with Enhanced Anticancer Efficacy. *ACS Applied Bio Materials*, 3[10], 6811-6822. <https://doi.org/10.1021/acsabm.0c00764>.
13. Yadava, S. K., Basu, S. M., Chauhan, M., Sharma, K., Pradhan, A., V., R., & Giri, J. [2020]. Low temperature, easy scaling up method for the development of smart nanostructure hybrid lipid capsules for drug delivery application. *Colloids and Surfaces B: Biointerfaces*, 190, 110927. <https://doi.org/10.1016/j.colsurfb.2020.110927>.
14. Polley, P., Gupta, S., Singh, R., Pradhan, A., Basu, S. M., V., R., Yadava, S. K., & Giri, J. [2020]. Protein-Sugar-Glass Nanoparticle Platform for the Development of Sustained-Release Protein Depots by Overcoming Protein Delivery Challenges. *Molecular Pharmaceutics*, 17[1], 284-300. <https://doi.org/10.1021/acs.molpharmaceut.9b01022>.
15. Szwed, M., Torgersen, M. L., Kumari, R. V., Yadava, S. K., Pust, S., Iversen, T. G., Skotland, T., Giri, J., & Sandvig, K. [2020]. Biological response and cytotoxicity induced by lipid nanocapsules. *Journal of Nanobiotechnology*, 18[1], 5. <https://doi.org/10.1186/s12951-019-0567-y>.
16. Raghavan, M., Sridharan, K. S., & Mandayam Rangayyan, Y. [2020]. Using epidemic simulators for monitoring an ongoing epidemic. *Scientific Reports*, 10[1], 16571. <https://doi.org/10.1038/s41598-020-73308-5>.
17. Revi, N., & Rengan, A. K. [2020]. Eugenol-Encapsulated Nanocarriers for Microglial Polarisation: A Promising Therapeutic Application for Neuroprotection. *BioNanoScience*, 10[4], 1010-1017. <https://doi.org/10.1007/s12668-020-00789-z>.
18. Appidi, T., Mudigunda, S. V., Kodandapani, S., & Rengan, A. K. [2020]. Development of a label-free gold nanoparticle-based rapid colorimetric assay for clinical/point-of-care screening of cervical cancer. *Nanoscale Advances*, 2[12], 5737-5745. <https://doi.org/10.1039/D0NA00686F>.
19. Das, P., Mudigunda, S. V., Darabdhara, G., Boruah, P. K., Ghar, S., Rengan, A. K., & Das, M. R. [2020]. Biocompatible functionalized AuPd bimetallic nanoparticles decorated on reduced graphene oxide sheets for photothermal therapy of targeted cancer cells. *Journal of Photochemistry and Photobiology*

- B: Biology, 212, 112028. <https://doi.org/10.1016/j.jphotobiol.2020.112028>.
20. Gunapu, D. V. S. K., Mudigunda, V. S., Das, A., Rengan, A. K., & Vanjari, S. R. K. [2020]. Facile synthesis and characterization of Poly [3, 4-ethylenedioxythiophene]/ Molybdenum disulfide (PEDOT/MoS<sub>2</sub>) composite coatings for potential neural electrode applications. *Journal of Applied Electrochemistry*, 50(9), 943–958. <https://doi.org/10.1007/s10800-020-01447-8>.
  21. Jogdand, A., Alvi, S. B., Rajalakshmi, P. S., & Rengan, A. K. [2020]. NIR-dye-based mucoadhesive nanosystem for photothermal therapy in breast cancer cells. *Journal of Photochemistry and Photobiology B: Biology*, 208, 111901. <https://doi.org/10.1016/j.jphotobiol.2020.111901>.
  22. Appidi, T., Pemmaraju, D. B., Khan, R. A., Alvi, S. B., Srivastava, R., Pal, M., Khan, N., & Rengan, A. K. [2020]. Light-triggered selective ROS-dependent autophagy by bioactive nanoliposomes for efficient cancer theranostics. *Nanoscale*, 12(3), 2028–2039. <https://doi.org/10.1039/C9NR05211A>.
  23. Ravichandran, G., Rengan, A.K [2020]. Aptamer-mediated nanotheranostics for cancer treatment: A review. *ACS Applied Nano Materials*, 2020, 3(10), pp. 9542–9559. <https://doi.org/10.1021/acsanm.0c01785>.
  24. Shyama Sasikumar, Shibu Chameettachal, Peter Kingshott, Brett Cromer, and Falguni Pati, 3D Hepatic Mimics – the need for a multicentric approach, *Biomedical Materials*, 15, 2020, 052002.
  25. Raghavan, M., Sridharan, K. S., & Mandayam Rangayyan, Y. [2020]. Using epidemic simulators for monitoring an ongoing epidemic. *Scientific Reports*, 10(1), 16571. <https://doi.org/10.1038/s41598-020-73308-5>.
  26. Rizvi, M. S., Peyla, P., Farutin, A., & Misbah, C. [2020]. Deformable microswimmer in an external force field. *Physical Review Fluids*, 5(3), 033101. <https://doi.org/10.1103/PhysRevFluids.5.033101>.
  27. Kumar, A., Rizvi, M. S., Athilingam, T., Parihar, S. S. & Sinha, P. [2020]. Heterophilic cell-cell adhesion of atypical cadherins Fat and Dachsous regulate epithelial cell size dynamics during *Drosophila* thorax morphogenesis. *Molecular Biology of the Cell*, 31(7), 546–560. <https://doi.org/10.1091/mbc.E19-08-0468>.
  28. Aoun, L., Farutin, A., Garcia-Seyda, N., Negre, P., Rizvi, M. S. et al. [2020]. Amoeboid Swimming Is Propelled by Molecular Paddling in Lymphocytes. *Biophysical Journal*, 119(6), 1157–1177. <https://doi.org/10.1016/j.bpj.2020.07.033>
  29. Lau LW, Eranki A, Celik H, Kim A, et al. [2020] Are Current Technical Exclusion Criteria for Clinical Trials of Magnetic Resonance–Guided High-Intensity Focused Ultrasound Too Restrictive? Early Experiences at a Pediatric Hospital. *Journal of Ultrasound in Medicine*. 2020 Sep;39(9):1849–55.
  30. Spiliopoulos M\*, Kuo CY\*, Eranki A\*, et al. [2020] Characterizing placental stiffness using ultrasound shear-wave elastography in healthy and preeclamptic pregnancies. *Archives of Gynecology and Obstetrics*. 2020 Nov;302(5):1103–12. [\* à Equal Contribution].

#### Publications (Conference)

1. Panta, P., Kumar, P., Sarode, S., & John, R. [2020]. A-scan spectral intensity profile in OCT as a potential imaging



- biomarker of oral precancerous and cancerous tissues. *Lasers in Dentistry* XXVI, 11217, 112170B. <https://doi.org/10.1117/12.2543949>.
2. Iyengar, R. S., & Raghavan, M. [2020]. MPI Parallelization of NEUROiD Models Using Docker Swarm. 2020 IEEE 26th International Conference on Parallel and Distributed Systems (ICPADS), 655–660. <https://doi.org/10.1109/ICPADS51040.2020.00092>.
  3. Prakash, S. C., Ganguly, S., Yadav, P. K., Raghavan, M., & Sridharan, K. S. [2020]. Evaluation of a gamified upper-arm bimanual trainer for stroke patients—A healthy cohort study. 2020 International Conference on Signal Processing and Communications (SPCOM), 1–5. <https://doi.org/10.1109/SPCOM50965.2020.9179602>.
  1. Mallampalli, K., Patel, S., Iyengar, R. S., Sridharan, K. S., & Raghavan, M. [2020]. Tool for image annotation based on gaze. 2020 International Conference on Signal Processing and Communications (SPCOM), 1–5. <https://doi.org/10.1109/SPCOM50965.2020.9179496>.
  2. Prakash, S. C., Ganguly, S., Yadav, P. K., Raghavan, M., & Sridharan, K. S. [2020]. Evaluation of a gamified upper-arm bimanual trainer for stroke patients—A healthy cohort study. 2020 International Conference on Signal Processing and Communications (SPCOM), 1–5. <https://doi.org/10.1109/SPCOM50965.2020.9179602>.
  3. Mallampalli, K., Patel, S., Iyengar, R. S., Sridharan, K. S., & Raghavan, M. [2020]. Tool for image annotation based on gaze. 2020 International Conference on Signal Processing and Communications (SPCOM), 1–5. <https://doi.org/10.1109/SPCOM50965.2020.9179496>.
  4. Eranki A, Ries A, Srinivasan P, et al. [2020] Immune sensitization and therapeutic impact of boiling histotripsy in refractory murine neuroblastoma. Focused Ultrasound Symposium, 2020.
  5. Eranki A, Ries A, Srinivasan P, et al. [2020] Temporal Dynamics of Intratumoral Immune Cell Infiltration Triggered by Boiling Histotripsy. Focused Ultrasound Symposium, 2020.
  6. Tydings C, Eranki A, Sharma KV, Kim A. [2020] High intensity focused ultrasound thermal ablation in combination with checkpoint inhibitors for the treatment of refractory murine neuroblastoma. Focused Ultrasound Symposium, 2020.

#### Funded Research Projects

1. Dr Jyotsnendu Giri, Rapid affordable, portable SARS-CoV-2 screening kit for resource-limited settings, SERB Jul 7, 2020, 14.42L.
2. Dr Kousik Sarathy Sridharan, SurgeoAssist-An indigenous neurosurgical assistance platform for safer spinal surgeries, BIRAC, Aug 4, 2020, 42.70L.
3. Dr Subha Narayan Rath, Bio-Inspired Nano-Hierarchical Architecture of Fabrication and Maturation of Spheroid-based Tendon-Ligament Tissues by Bio-3D Printer, Indo-JSPS CFP-2020, 2021, 12L.
4. Dr Jyotsnendu Giri, Injectable nanofibrous carriers at the next generation in situ biomimetic 3D-matrix for cartilage repair, SERB, Mar 22, 2021, 32.75L.
5. Dr Avinash Eranki, Non-invasive diagnosis of breast cancer using ultrasound-based liquid biopsy in a point-of-care setting, DST, Mar 24, 2021, 35.42L.

6. Dr Aravind Kumar Rengan, NIR Light Responsive Hybrid Cell Membrane Coated Nanosomes for Targeted Cancer Therapeutics, SERB, Mar 25, 2021, 42.49L.

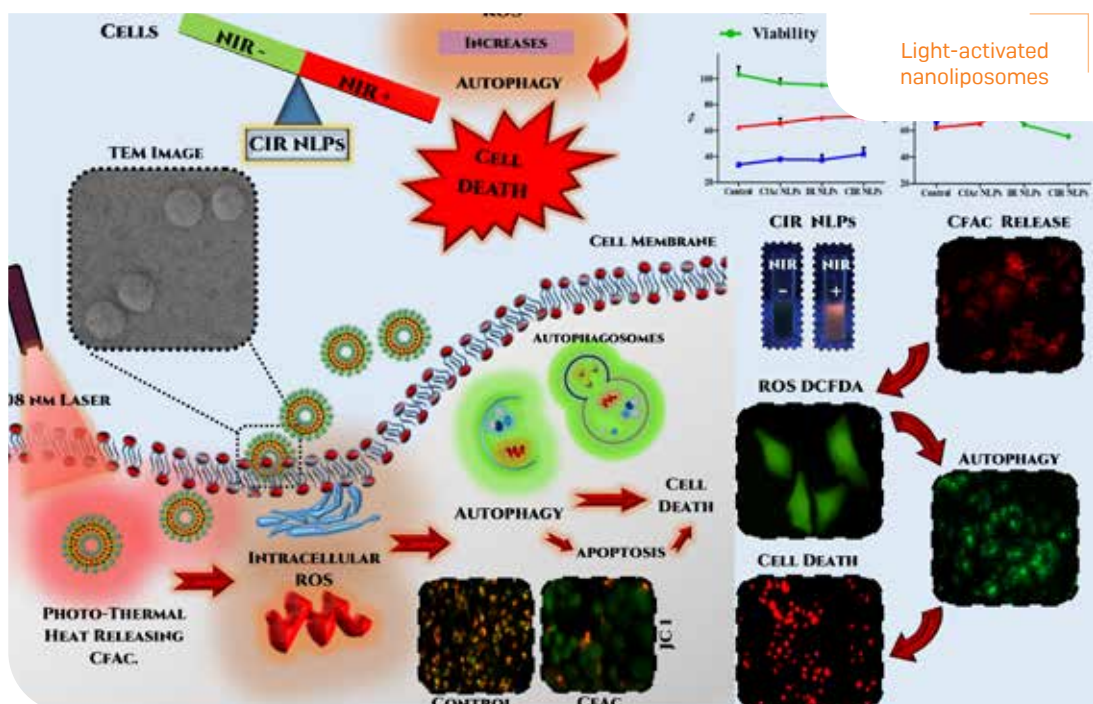
### Awards and Recognitions

1. Ms Ruby Singh, Ms Poulomi Polley, has been awarded Evonik "RESOMER" Award 2020 [Cash Prize of 1500 GBP] [Dr Jyotsnendu Giri].
2. Mr Soham Ghosh (PhD student) has been awarded PMRF [Dr Falguni Pati].
3. Ms Suranjita Ganguly – PhD student
4. Dr Avinash Eranki, Assistant Professor, has received the 2020 Bracco Imaging Distinguished Young Investigator Award
5. Dr Avinash Eranki, Assistant Professor, has been appointed Visiting Researcher at University Medical Center Utrecht, Netherlands (Jan 2021 - Dec 2024).
6. Dr Avinash Eranki, Assistant Professor, has been selected as an Active Member of the American Association for Cancer Research.

1. The development of "DuroKea Technology" has been adopted into the innovative long-lasting hygiene products, DuroKea S, DuroKea M, DuroKea H, and DuroKea H Aqua for common people.

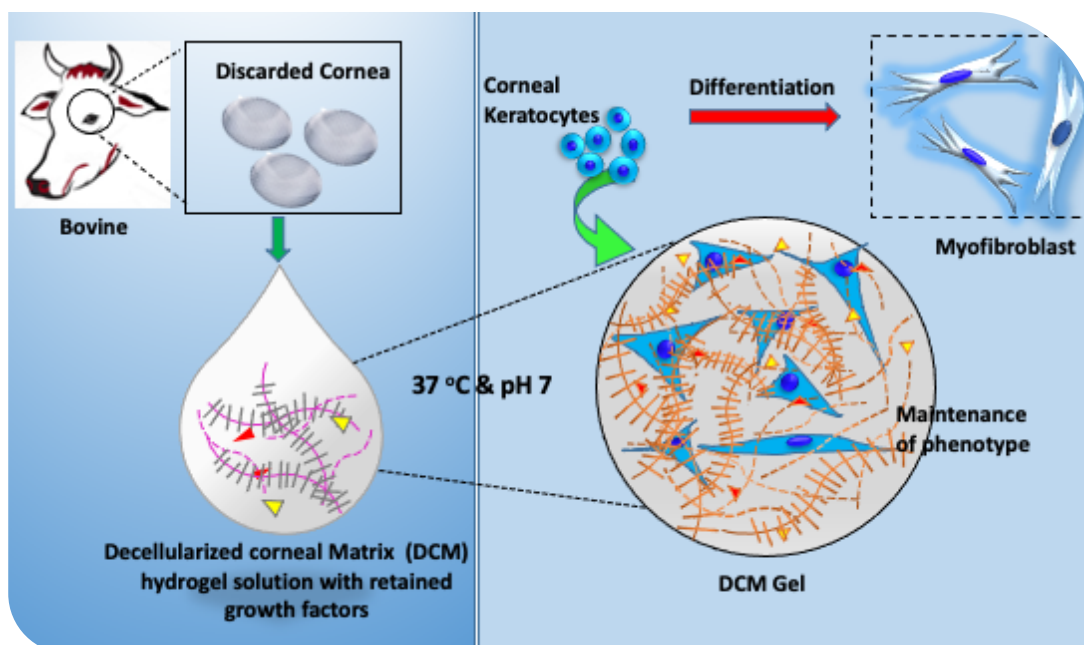


2. A high impact research work involving light-activated nanoliposomes were developed and tested for their in-vitro and in-vivo cancer theranostic efficacy- A.K Rengan et al. Nanoscale, 12(3), 2028–2039



3. We are working on several projects majorly based on 3D bioprinting concepts on developing artificial cornea, liver, esophagus, skin, trachea, and others. The primary step of this process is to develop a bio-ink, which is a printable formulation consisting of cells, matrix materials, and other necessary supplements for cell survival and function. We developed a novel process to prepare bio-ink from human and animal tissues/organs by throwing out the cells from these tissues and dissolving the acellular matrix or extracellular matrix (ECM) by an in-house developed protocol. The ECM bioink is then mixed with the cells (stem cells or primary cells) and used for printing a particular tissue construct by designing tissue-specific structure and architecture and employing a 3D bioprinter to reproduce that design. Depending upon the target tissue, the most relevant cell types are chosen for printing the structure, like for printing corneal stroma, we use corneal keratocytes and for printing liver, we use primary hepatocytes. The printed tissue constructs are then cultured in a cell-culture incubator for their further maturation. Upon maturation, the tissues will be used for implantation purposes. Furthermore, the printed tissues are also being used as in vitro models for drug toxicity screening.

Recently, we have developed decellularized cornea matrix (DCM) hydrogel from the cadaveric human cornea that is generally not qualified for transplantation and discarded. We have also prepared the hydrogel from discarded bovine corneas. The DCM hydrogel maintains corneal fibroblasts, keratocytes' morphology, and functions and prevents their differentiation towards myofibroblasts. This hydrogel has the potential to prevent scarring of the cornea following injury as it prevents myofibroblastic differentiation and fibrosis. The in vivo study on Rabbit is going on now in collaboration with LVPEI and CCMB to evaluate the potential of this hydrogel for several corneal indications.



*Decellularized cornea matrix (DCM) hydrogel was prepared from the discarded bovine cornea and characterized for its ability to support corneal tissue regeneration. The DCM hydrogel maintains corneal fibroblasts, keratocytes' morphology, and functions and prevents their differentiation towards myofibroblasts. This hydrogel has the potential to prevent scarring of the cornea following injury as it prevents myofibroblastic differentiation and fibrosis.*

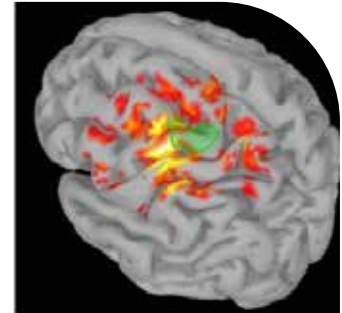
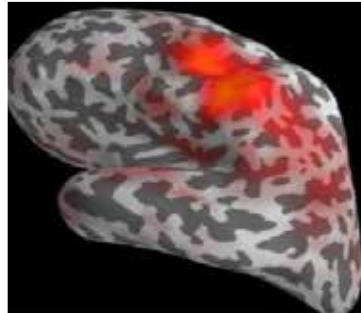
4. **Neuroimaging** – Using functional and anatomical information to diagnose, prognosticate and treat neurological disorders.

**Intra-operative neuromonitoring** – Monitoring the state of the central and peripheral nervous system to improve efficacy and safety of neuro-surgeries.

**Neuromodulation** – Deploying non-invasive stimulation techniques to modulate brain activity to treat, rehabilitate, and enhance treatment paradigms.



*Neuroimaging*



*Intra-operative neuromonitoring & Neuromodulation*

5. MURL is focused on the intersection of basic engineering, biology, and medicine, combined with clinical trials. Our lab is led by Dr Avinash Eranki, Assistant Professor within the [Department of Biomedical Engineering](#) at the Indian Institute of Technology, Hyderabad. He was also part of a team to first treat children with bone tumors. His recent work on therapeutic ultrasound and immunotherapy is currently being translated to a clinical trial to treat patients with Breast Cancer and Neuroblastoma.

MURL develops smart therapeutic & diagnostic ultrasound techniques for broad clinical themes including cancer, maternal/fetal, and musculoskeletal applications.

Our vision is to develop and translate medical ultrasound techniques and devices to the clinic, leading to improved patient care.



## »» Department of Biotechnology

The Department of Biotechnology at IITH is actively conducting research in cutting-edge areas of Biotechnology and Life science. The Department offers MTech and PhD programs. Currently, the department has 9 faculty members, 68 PhD and 19 MTech students. The department's research is focused on both applied and basic research, aiming to provide solutions for immediate use and generate future ideas. The ongoing research areas include Molecular Biophysics, Protein misfolding, Cell signaling, Structural Biology, DNA repair, DNA-protein interaction, RNA biology, Genomics, Transcriptomics, Chromosome dynamics, Circadian Rhythms, and Disease Biology. The department also received several extramural research funding. The Department has state-of-the-art infrastructure and research facilities that cover both theoretical and experimental aspects of all core research areas. Industry interaction and academic exchanges are integral characteristics of our department. The two years MTech (Medical Biotechnology) program was started in 2014 and the curriculum is designed to provide equal emphasis on both a strong theoretical foundation as well as developing research skills. The MTech program also provides a unique platform to pursue research in any of the areas mentioned above. The aim of our PhD program is to produce highly sought-after and knowledgeable scientists for pursuing careers in academia, industry, and government. The department also has plans to expand the program in related areas, including bioinformatics and computational biology, and Industrial Biotechnology.



A cell is regarded as the true biological atom. – Gorge Henry Lewes





## Faculty



**Thenmalarchelvi Rathinavelan**

PhD – University of Madras  
**Associate Professor & HoD**

*Research Areas:* Computational Biology; Biophysics; Biomolecular NMR



**Anindya Roy**

PhD – IISC Bangalore  
**Professor**

*Research Areas:* DNA Repair



**Basant Kumar Patel**

PhD – Banaras Hindu University  
**Associate Professor**

*Research Areas:* Protein Misfolding in Neurodegenerative Diseases



**N K Raghavendra**

PhD – IISC Bangalore  
**Associate Professor**

*Research Areas:* HIV-1 Biology



**Rajakumara Eerappa**

PhD – CCMB, Hyderabad  
**Associate Professor**

*Research Areas:* Epigenetics and DNA repair, Enzyme/protein engineering, Structural Biology, Computational Biology, X-ray crystallography



**Anamika Bhargava**

PhD – Innsbruck Medical University, Austria  
**Associate Professor**

*Research Areas:* Voltage-Gated Calcium Channels; Electrophysiology; Channelopathies; Imaging of Ion Channels; Zebra fish Animal Model; Cell signalling



**Ashish Misra**

PhD – IISc, Bangalore  
**Assistant Professor**

*Research Areas:* Genomics; Epitranscriptomics; Cancer; RNA Biology; Alternative Splicing



**Sandipan Ray**

PhD – IIT Bombay  
**Assistant Professor**

*Research Areas:* Circadian clocks and sleep; Infectious diseases; Quantitative proteomics; Mass spectrometry; Mechanism of drug action; Systems biology Metabolism; Post-translational modifications



**Gunjan Mehta**

PhD – IIT Bombay  
**Assistant Professor**

*Research Areas:* Chromosome Biology and Cell Division, Transcription Regulation, Single-Molecule Imaging and Fluorescence Microscopy, Epigenetic Transcription Memory/Mitotic Bookmarking, Developmental Disorders and Cancers

## Publications (Journal)

1. Girdhar, A., Bharathi, V., Tiwari, V. R., Abhishek, S., Deeksha, W., Mahawar, U. S., Raju, G., Singh, S. K., Prabusankar, G., Rajakumara, E., & Patel, B. K. [2020]. Computational Insights into the mechanism of AIM4-mediated inhibition of aggregation of TDP-43 protein implicated in ALS and evidence for in vitro inhibition of liquid-liquid phase separation (LLPS) of TDP-432C-A315T by AIM4. *International Journal of Biological Macromolecules*, 147, 117-130. <https://doi.org/10.1016/j.ijbiomac.2020.01.032>.
2. Anindya, R. [2020]. Single-stranded DNA damage: Protecting the single-stranded DNA from chemical attack. *DNA Repair*, 87, 102804. <https://doi.org/10.1016/j.dnarep.2020.102804>.
3. Patro, L. P. P., Sudhakar, K. U., & Rathinavelan, T. [2020]. K-PAM: A unified platform to distinguish Klebsiella species K- and O-antigen types, model antigen structures and identify hypervirulent strains. *Scientific Reports*, 10(1), 16732. <https://doi.org/10.1038/s41598-020-73360-1>.
4. Rajakumara, E., Satish, M., & Abhishek, S. [2020]. In vitro studies on non-canonical DNA binding specificities of KAP6 and HM01 and mechanistic insights into DNA bound and unbinding dynamics of KAP6. *International Journal of Biological Macromolecules*, 160, 925-933. <https://doi.org/10.1016/j.ijbiomac.2020.05.228>.
5. Akila, M., Earappa, R., & Qureshi, A. [2020]. Ambient concentration of airborne microbes and endotoxins in rural households of southern India. *Building and Environment*, 179, 106970. <https://doi.org/10.1016/j.buildenv.2020.106970>.
6. Kumari, N., Bhargava, A., & Rath, S. N. [2020] T-type calcium channel antagonist, TTA-A2 exhibits anti-cancer properties in 3D spheroids of A549, a lung adenocarcinoma cell line. *Life Sciences*, 260, 118291. <https://doi.org/10.1016/j.lfs.2020.118291>.
7. Pullaguri, N., Nema, S., Bhargava, Y., & Bhargava, A. [2020] Triclosan alters adult zebrafish behavior and targets acetylcholinesterase activity and expression. *Environmental Toxicology and Pharmacology*, 75, 103311. <https://doi.org/10.1016/j.etap.2019.103311>.
8. Giri, B., Saini, T., Kumbhakar, S., K, K. S., Muley, A., Misra, A., & Maji, S. [2020]. Near-IR light-induced photorelease of nitric oxide (NO) on ruthenium nitrosyl complexes: Formation, reactivity, and biological effects. *Dalton Transactions*, 49(31), 10772-10785. <https://doi.org/10.1039/D0DT01788D>.

## Funded Research Project - 2020-2021

1. Dr N K Raghavendra, Inhibition of the interaction between receptor binding domain of spike protein of SARS-CoV-2 and human ACE2 by protein mimic DNA, DBT, Mar 12, 2021, 6.00L.
2. Dr Rajakumara Eerappa, Structure-based design, and evaluation of inhibitors against phosphodiesterases for enhancing sperm motility and early embryo development and to reduce gamete and embryo toxicity, SERB, Mar 22, 2021, 41.4L.

### Workshops Conducted

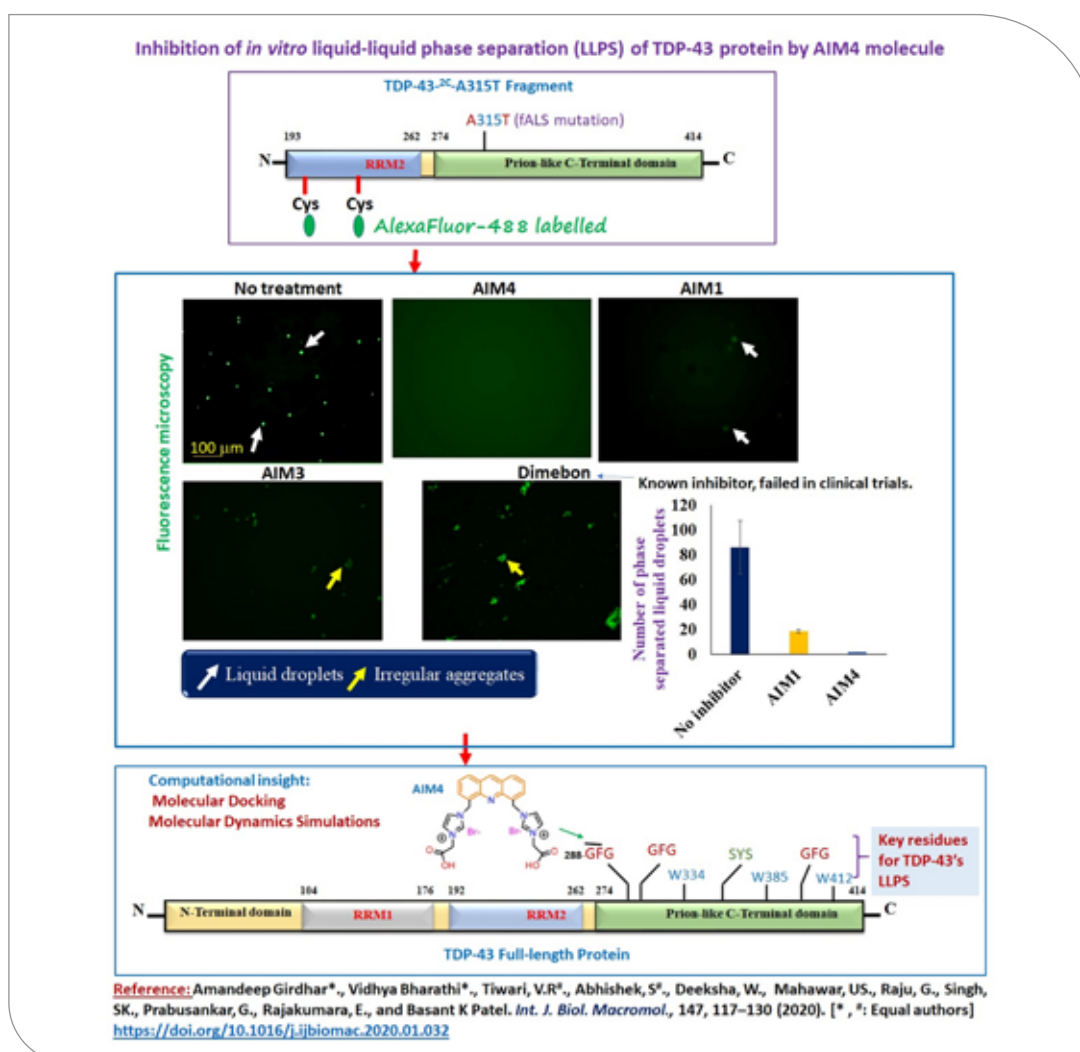
1. One day online workshop for demonstration of ZebraPace technique for students and faculty members of G. Pulla Reddy College of Pharmacy, on 24th March 2021.

### Awards and Recognitions

1. Mr Narasimha Pullaguri, received DST AWASAR Award, Feb 2021. (Dr Anamika Bhargava).
2. Dr Gunjan Mehta, Assistant Professor, has received Har-Govind Khorana Innovative Young Biotechnologist Award.
3. Dr Gunjan Mehta, Assistant Professor, has received Ramalingaswami Fellowship.

## 1. Inhibition of *in vitro* liquid-liquid phase separation (LLPS) of TDP-43 protein by AIM4

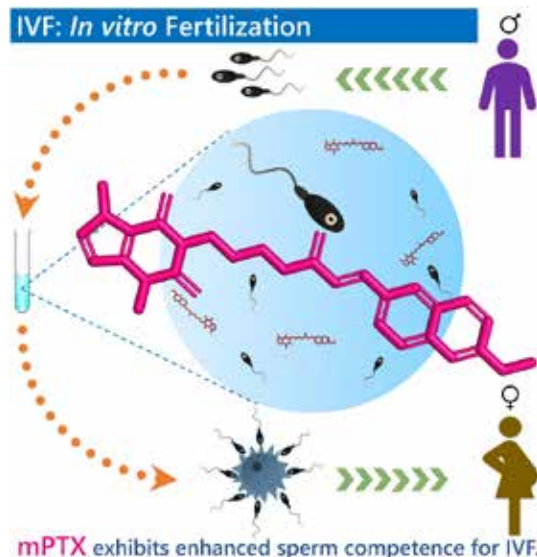
TDP-43 is a versatile RNA/DNA-binding protein and the dyshomeostasis of its structure-function is implicated in the pathogenesis of TDP-43 proteinopathies like ALS disease. Its cytoplasmic mislocalization, liquid-liquid phase separation (LLPS), and aggregation can cause cytotoxicity leading to the TDP-43 proteinopathies. Targeting of the TDP-43 proteinopathies is yet an unmet goal thus, multi-faceted strategies such as reducing the oxidative stress and inhibiting the TDP-43's aggregation, are being actively pursued. We have identified an acridine derivative, AIM4, which shows potential for inhibiting the TDP-43 aggregation *in vitro*. We find that AIM4 can also inhibit the *in vitro* LLPS of TDP-43 whereas other molecules, AIM1 and AIM3, which contain the same structural backbone but different functional groups cannot. Using molecular docking and molecular dynamics simulations [MDS], we predicted that AIM4 could bind to the Gly-288 & Phe-289 residues of TDP-43 which have been shown by other researchers to be important for the TDP-43's LLPS. In summary, AIM4 can be further investigated towards its applicability as a molecule to target the TDP-43 proteinopathies.



2. **Designing the molecule which enhances sperm competence for in vitro fertilization (IVF)**

In collaboration with Dr Jagadeesh Prasad Dasappa's group from the Mangalore University and Prof Guruprasad Kalthur's group from the Kasturba Medical College, Manipal Academy of Higher Education, we have designed the organic small molecule mPTX which improves the sperm functional competence required for in vitro fertilization (IVF).

Our studies have demonstrated that mPTX, a modified compound from pentoxifylline, was able to increase sperm motility, prolong the in vitro sperm survival, improve the fertilization potential without affecting the developmental competence of the embryos at a four-fold lower concentration compared to widely used pharmacological agent- pentoxifylline in IVF technology. Our molecule, mPTX is proposed to be a better pharmacological agent for assisted reproductive technology than the existing drug used for sperm motility enhancement.



3. **Unraveling the structural and mechanistic basis of symmetric non-CG methylated DNA recognition by the UHRF1.**

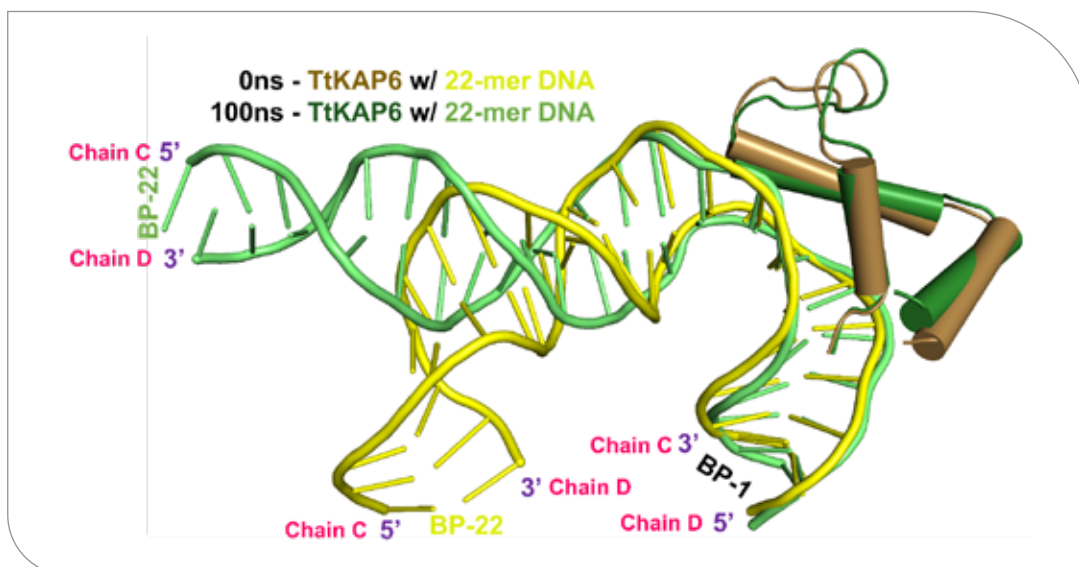
UHRF1 has recently been identified as a novel oncogene in hepatocellular carcinoma, the primary type of liver cancer. UHRF1 is a bonafide reader of hemi-methylated DNA and is essential for the maintenance of DNA methylation. Using ITC binding and X-ray crystallographic structural studies we have shown that the SRA domain of UHRF1 can recognize different methylation statuses of DNA and a single base spacer between symmetric 5mCs is required for dual flip out recognition of 5mCs in a non-CG context.



#### 4. Non-canonical DNA binding specificities of KAP6 from Trypanosoma causal agent of sleeping sickness

High mobility group (HMG) proteins are non-histone chromatin architectural proteins, bind different DNA structures and chromatin, induce conformational changes in the chromatin and topological changes in DNA that facilitate the replication, transcription, recombination, and repair of both nuclear and mitochondrial DNA.

Our investigations revealed that HMGB protein, KAP6, binds non-canonical DNAs (splayed and flap DNA, Holliday Junction) tighter than B-form DNA. Simulation analyses revealed that the  $\sim 90^\circ$  bend in DNA induced by the KAP6 HMG box is a result of two  $\sim 45^\circ$  bends, by helices of the protein. Our data also suggests that the orthologs of KAP6 are oligomers in solution, which could be necessary for their functioning such as  $180^\circ$  DNA bending and looping during kDNA packaging.



*HMGB box of TtKAP6 protein bent the DNA by  $90^\circ$ , which is required for packing of mitochondrial DNA of Trypanosoma causal agent of sleeping sickness.*



## »» Chemical Engineering

With IIT Hyderabad standing tall in the NIRF ranking, ChE@IITH is committed to set new heights for excellence in chemical engineering education, research, and expert consulting support to the process industries. With 20 committed faculty members, the department targets to execute this ambitious plan by adopting a holistic approach of our fractal and hands-on / project-based practical teaching, connecting our inter and multidisciplinary research approaches to the socially relevant problems, inculcating the start-up culture, and making high-quality education accessible for all. Broadly, teaching covers various aspects of chemical, biochemical, minerals, and materials engineering. Our electives expose our students to state-of-the-art developments in the fields of energy, new materials, Nano-science, machine learning, and Biochemical Engineering. ChE@IITH encompasses both BTech and MTech programs featuring a curriculum that is both comprehensive and as flexible as having the option of exploring internship opportunities. Hosting nearly 51 PhD and 27 MTech students, the department's strong commitment towards research is evidenced by INR 35 crores extramural funding that faculties have obtained, many of which have been translated into high TRL level inventions. Faculty bestowed with the highly prestigious DST Swarna Jayanti award and the department awarded with the first tier DST FIST support are bearing the testimonies of quality and research environment in the department. Faculty from the department are actively involved in hosting conferences and outreach workshops benefitting the students and faculties across several institutes in India. The department also houses state-of-the-art research and teaching laboratories. The faculty members in the department conduct research in a wide variety of exciting areas such as catalysis, fluid flow, Nanotechnology, materials for energy and biological applications, bioengineering, atomistic simulations, efficient energy harvesting and storage, process control and optimization, machine learning, techno-economic analysis and supply chain management, mineral processing and climate change. With such aims, the department aligns itself with the nation's several missions and dedicates itself to the dream of nation-building.



## Faculty



### Narasimha Mangadoddy

PhD – JKMRC, University of Queensland - Australia

**Associate Professor & HoD**

**Research Areas:** Mineral Processing; CFD; Multi Phase Flows; Fluidization; Particulate Technology



### Kirti Chandra Sahu

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### Vinod Janardhanan

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**Professor**

**Research Areas:** Heterogeneous Catalysis; Fuel Cells



### Saptarshi Majumdar

PhD – IIT Kharagpur

**Professor**

**Research Areas:** Multi-Scale Modeling; Bio-Materials Design; Industrial Process Analysis



### Sunil K Maity

PhD – IIT Kharagpur

**Professor**

**Research Areas:** Hydrodeoxygenation of Vegetable Oils and Oxygenated Compounds; Steam Reforming and Oxidative Steam Reforming of Bio-butanol; Process Design using Aspen Plus and Techno-Economic Analysis;



### Kishalay Mitra

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**Professor**

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### Anand Mohan

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**Research Areas:** Catalysis Over Supported Metals and Metal Oxides; Structure Property Correlations; Fuels and Chemicals from Renewable Sources; Methane and CO<sub>2</sub> Conversion; Reaction Kinetics



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**Research Areas:** Solid State Fermentation; Submerged Fermentation; Lipase; Biodiesel; Edible Mushroom; Statistical Design of Experiments; Microbial Enzyme Production;

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PhD – University of Alberta, Canada

**Associate Professor***Research Areas:* System Identification; Compressed Sensing**Balaji Iyer Vaidyanathan Shantha**

PhD – IIT Bombay

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**Assistant Professor***Research Areas:* Biomaterials; Electrospinning; Drug Delivery; Stem Cell Differentiation; Inflammation**Suahanya Duraiswamy**

PhD – NUS, Singapore

**Assistant Professor***Research Areas:* Micro Fluidics; Micro Reaction Engineering; Biodiagnostics / Biosensors; Micro Scale Particle Synthesis and Manipulations**Shelaka Gupta**

PhD – IIT Delhi

**Assistant Professor***Research Areas:* Density Functional Theory; Heterogeneous Catalysis; Biorenewables, Green Chemistry, Environment**Vikrant Verma**

PhD – Eindhoven University of Technology, The Netherlands

**Assistant Professor***Research Areas:* Multiphase Flow Reactors, Fluidized beds, CFD & DEM, CO<sub>2</sub> Capture Using Solid Sorbent**Alan Ranjit Jacob**

PhD – University of Crete, Greece

**Assistant Professor***Research Areas:* Rheology, Colloids & Interfaces, Polymeric gels and Composite nano-materials

### Patents Filed/Granted

1. Santosh Kumar Sriramoju, Pratik Swarup Dash, Raja Banerjee, Saptarshi Majumdar, and Debaprasad Shee, A system and process for segregation of low ash clean coal from coal tailing, Indian Patent [dated 05/02/2020, Appl. no: 202031005007].
2. Chandra Shekhar Sharma, Anil D. Pathak, Metal-CO<sub>2</sub> Battery with CO<sub>2</sub> as an Energy Carrier for Mars Exploration, April 20, 2020, Application No. 202041016948.
3. Chandra Shekhar Sharma, Mamidi Suresh, Anil D. Pathak, Ananya Gangadharan, Hierarchical Three-dimensional Hybrid Carbon Microelectrode Arrays as an Anode for Energy Storage Devices, June 3, 2020, 202041023243.
4. Shital Yadav, Tulika Rastogi, Illa M Pujitha, Chandra Shekhar Sharma, Cellulose Acetate based Non-woven Matrix with High Absorbency Properties for Female Hygiene Products, September 16, 2020, UK Patent, GB2548707.
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### Publications (Journal)

1. Akash Nathani, Poonam Rani, Chandra S. Sharma. Controlled Architecture of Electrospun Nanofibers and Their Applications in Nano-structured Polymers and Their Applications, Alamgir Karim [Editor], Part of a five-volume set of Soft Matter on the Nanoscale, to be published by World Scientific Publishing Company [Aug. 2020].
2. Mrunalini K. Gaydhane, Chandra S. Sharma, Cellulosic Nanofibers: A Renewable Nanomaterial for Polymer Nanocomposites, Review Volume: Nanotechnology in Textiles: Advances and Developments in Polymer Nanocomposites, Mangala Joshi [Editor], Jenny Stanford Publishing [May 2020].
1. Agrawal, M., Katiyar, R. K., Karri, B., & Sahu, K. C. (2020). Experimental investigation of a nonspherical water droplet falling in air. *Physics of Fluids*, 32[11], 112105. <https://doi.org/10.1063/5.0031642>.
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4. Gautam, K., Narayana, P. A. L., & Sahu, K. C. (2020). Linear instability is driven by an electric field in the two-layer channel flow of Newtonian and Herschel–Bulkley fluids. *Journal of Non-Newtonian Fluid Mechanics*, 285, 104400. <https://doi.org/10.1016/j.jnnfm.2020.104400>.

### Book/Book Chapter



5. Kannan, Y. S., Balusamy, S., Karri, B., & Sahu, K. C. [2020]. Effect of viscosity on the volumetric oscillations of a non-equilibrium bubble in free-field and near a free surface. *Experimental Thermal and Fluid Science*, 116, 110113. <https://doi.org/10.1016/j.expthermflusci.2020.110113>.
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10. Kumar, G., Narayana, P. A. L., & Sahu, K. C. [2020]. Linear and nonlinear thermosolutal instabilities in an inclined porous layer. *Proceedings of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 476 [2233], 20190705. <https://doi.org/10.1098/rspa.2019.0705>.
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#### Publications (Conference)

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2. Kandukuri, K. R., Polisetty, V. G., & Jampana, P. [2020]. Modeling and

- Control Study of Solid Oxide Fuel Cell at Low Operating Pressures. IFAC-PapersOnLine, 53(1), 289–294. <https://doi.org/10.1016/j.ifacol.2020.06.04>
3. Theertham G.T., Varanasi S. K., & Jampana,P.[2020]. SparsityConstrained Reconstruction for Electrical Impedance Tomography. IFAC-PapersOnLine, 53(2), 355–360. <https://doi.org/10.1016/j.ifacol.2020.12.185>
4. Miriyala, S. S., & Mitra, K. [2020]. Optimal Control using Evolutionary Algorithms through Neural network-based TRANSFORMation. 2020 IEEE Symposium Series on Computational Intelligence [SSCI], 1379–1386. <https://doi.org/10.1109/SSCI47803.2020.9308475>
5. Pujari, N. K., Miriyala, S. S., & Mitra, K. [2020]. Auto-tuned Deep Recurrent Neural Networks for Application in Wind Energy Conversion Systems 2020 IEEE Symposium Series on Computational Intelligence [SSCI], 3065–3072. <https://doi.org/10.1109/SSCI47803.2020.9308478>.
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8. Pantula, P. D., Miriyala, S. S., Giri, L., & Mitra, K. [2020]. Synchronicity Identification in Hippocampal Neurons using Artificial Neural Network assisted Fuzzy C-means Clustering. 2020 IEEE Symposium Series on Computational Intelligence [SSCI], 1594–1600. <https://doi.org/10.1109/SSCI47803.2020.9308344>.
9. Inapakurthi, R. k, Miriyala, S. S., Kolluri, S., & Mitra, K. [2020]. Nonlinear Model Predictive Control of Industrial Grinding Circuits using Machine Learning. 2020 IEEE Symposium Series on Computational Intelligence [SSCI], 1921–1927. <https://doi.org/10.1109/SSCI47803.2020.9308181>
10. Gumte, K. G., & Mitra, K. [2020]. Strategic biofuel supply chain network design and techno-economic-environmental analysis for an Indian scenario. IFAC-PapersOnLine, 53(1), 69–74. <https://doi.org/10.1016/j.ifacol.2020.06.012>
11. Inapakurthi, R. kiran, Miriyala, S. S., & Mitra, K. [2020]. Modeling of pollutants and particulate matter in the air using auto-tuned deep recurrent networks. IFAC-PapersOnLine, 53(1), 530–535. <https://doi.org/10.1016/j.ifacol.2020.06.089>
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14. Suman, G., Saxena, A., & Giri, L. [2020]. Confocal Imaging of Intercellular Calcium in HeLa Cells for Monitoring Drug-Response: Biophysical Framework for Visualization of the Time-Lapse Images. 2020 IEEE 17th International Symposium on Biomedical Imaging (ISBI), 1–4. <https://doi.org/10.1109/ISBI45749.2020.9098697>.
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16. Duraiswamy, S., & Yung, L. Y. L. [2020]. Effect of dean flows on sub-micron particles in low aspect ratio microchannels—Analysis of dff. 242–243. Scopus.
17. Duraiswamy, S., Yung, L. Y. L., & Chen, S. L. [2020]. Spiral microfluidics enhanced the isolation of epithelial cells from infected mice urine. 755–756. Scopus.

#### Funded Research Projects

1. Prof Sunil K Maity Utilization of waste corn cobs for the production of furfural, IIT Hyderabad, May 2020, 10L.
2. Dr Suahanya Duraiswamy, Microfluidic Chip to capture and Lyse Pathogen from Body fluids, MoE-STARS, May 15, 2020, 49.82L.
3. Prof Vinod Janardhanan, Kinetic Modelling of Iron Oxide Reduction, Tata Steel, Jun 3, 2020, 7.67L.
4. Dr Narasimha Mangadoddy, Development and Application of a GPU Based Coupled DEM-CFD Model for Predicting non-spherical Particle Dynamics and Performance of Mineral Processing Unit, SERB, Dec 31, 2020, 57.24L.
5. Dr Satyavrata Samavedi, Connecting operating variables, cone/jet features and mesh properties in electrospinning: using experiments and modeling to bridge theory and applications, SERB, Dec 28, 2020, 39.53L.
6. Prof Chandra Shekhar Sharma, Swarna Jayanthi Fellowship & Research Grant, SERB-DST, Dec 9, 2020, 25.00L.
7. Prof Chandra Shekhar Sharma, Scientific Understanding and Technical Development of Metal-CO<sub>2</sub> battery with CO<sub>2</sub> as an Energy Carrier for India's Mars Mission [Swarna Jayanthi Fellowship [SJF] SERB, Jan. 1, 2021, 192.80L.
8. Dr Narasimha Mangadoddy, Recovery of galena, sphalerite, and other valuable metals from lead-zinc tailings, Ministry of Mines & HZL jointly, Sanctioned 2nd Feb 2021, 25L.
9. Prof Kirti Chandra Sahu, Effects of phase change, coalescence and breakup on raindrop dynamics, SERB, Feb 26, 2021, 56.14L.
10. Prof Kishalay Mitra, Robust Wind Energy Conversion System when deep learning meets sustainable energy utilization, National Supercomputing Mission (NSM), DST, New Delhi Mar 12, 2021, 41.98L.
11. Dr Lopamudra Giri, Development of computational and visualization software for evaluating GPCR targeting drugs with the aim of mitigating corona virus infection level, SERB, Aug 14, 2020, 5.5L.
12. Dr Balaji Iyer Vaidyanathan Shantha, Multi-scale simulations for Design of Particle - Polymer hybrid materials, IISc, Bangalore, Mar 27, 2021, 22.26L.



### Workshops/ Seminars Conducted

1. CARBON Lab 10th Anniversary Webinar Series Webinar 1: Carbon Materials & Energy Storage on December 20, 2020  
Speaker 1: Prof Ashutosh Sharma, Secretary, DST, A Date with Carbon.  
Speaker 2: Prof Marc Madou, University of California, Irvine, Carbon Origami  
Speaker 3: Dr Tata N. Rao, Associate Director, ARCI, Role of Nanomaterials in Energy Storage Devices: Balancing the Power & Energy.
2. Member, organizing committee & speaker, Workshop on Academic and Professional Development for Young Scientists: One-day workshop organized under the aegis of Indian National Young Academy of Sciences [INYNAS] at the University of Hyderabad [Feb 2020].
3. Series of guest lectures on "Using OneNote for online teaching" for 5-day TEQIP Faculty Training Workshop on "Advanced Pedagogies: Active Learning and Digital Tools", IIT Hyderabad [Oct/ Dec 2020].
4. Guest lecture on "Introduction to physical polymer science", for 5-day AICTE-sponsored faculty development workshop on "Fundamentals of polymer rheology and soft matter" organized by Kavayitri Bahinabai Chaudhari North Maharashtra University Jalgaon [Sept 2020].
- International Advisory Committee (IAC) member from India at International Mineral Processing Council (IMPC) since December 2020.
4. Ms Mandakini Padhi has won the Best presenter award at XVI International Forum-Contest of Students and Young Researchers- Topical Issues of Rational Use of Natural Resources" held online in Saint-Petersburg Mining University under the patronage of the International Competence Center for Mining-Engineering Education under the auspices of UNESCO. June 17-19, 2020.
5. Dr Chandra Shekhar Sharma, Associate Professor, has been awarded DST Swarna Jayanti Fellowship 2020 [Engineering Sciences].
6. Dr Chandra Shekhar Sharma, Associate Professor, has been appointed as Chairperson of the Indian National Young Academy of Sciences [INYNAS].
7. Dr Chandra Shekhar Sharma, Associate Professor, has been inducted as a Member of Global Young Academy, 2020-25.
8. Dr Chandra Shekhar Sharma, Associate Professor, has received IITH Inaugural Faculty Research Excellence Award, 2020.
9. Dr Chandra Shekhar Sharma, Associate Professor, has been inducted as a Member of the SERB SUPRA Screening Committee, Jan. 2020.
10. Dr Chandra Shekhar Sharma, Associate Professor, has been a Special Invitee of Project Advisory Committee [PAC] – 'Materials & Engineering Sciences' of International Bilateral Cooperation Division [IBCD], DST, Feb. 2020.

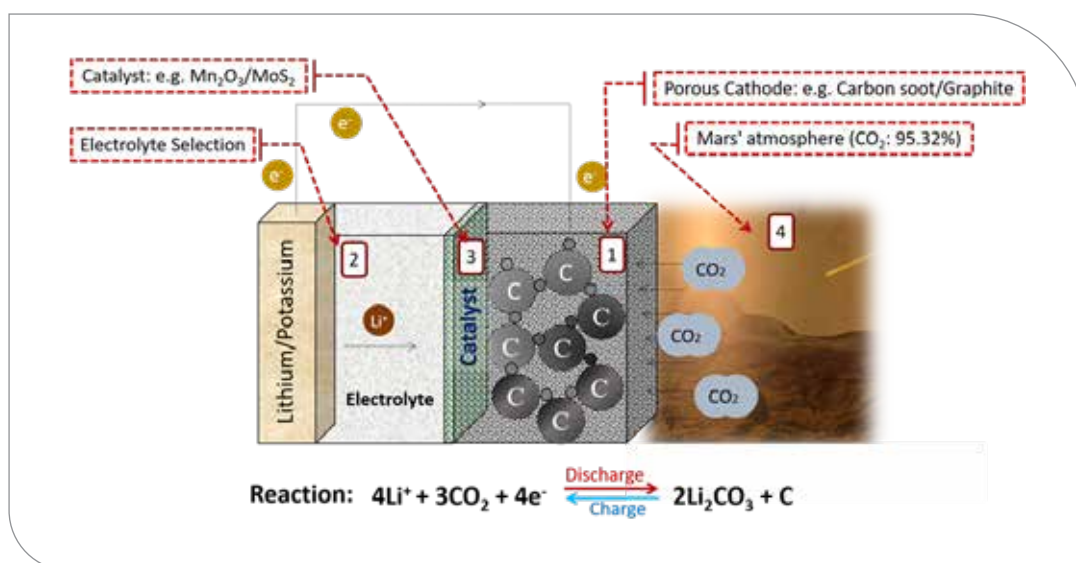
### Awards and Recognitions

1. Prof Kirti Chandra Sahu, Professor, has received the Institute Research Excellence Award [2021].
2. Prof Kirti Chandra Sahu, Professor, has received Fellow of Institute of Physics [IOP], UK [2021].
3. Dr Narasimha Mangadoddy, Associate Professor, has been Inducted as the

11. Mr Mamidi Suresh, has been awarded the Best Thesis Poster Award in the 2nd KPIT Shodh Awards at IISER-Pune (Jan 2020).
12. Mr Akash Nathani has been awarded the IITH Excellence in Research (PhD Students) Award (Aug 2020).
13. Mr Ankeet Krishna has been awarded the IITH Excellence in Academics (Students) Award (Aug 2020).
14. Mr Alok Kumar Pandey has been awarded the INAE Innovative Student Projects Award 2020 for Bachelor's Project (Dec. 2020 ).
15. Prof Kishalay Mitra, Professor, and Kapil Gumte received International IFAC conference "Advances in Control and Optimization of Dynamical Systems" (ACODS 2020) bestowed the BEST PAPER AWARD to Mr Kapil Gumte and Prof Kishalay Mitra for their paper titled "Strategic biofuel supply chain network design and techno-economic-environmental analysis for an Indian scenario".
16. BATTERY 2030+, a long-term roadmap for forward-looking battery research in Europe, prepared by the EU Horizon 2020 initiative mentions research work of Prof Kishalay Mitra in the Li+ Battery space that can open up new opportunities to explore new cell formats and designs.
17. Prof Kishalay Mitra, Professor, was Invited as Panel Member and to deliver a lecture @ the Vaibhav Summit on the broad theme of Climate Change ["Meeting Climate Change Challenges through Hand Shaking with AI"] held on October 16, 2020.

## Chemical Engineering *Highlights* //

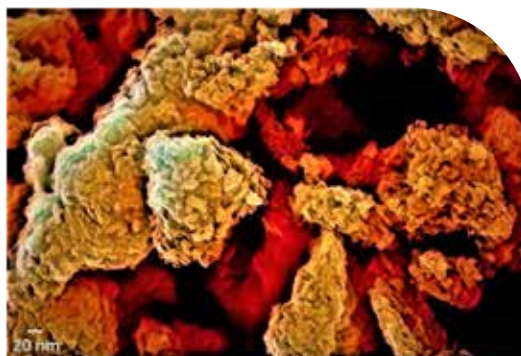
1. A multi-component mathematical model for hydro cyclone classifier is developed utilizing the new multi-component classification performance data obtained as part of the funded project by SERB [EMR/2016/003781] during 2017-2020. Inputs from the CFD studies on the bi-component separation mechanism in terms of multicomponent particle rheology as well as the segregation phenomena are utilized in this new model development. The new model includes the very first attempt to present the component's solids recovery model in the empirical form. Model validation with additional data and literature data is attempted and found reasonably close them. Further scale-up studies of this model for industrial application, simulation, and translation into a commercial simulator level will be attempted in the future.
2. Metal CO<sub>2</sub> Battery: An Indigenous Technology for India's Mars Mission and to Fix CO<sub>2</sub> Emissions on Earth. This project has been awarded for the prestigious DST Swarna Jayanti Fellowship 2020 to Dr Chandra Shekhar Sharma. In this project, we aim to scientifically explore and develop a working prototype of Metal [M]-CO<sub>2</sub> battery technology to explore the feasibility of this technology in the Mars mission particularly for the surface landers and rovers by using the CO<sub>2</sub> gas [95.32%] abundantly available in its atmosphere. The development of Metal-CO<sub>2</sub> batteries will provide high specific energy density with the reduction in mass and volume which will help the reduction of payload mass and launch cost in planetary missions. Another parallel and important aspect of this proposal is to develop Metal-CO<sub>2</sub> battery technology also as a promising clean strategy for restraining the climate effects of CO<sub>2</sub> emissions on earth as we all know that it is one of the main reasons for global warming. For traditional CO<sub>2</sub> fixation methods, large energy is required leading to more CO<sub>2</sub> emissions. Metal-CO<sub>2</sub> batteries have a great potential to offer significantly high energy density than the currently used Li-ion batteries and provide a striking option to fix CO<sub>2</sub> emissions & environmental protection also.



*Schematic of Metal-CO<sub>2</sub> [Li-CO<sub>2</sub>] Battery*

## References

- Anil D Pathak, CS Sharma, Candle soot carbon cathode for rechargeable Li-CO<sub>2</sub>-Mars battery chemistry for Mars exploration: A feasibility study, Materials Letters, 2021, 283, 128868. [Featured Letter].
- Chandra Shekhar Sharma, Anil D. Pathak, Metal-CO<sub>2</sub> Battery with CO<sub>2</sub> as an Energy Carrier for Mars Exploration, April 20, 2020, Application No. 202041016948.
- <https://dst.gov.in/swarnajayanti-fellow-work-metal-co2-battery-which-can-reduce-payload-mass-launch-costs-planetary>.



Carbon Hot-wings

Carbon Hot-wings morphology is achieved by activation of candle soot. The dense nanosheet like morphology ranges from 30 to 50 nm and seems like hot-wings. This image was captured by a Field emission scanning electron microscope.

Reference: Poonam Rani et. Al., Applied Surface Science (2021)

### International Sci-Art Image Competition 2021

#### 1<sup>st</sup> Prize (Experimental Category)

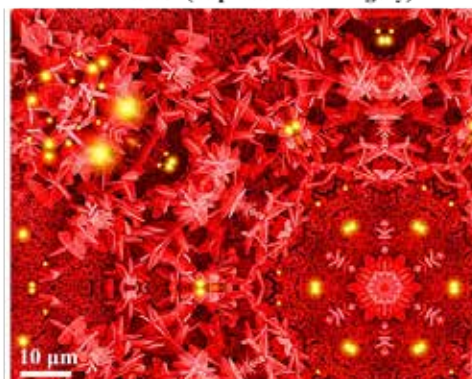


Floral Tessellation

The FESEM image represents nickel foam decorated with arrays of cobalt-molybdenum mixed sulphide microflower as synthesized using hydrothermal method. The hierarchical flower architecture based electrode have exhibited excellent electrochemical performance when evaluated for high-performance supercapacitor application.

Image courtesy: Shalakha Saha, CARBON Lab, Dept. of Chemical Engineering, IIT Hyderabad

#### 2<sup>nd</sup> Prize (Experimental Category)

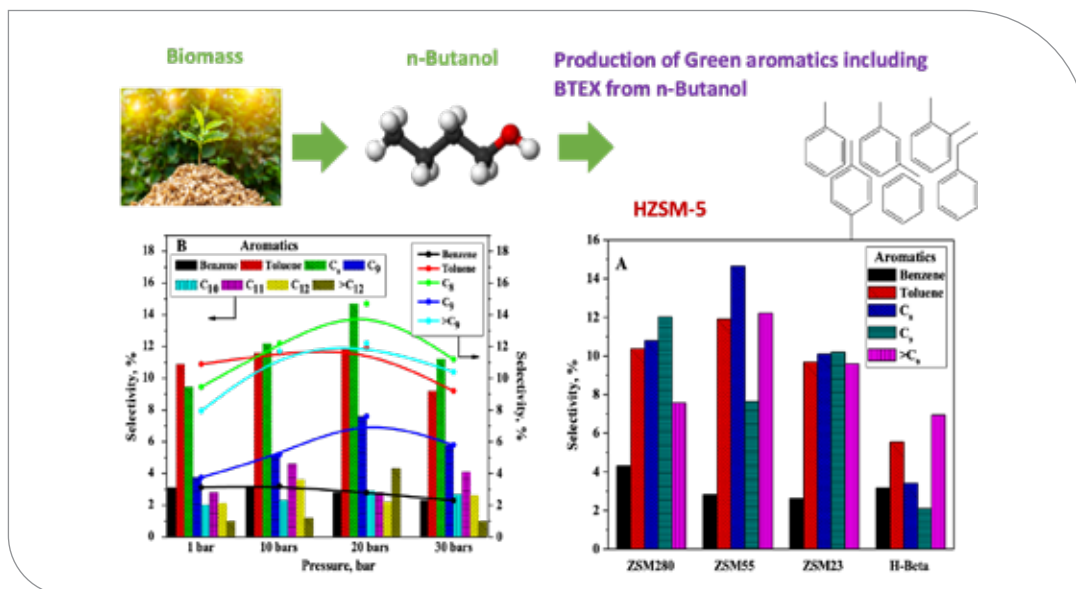


Flower Motifs

The FESEM image illustrates nickel foam adorned with metal-organic framework derived cobalt-molybdenum mixed sulphide microscale flower array. A facile hydrothermal method has been employed for the fabrication of these microscale flower architecture assembled by nanoplates. Such hierarchical flower morphology based material when assessed for supercapacitor application demonstrated excellent electrochemical performance.

Image courtesy: Shalakha Saha, CARBON Lab, Dept. of Chemical Engineering, IIT Hyderabad

- The production of aromatics from biomass is very much essential to address the sustainability issue of human civilization.

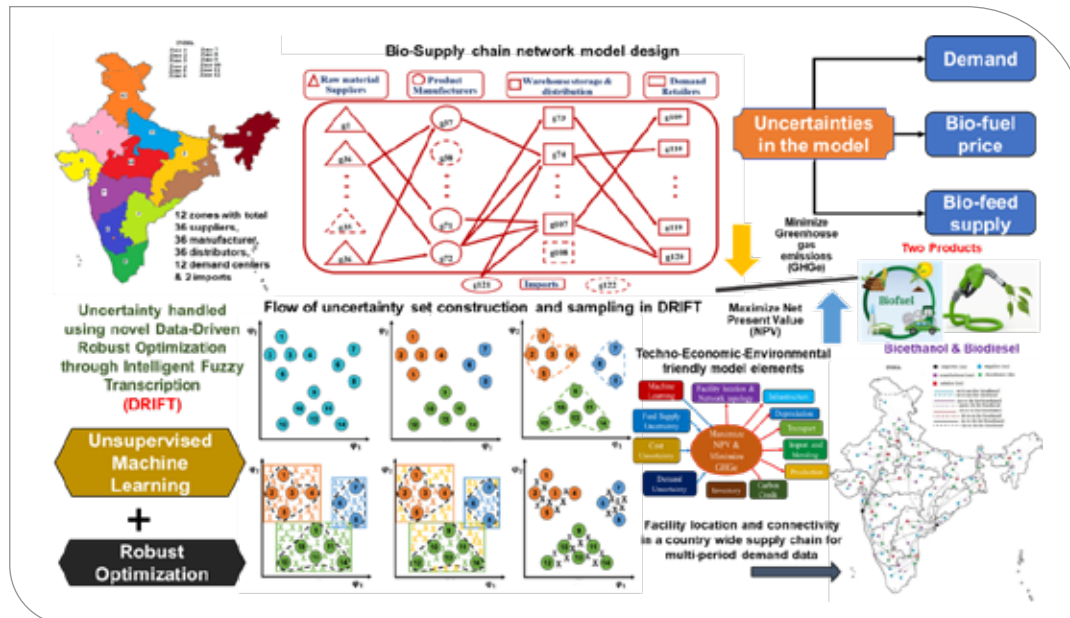


#### Process for building block aromatics production

A novel process for building block aromatics production with high selectivity from n-butanol using various zeolite-based solid acid catalysts in a high-pressure fixed-bed reactor has been developed. H-Beta zeolite showed lower selectivity towards aromatics and benzene-toluene-ethylbenzene-xylene (BTEX) compared to HZSM-5 zeolite because of rapid catalyst deactivation. The selectivity to aromatics was strongly dependent on the silica-alumina (Si-Al) mole ratio of HZSM-5. The highest selectivity to aromatics was observed over HZSM-5 (Si/Al= 55) because of the presence of an optimum quantity of Brønsted acid sites and organic radicals. The aromatics and BTEX selectivity are improved with increasing operating pressure up to 20 bar and reduced slightly at higher pressure. The aromatics and BTEX, selectivity, however, declined with an increasing weight hourly space velocity (WHSV) and enhanced with increasing operating reaction temperature up to 623 K. The maximum aromatics selectivity was 49.2% with 29.4% BTEX over HZSM-5 (Si/Al = 55) under optimum reaction conditions: 20 bar, 623 K, and 0.75 h<sup>-1</sup> WHSV.



4. Use of data-driven robust optimization algorithms in designing India wide Bio-Supply chain network under parameter uncertainty



#### Bio-Supply chain network

To address the dual crisis related to the usage of fossil fuels i.e. environmental pollution and dwindling reserves, in Global Optimization and Knowledge Unearthing Laboratory [GOKUL], we have been researching on designing a country-wide robust supply chain network [SCN] based on bio-energy renewables. Amidst various renewable energy sources, biomass can be utilized as and when needed by storing it for the future without taking the help of any additional energy storing device, which makes it free from having the restriction of using it instantaneously like wind, solar energy, etc. Renewable energy produced from biomass has a tremendous promise from the perspective of growth and sustainability. India, being an agrarian country with a regular cultivation plan of a diversified range of crops, stands here a special chance of utilizing the enormous amount of biomass it generates every year which can be utilized efficiently. To extract maximum benefit out of such studies, a country-wide systematic effort is needed by which a successful SCN can be built for such a huge waste to wealth creation initiative, where every stage of operation starting from the movement of raw materials to the finished products can be designed optimally. To handle the real-time uncertainties in demand, international biofuel price, and bio feed supply, Robust Optimization [RO] has been employed for performing the supply chain modeling under uncertainty. However, the approach of RO generates conservative solutions due to the usage of conventional uncertainty sets such as box, budgeted, ellipsoidal, etc. To address this issue, data-driven robust optimization through intelligent fuzzy transcriptions [DRIFT] has been proposed, which combines unsupervised machine learning-based clustering

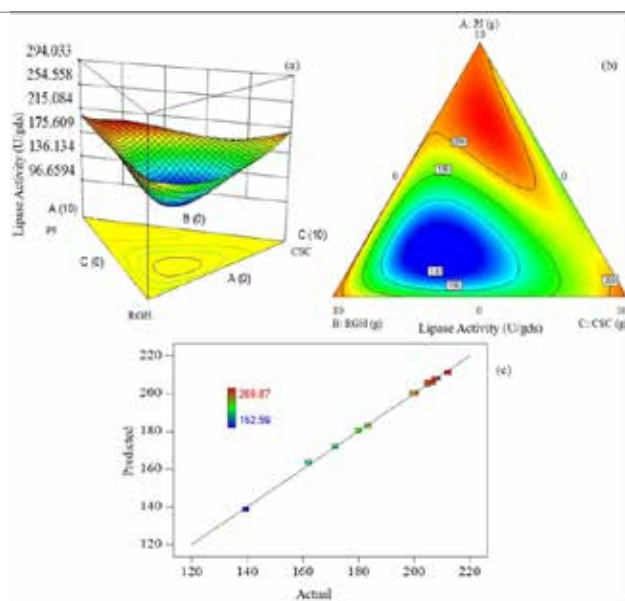


and boundary detection of regions of interest with RO. A robust solution has been provided for eight types of biomass feed and their corresponding technologies based on different geography and seasonality to ensure biomass feed supply throughout the year. The impact of uncertainty in product demand, import price, and biomass feed supply on other SC decisions can be shown in terms of cost component analysis of facility infrastructure, production, transport, inventory, and import. ACODS 2020, an IFAC conference, held in IIT Madras, bestowed the BEST PAPER AWARD to Mr Kapil Gumte and Prof Kishalay Mitra for this work.

## 5. Lipase production

Lipases [E.C. 3.1.1.3] are a group of enzymes that catalyze the hydrolysis of triacylglycerols into di-acylglycerol, mono-acylglycerol then glycerol, and FFA at the water-lipid interface. Lipases can use relatively broad spectrum substrates, stability towards high temperature, pH, and they are enantioselective and regioselective. A novel solid substrate *Prosopis juliflora* [PJ] has been studied for the production of lipase [E.C. 3.1.1.3] using *Aspergillus niger* MTCC 872 in solid-state fermentation. Simplex centroid mixture design [SCMD] was implemented to optimize the tri-substrate mixture composition consisting of *Prosopis juliflora* [PJ], red gram husk [RGH], and cottonseed cake [CSC]. Mixture taken in the ratio of 6.66:1.66:1.66 for PJ:RGH: CSC has shown the highest lipase activity of  $212.20 \pm 6.36$  U/gds at 30°C, 7 pH and 70% initial moisture content (v/w). Sequential optimization of physical parameters was done using the central composite face-centered design. The optimum mixture composition has shown the highest lipase activity of  $269.87 \pm 8.09$  U/gds at 35°C, 7 pH, and 75% initial moisture content (v/w). Large scale production using 1kg substrate was carried out in a tray bioreactor and the highest lipase activity of  $208.79 \pm 6.26$  U/gds is obtained.

*Fig.1. (a) 3-D surface plot for the optimum lipase activity using the tri-substrate mixture. (b) 2-D contour plot for optimum lipase activity and (c) The comparison between predicted and actual lipase activity obtained from simplex centroid mixture design.*



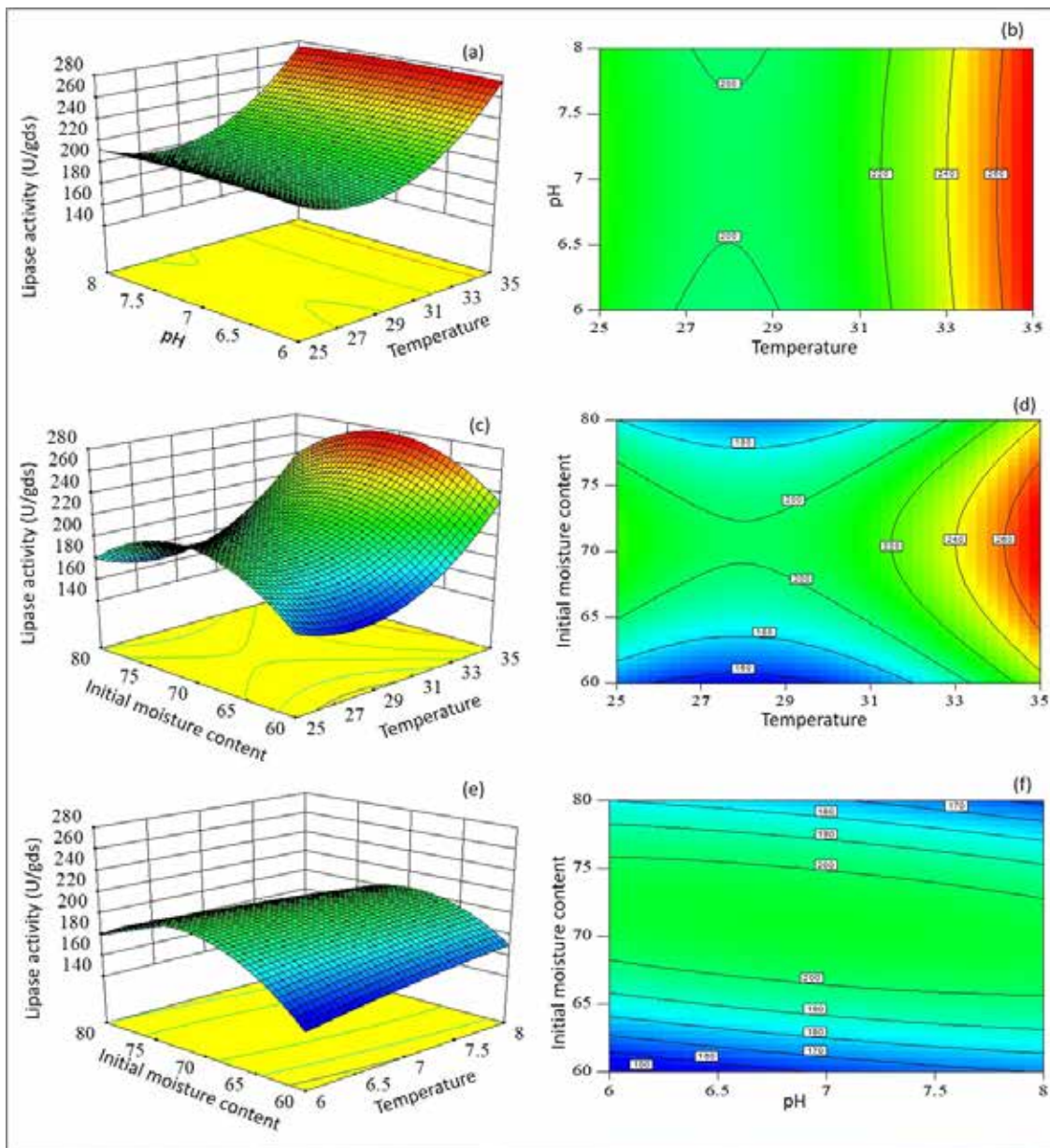
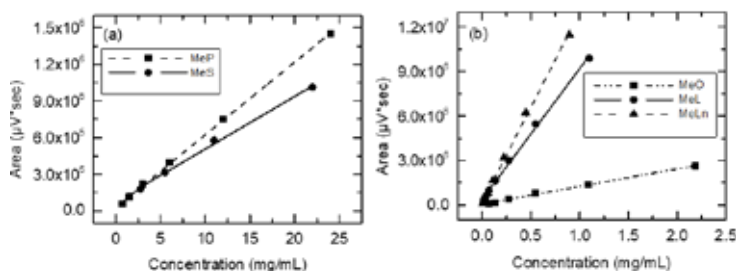


Fig.2. Interaction effect of physical parameters by response surface plots and corresponding contour plots for lipase activity. [a & b] Temperature and pH at 70 % initial moisture content [c & d] Temperature and initial moisture content at pH 7.0 and [e & f] pH and initial moisture content at 35 °C.

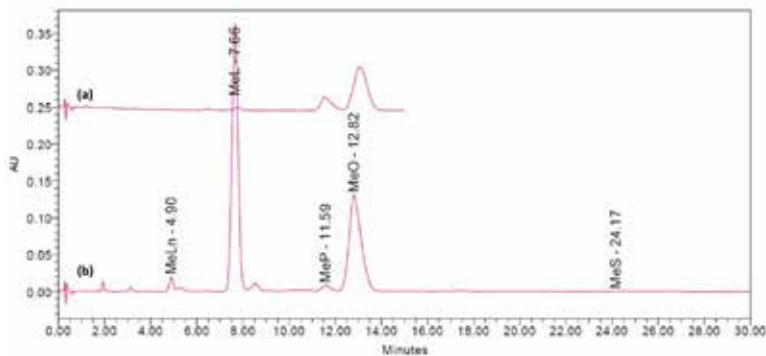
## Application of Lipase in Biodiesel Production

Biodiesel, fatty acid methyl esters (FAMES), has gained importance as an alternative to the existing conventional diesel fuels. It is produced by the transesterification or esterification of vegetable oils, animal fat, waste cooking oils, and algal oils with alcohol in the presence of a chemical or biocatalyst [lipase]. The properties of biodiesel depend on the vegetable oils' fatty acid composition. The composition of the fatty acid varies with the amount of saturated and unsaturated fatty acid quantity. Fatty acids will form their corresponding methyl esters. Different analytical techniques have been utilized to measure biodiesel's quantity in gas chromatography (GC) and HPLC. One frequent problem occurring during the FAMES analysis in HPLC using the C18 column is the poor peak separation of MeP and MeO. MeP and MeO overlap in chromatographic peaks that cause difficulty in biodiesel quantification. In this study, a new HPLC method was successfully developed for the biodiesel analysis using the mobile phase mixture: acetonitrile, water, and acetone as 62 %, 33 %, and 5 % respectively with 2.20 mL/min flow rate in an isocratic reverse-phase HPLC using a C18 column with UV-VIS detector.

*Fig.3. Calibration curves for methyl esters (a) methyl palmitate and methyl stearate (b) methyl oleate, methyl linoleate, and methyl linolenate.*



*Fig.4. HPLC chromatogram of the FAMES using method B with the mobile phase 62 % acetonitrile, 33 % water, and 5 % acetone (a) Separation of MeP and MeO for the known concentration mixture and (b) Biodiesel produced from palm oil and methanol via transesterification.*

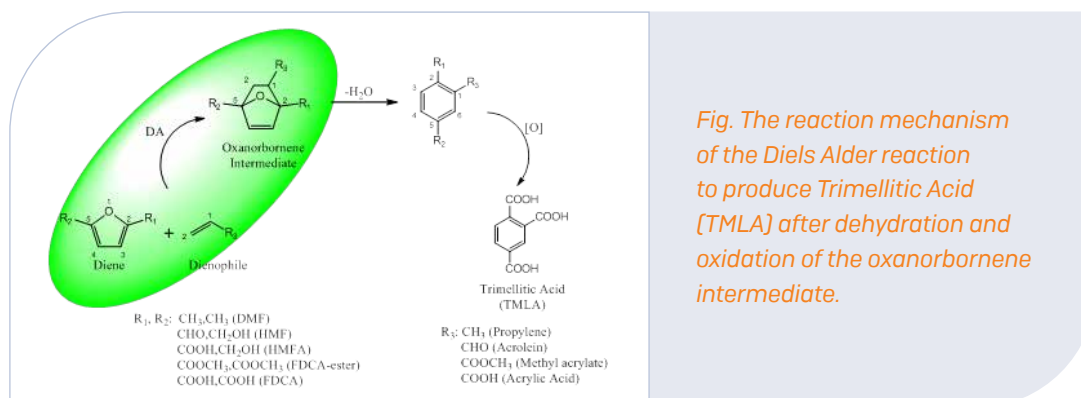


## 6. High cell density mushroom production

Mushrooms have a high demand in society because of their high nutritive and medicinal properties. The top five genera of mushrooms, being cultivated around the world are *Agaricus*, *Pleurotus*, *Volvariella*, *Lentinula*, *Calocybe*. Of these *Pleurotus* sps., are mostly consumed because of their flavor and nutritional values in both fresh and dried forms. Submerged cultivation of mushrooms paves a way for faster and efficient production of biomass of mushrooms by having superior control over various parameters involved in the growth. In this work, initially, the production of biomass from submerged fermentation (SmF) is carried out in the flask level in two stages (i) Seed culture medium and (ii) Fermentation medium, further which can be scaled up to bioreactors. The fermentation conditions maintained are 25°C, 150 rpm, and pH of 5.5.

7. The design of materials with superior catalytic properties holds the key to develop successful technologies for the production of renewable energy and chemicals. In this regard, a bottom-up approach is applied, wherein quantum mechanical ab initio density functional theory (DFT) simulations of reactions occurring on the material surface are guiding the rational design of heterogeneous catalysts. The inherent design ideas vary and depend on the problem at hand. Overall, the ab initio level DFT simulations provide us a mechanistic insight into the reaction, which in turn offers us an opportunity to engineer the material.
8. Effect of substituents and promoters on the Diels–Alder cycloaddition reaction in the biorenewable synthesis of trimellitic acid

An efficient route to produce oxanorbornene, a precursor for the production of bio-based trimellitic acid (TMLA) via the Diels–Alder (DA) reaction of biomass-derived dienes and dienophiles has been proposed by utilizing density functional theory (DFT) simulations. It has been suggested that DA reaction of dienes such as 5-hydroxymethyl furfural (HMF), 2,5-dimethylfuran (DMF), furan dicarboxylic acid (FDCA), and biomass-derived dienophiles (ethylene derivatives e.g., acrolein, acrylic acid, etc.) leads to the formation of an intermediate product oxanorbornene, a precursor for the production of TMLA. The activation barriers for the DA reaction were correlated to the type of substituent present on the dienes and dienophiles. Among the dienophiles, acrolein was found to be the best candidate showing a low activation energy (<40 kJ mol<sup>-1</sup>) for the cycloaddition reaction with dienes DMF, HMF, and hydroxy methyl furoic acid.



*Fig. The reaction mechanism of the Diels Alder reaction to produce Trimellitic Acid (TMLA) after dehydration and oxidation of the oxanorbornene intermediate.*

## »» Department of Chemistry

The Department of Chemistry at the Indian Institute of Technology Hyderabad is among the premier educational institute in India. The department started functioning from the very inception of IITH and was the first department to offer the PG program (two-year MSc Chemistry) in science in 2010. Over the years has grown from strength to strength in every aspect of the academic setup. Currently, the department has 16 faculty members, 86 MSc students, and 94 PhD scholars. The joint effort by the enthused students, the committed staff members, under the effective guidance of the faculty members have propelled the momentum in the forward direction and excelled in both the teaching and research field. The Department of Chemistry at IITH is devotedly pursuing research in fundamental as well as applied research. The department is engaged in a diverse range of challenging research problems. The ongoing research areas comprise Battery Materials, Bio-inorganic/-organic Chemistry, Biophysical and Microscopy, Computational chemistry, Development of next-generation solar cells and conducting polymers, Environmental remediation, Functional Organic Materials, and Supramolecular Chemistry, Heterogeneous Catalysis, Homogeneous catalysis, Laser spectroscopy, Medicinal, and Bio-inspired Synthesis, Metal catalyzed Water Splitting/CO<sub>2</sub> Reduction/Hydrogen Generation, Molecular Magnetism, Heavy Element Chemistry, Natural Product Synthesis, Organometallic Chemistry, Synthetic Methodologies, and Superconducting and thermoelectric materials. The Department has state-of-the-art infrastructure and research facilities covering experimental and theoretical aspects of all core research areas.

The accomplishment of our alumni, both master and PhD scholars speaks volumes about the quality of education and training provided to the students. The master's curriculum is uniquely designed to provide equal emphasis on both a strong theoretical foundation as well as developing research skills. The year-long MSc project of this program makes students research ready to handle the real-time scientific challenges. It, not an overstatement that the MSc-Chemistry at IITH is one of the most sought-after programs among science students. Some of the MSc graduates have successfully completed PhD in Ivy league universities/top-ranked universities and are potential faculty candidates in the near future. Our PhD program aims to produce highly sought-after and knowledgeable scientists for pursuing careers in academia, industry, and government and to contribute to the overall success of the scientific development of the country.



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#### Publications [Conference]

1. Biswas, C., Devarajan, K., Panda, T. K., & Raavi, S. S. K. [2020]. Enhanced Broadband Emission in Novel Phenanthroimidazole Derivative Molecules via Excited State Intramolecular Proton Transfer. OSA Advanced Photonics Congress [AP] 2020 [IPR, NP, NOMA, Networks, PVLED, PSC, SPPCom, SOF] [2020], Paper JTh3G.5, JTh3G.5. <https://doi.org/10.1364/NOMA.2020.JTh3G>.

### Funded Research Projects

1. Prof G. Satyanarayana, Structure-based design and evaluation of inhibitors against phosphodiesterases for enhancing sperm motility and early embryo development and to reduce gamete and embryo toxicity, SERB, 14-March-2021, 62.60L.
2. Prof Melepurath Deepa, Liquid Junction solar cells with silicon nanowires photoanodes modified with hole conducting materials, MoE-STARS, May 15, 2020, 65.21L.
3. Prof Melepurath Deepa Rechargeable Zinc-ion Batteries with Specifically Designed Cell Configurations for Long Cycle Life and Good Reversibility, SERB, Dec 23, 2020, 40.73L.
4. Prof Melepurath Deepa, Development of Organic Electrochromic Molecules, Polycyced Inc., Arizona, USA, Dec 10, 2020, 5.00L.
5. Prof Ch Subrahmanyam, Study of storage aging conditions (i.e. Shelf-life and Out -life) on physical, thermal, and mechanical properties of Epoxy-based prepreg systems (i.e. Tow & Fabric prepreg), DRDO, Directorate of Futuristic Technology Management, 32.03L.
6. Prof Ch Subrahmanyam, Hot electrons transfer in semiconductors for artificial photosynthesis, DST-JSPS, 7.0L.
7. Prof Ch Subrahmanyam Non-thermal plasma in conjunction with electrochemical nano biosensor platform for continuous monitoring and elimination of water-borne pathogens, DST-NATAG, 90L.
8. Prof Tarun K. Panda, Teachers Associateship for Research Excellence [TARE] – Dr Archana, SERB, Feb 12, 2021, 3.35L.
9. Prof Prabu Sankar Ganesan, Luminescent Bio-polymer Encapsulated Metal [PoeM], Nanoparticles for Imaging and Therapeutic Applications, IITH, 01.05.2020, 1L.
10. Dr Bhabani S. Mallik, Computational Design of Nonflammable and Highly conductive electrolytes for metal-ion batteries using HPC, IISc, Bangalore, Mar 27, 2021, 18.50L.
11. Dr Krishna Gavvala, Exploring Novel Nucleoside Analogues to Probe the Key Protein-DNA Interactions using Spectroscopic Tools, SERB, Jan 13, 2021, 27.61L.
12. Dr Saurabh Kumar Singh, Computational Exploration of Bonding and Covalency in Actinide Molecular Complexes, SERB, Dec 24, 2020, 28.09L.

### Workshops Conducted

1. Dr Supriya Rej, Department of Applied Chemistry, Faculty of Engineering, Osaka University, Japan Non-biased C–H Bond Functionalization with the Aid of Directing Auxiliary, 21st August 2020.
2. Dr Amrita Das, Department of Applied Chemistry, Faculty of Engineering, Derivatization and Synthesis of Heteroarene Core Structures of Biologically Active Compounds via Greener Synthetic Routes, 21st August 2020.
3. Dr Prasenjit Das, Department of Chemistry, University of Pittsburgh, USA, Strategic design of functional triazine-based metal-organic frameworks and covalent organic frameworks and their multifarious applications, 28th August 2020.
4. Dr Tigmanshu Pal, Research Institute of Science and Technology, Tokyo University of Science, Interfacial Synthesis of d8 Metalladithiolene Based Coordination Nanosheet, 28th August 2020.

5. Organized one ATAL-FDP on Leadership & Excellence during 7-11 September 2020 by IIT Hyderabad in the online mode, in collaboration with the AOL Foundation, which had more than 200 registered participants (conducted as a Dean Faculty).
6. Sayak Das Gupta, University of Florida, USA, Molecular Cerium/Manganese/Oxo Chemistry, 12th September 2020.
7. Dr Akanksha Tyagi, Council on Energy, Environment, and Water (CEEW), Beyond laboratory: Public policy as an alternate career for STEM researchers, 19th September 2020.
8. Prof A. T. Biju, Department of Organic Chemistry, Indian Institute of Science, Bangalore, Molecular Rearrangements Involving Aryne Intermediates, 23rd September 2020.
9. Prof Dr Peter W. Roesky, Institut für Anorganische Chemie, Karlsruher Institut für Technologie (KIT), Useful and Useless Chemistry. Selected Examples from the Periodic Table of Elements, 7th October 2020.
10. Rini Choudhury, Assistant Director (OT), Indian Information Service, Government of India, Beyond STEM: Civil Services as a Career Path, 14th October 2020.
11. Dr Yusuke MAEGAWA, Digital Intelligence Department in Shionogi, Co. Ltd., Career Path of Chemists in the Pharmaceutical Industry - with a Case of a Japanese Researcher, 16th October 2020.
12. Prof Ian A Tonks, Department of Chemistry, University of Minnesota – Twin Cities, Ti-Catalyzed Nitrene Transfer Reactions: Harnessing the Till/TiIV Redox Couple for New Transformations, 21st October 2020.
13. Prof Dr Matthias Tamm, Institute of Inorganic and Analytical Chemistry Technische Universität Braunschweig, 16th November 2020.

#### Awards and Recognitions

1. Prof Ch Subrahmanyam, Professor, received a Fellow of the Royal Society Chemistry.
2. Prof Tarun K Panda, Professor, received the CRSI Bronz medal 2021 for research contribution.
3. Prof Tarun K Panda, Professor, received a Certificate of appreciation Highly cited author as one of the top 5% of highly cited authors in the Royal Society of Chemistry journals, 2019.
4. Mr Dhileep Nagi Reddy, PhD scholar received Research excellence.
5. Ms Aritri Biswas, a PhD scholar, received Research excellence.

## Chemistry *Highlights* //

1. The central theme of our research is an organic synthesis with a focus on the development of novel/new synthetic methods based on transition metal catalysis, acid catalysis, metal-free transformations, and their application towards the synthesis of biologically active molecules. Over the past decade, the group focused on the fundamental research on the development of "green" strategies for efficient construction of various carbo- and heterocyclic architectures. In particular, palladium-catalyzed transformations such as C-H activations, domino cyclizations are explored along with their applications towards the synthesis of natural products. The group has developed a series of methodologies to achieve the goal through the innovation of concepts and methods, design, and development of new reagents, reactions, catalysts, and catalytic systems. These strategies have been demonstrated to be successful and powerful tools in the construction of complex and useful organic molecules, as well as in the concise synthesis of natural products, pharmaceuticals, and their analogs. Particularly in the year 2020, a highly stereoselective  $\gamma$ -arylation of tert-alkenols are explored by using [Pd]-catalysis holds special attention. Also, this strategy is successfully extended for the construction of indene scaffolds using intramolecular Friedel-Crafts alkylation sequence by employing simple acid [H<sub>2</sub>SO<sub>4</sub>], which triggered the intramolecular alkylation in short reaction times at room temperature. Significantly, water is used as a green solvent for attaining the desired products. It is worth mentioning that the indenenes have been accomplished using a single column chromatography technique.



*Transition-Metal Catalyzed Stereoselective  $\gamma$ -Arylation and Friedel-Crafts Alkylation: A Concise Synthesis of Indenes*

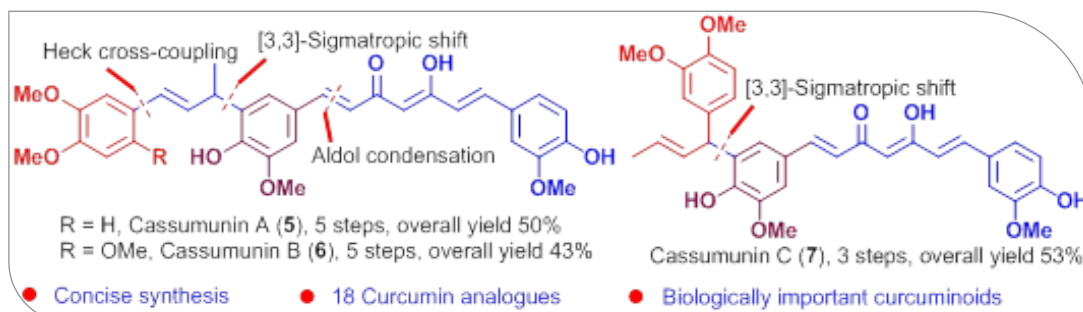
2. Alkaline earth (Ae) metal complexes of the amidophosphine borane ligand are highly active and iso-selective catalysts for the ring-opening polymerization (ROP) of rac-lactide (LA). The polymerization reactions are well controlled and produce polylactides with molecular weights that are precise and narrowly distributed. Kinetic studies reveal that the ROP of rac-LA catalyzed by all Ae metal complexes had the first-order dependency on LA concentration as well as catalyst concentration. [T. K. Panda et al. Chemistry – An Asian Journal, 15(6), 860–866].





### 3. Total Synthesis of [±]-Cassumunins A–C and Curcumin Analogues

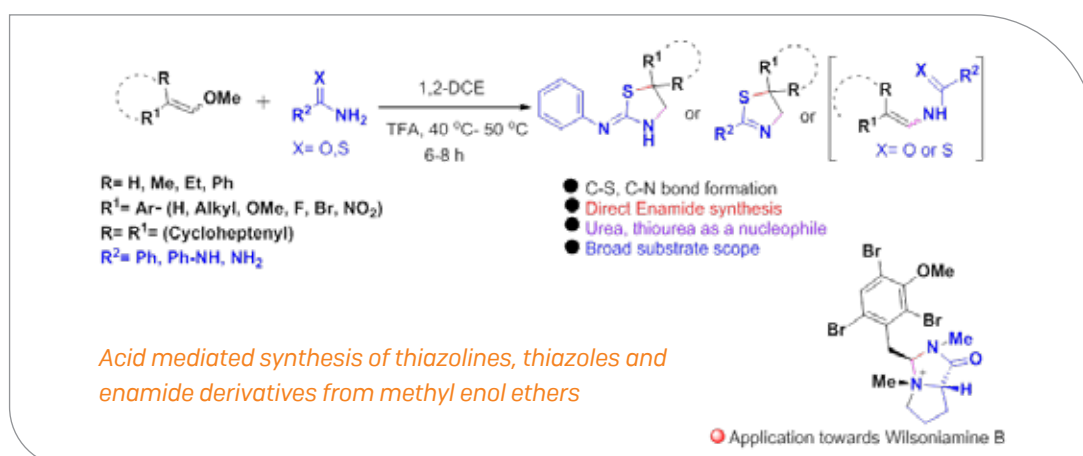
Mulla Althafh Hussain, Faiz Ahmed Khan, *Synthesis* 2020; 52(10): 1561-1575  
doi.org/10.1055/s-0039-1690794.



#### Total Synthesis of [±]-Cassumunins A–C and Curcumin Analogues

- The total synthesis of [±]-cassumunins A–C – superior antioxidants and anti-inflammatory agents.
  - Total synthesis of cassumunins A and B were accomplished in five linear steps while cassumunin C was in three linear steps with good overall yields.
  - The key features involved in this synthesis are tandem [3,3]-sigmatropic shift, SN2' reaction, and aldol condensation.
  - Moreover, a total of eighteen symmetrical and unsymmetrical curcumin analogs were synthesized.
4. **Acid mediated synthesis of thiazolines, thiazoles and enamide derivatives from methyl enol ethers: Application towards the synthesis of wilsoniamine B.**

Tapan Kumar Jena, Faiz Ahmed Khan. *Tetrahedron Lett.* 2020, 61, 151675  
doi.org/10.1016/j.tetlet.2020.151675.



Acid mediated synthesis of thiazolines and enamide derivatives from methyl enol ethers.

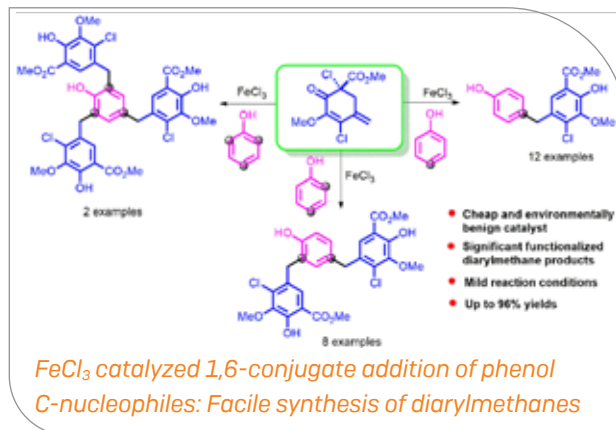
Enol ethers act as an electrophile and lead to form C-N and C-S bonds.

Application towards wilsoniamine B alkaloid.

5. **FeCl<sub>3</sub> catalyzed 1,6-conjugate addition of phenol C-nucleophiles: Facile synthesis of diarylmethanes.**

Sreenivas. K, Khan, F. A. Tetrahedron, Volume 76, Issue 6, 7 February 2020, 130885  
doi.org/10.1016/j.tet.2019.130885

- FeCl<sub>3</sub> Catalyzed synthesis of diarylmethane derivatives from phenol and cyclohexadienone derivative.
- In this strategy mono, bis, and tris 1,6-conjugate addition products are achieved successfully.
- Here we disclosed a novel approach for biologically significant diarylmethane derivatives under mild reaction conditions.



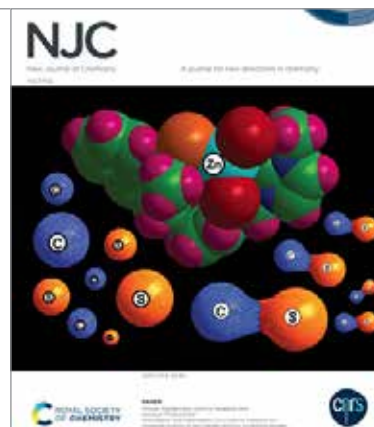
6. The Au...H-C interactions play a crucial role in the C-H bond activation reactions. Our recent work on gold-hydrogen bonding has been highlighted with cover art in Organometallics, American Chemical Society. The cover art depicts a rare intramolecular Au...H-C(sp<sup>3</sup>) hydrogen bonding interaction and blue light-emitting properties of gold(I)-N-heterocyclic carbene complex. The n-heptane arm of the carbene ligand modulates the hydrogen bonding interaction between Au(I) and the hydrogen atom of one of the CH<sub>2</sub> moieties.



7. Our recent work on chalcogen bonding has been highlighted with cover art in the European Journal of Inorganic Chemistry, Wiley. The cover art shows steric-controlled oxidation of mesoionic selenone using copper(II) salt to yield a rare tetraselenide from dimerized diselenides through chalcogen bonding [ChB]. The art represents the formation of single crystals from their concentrated solution with a unique structural aggregation along with unusual bonding features.

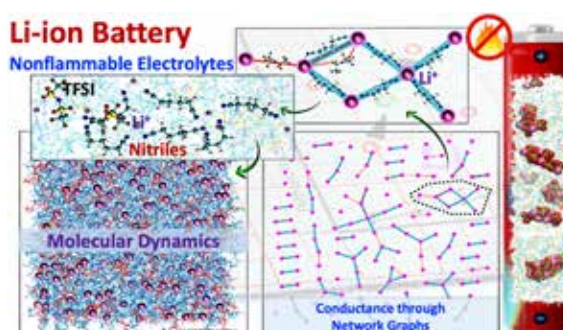


8. Our recent work on chalcogen bonding has been highlighted with cover art in the New Journal of Chemistry, Royal Society of Chemistry. The cover art depicts the first tetra coordinated zinc imidazoline selone catalyst-mediated C-S cross-coupling without scrubbing oxygen has been demonstrated.

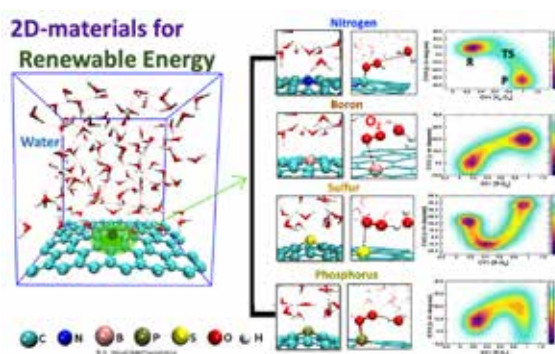


9. Designing electrolytes for safe and nonflammable Li-ion batteries

Li-ion battery technology proposed decades ago laid the foundation for an electronic revolution that has shaped the way human beings live today. The developments in this field have been very fast-paced, with a continuous effort by the scientific community to improve the efficiency of these cells.<sup>3</sup> The electrolyte used in batteries is a crucial component determining how ion transport occurs within them. The widely used electrolytes involve a mixture of cyclic and acyclic organic carbonates with LiPF<sub>6</sub> as the salt. This combination has successfully met many battery requirements but with a fair share of drawbacks. We apply classical molecular dynamics simulations to explore various industry-relevant properties of battery electrolytes based on nitriles and to design new electrolytes with appropriate properties for better performance.



*Network graphs and conductivity of Li-ion in dinitrile-based battery electrolytes from classical molecular dynamics simulations*



*Catalytic mechanism and reaction energetics of water oxidation reaction on doped 2D-surface from first principles molecular dynamics simulations*

Molecular oxygen and hydrogen can be obtained from the water-splitting process through the electrolysis technique. However, harnessing energy is very challenging due to the involvement of the 4e<sup>-</sup> reaction pathway. The pathway is associated with a substantial amount of reaction barriers. The energy barriers for individual steps can be explored using the biased first-principles molecular dynamics simulations to

overcome the high reaction barrier to know mechanistic details of the processes. The graphene surface with four different nonmetal doping atoms N, B, P, and S, can be the appropriate materials for generating renewable energy from water. The understanding of the catalytic process will help to design new catalysts for the process.

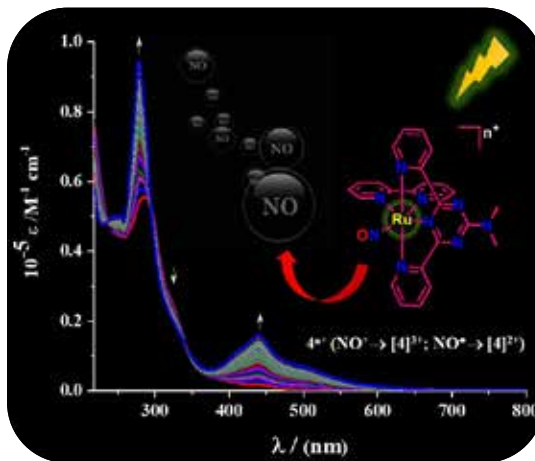
10. Our group developed a novel dual carbon battery consisting of zero transition metal that is environmentally benign. The fabricated 5.0 voltage (nominal voltage 4.65 V) cell provides an energy density of 100-watt hours per kilogram approximately and can be extended up to 150-watt hours per kilogram with further modifications. It may cut down the overall lithium-ion battery cost by 20%, and is expected to curb the unpredictability in market price.

The use of ubiquitous carbon as electrode active material as well as current collector replacing heavy metals brings in the aspects of lightness and flexibility. The research team believes that developed cells may find potential uses in high voltage applications, sophisticated battery-run medical devices, regenerative braking systems in electric vehicles, and stationary grids.

A manuscript based on this study is published in *Advanced Energy Materials* 11.17 (2021): 2100135.

#### 11. Photoactive Transition Metal Nitrosyls for NO release

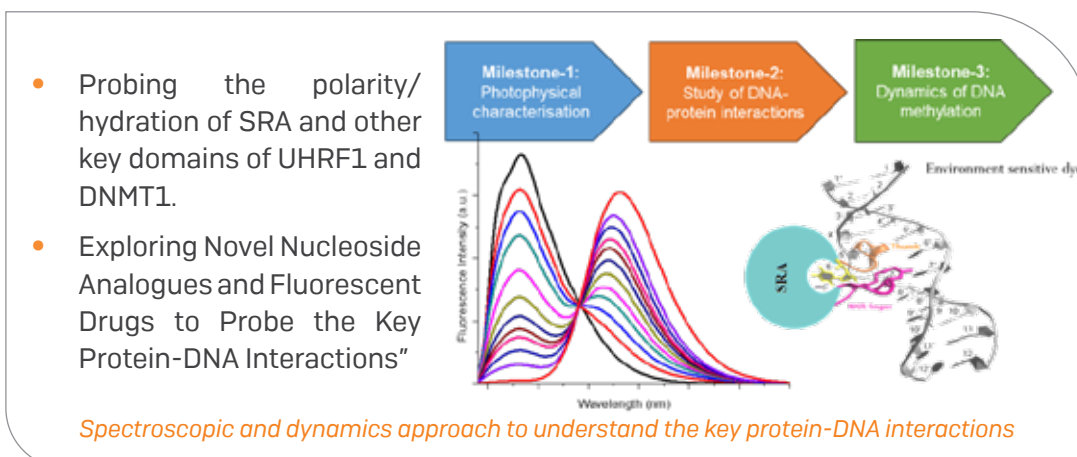
The small non-innocent molecule nitric oxide (NO) has inevitably been emphasized by the scientific community for decades due to its extraordinary role in the physiological and biological environment. Its most prominent roles in biological processes are primarily related to neuro-signaling, cardiovascular control, defense mechanisms other than tumor cells and microorganisms, and potential therapeutic applications. In this context, we have developed a series of transition metal nitrosyl which could photo deliver NO to biological targets on-demand which is very inspiring. Our ingenious design of metal nitrosyls resulting from polydentate ligands with strong absorption bands in the 500–800 nm region i.e., long wavelengths of visible light could perform the photo release without much tissue penetration and avoiding further speciation of the drug.



*Photoactive Transition Metal Nitrosyls for NO release*

12. Spectroscopic and dynamics approach to understand the key protein-DNA interactions
  - Unraveling the photophysics of fluorescent nucleoside analogues in different confined environments
  - Evaluating interactions of non-methylated and methylated DNA with proteins.





### 13. Dr S. Martha's Group

Martha group @ Department of Chemistry, IIT Hyderabad has developed a novel dual carbon battery consisting of zero transition metal that is environmentally benign. The fabricated 5.0 voltage [nominal voltage 4.65 V] cell provides an energy density of 100-watt hours per kilogram approximately and can be extended up to 150-watt hours per kilogram with further modifications. It may cut down the overall lithium-ion battery cost by 20%, and is expected to curb the unpredictability in market price.

The use of ubiquitous carbon as electrode active material as well as current collector replacing heavy metals brings in the aspects of lightness and flexibility. **The research team believes that developed cells may find potential uses in high voltage applications, sophisticated battery-run medical devices, regenerative braking systems in electric vehicles, and stationary grids.**

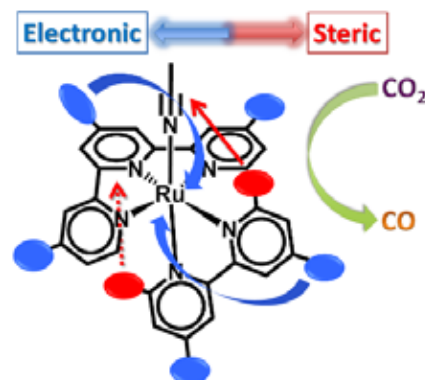
**A manuscript based on this study is published in Advanced Energy Materials 11.17 (2021): 2100135.**





**14. Research Highlights 2] from Dr S. Maji's group**  
**Bioinspired Molecular Catalysts for Carbon Dioxide Reduction**

The fast globalization of the 21st century has enforced the scientific community to think about alternative clean and sustainable energy sources of current exhaustible fossil fuels. Converting atmospheric CO<sub>2</sub> to higher-energy chemicals (CO, HCOOH, MeOH, or CH<sub>4</sub>) by photochemical, electrochemical, or photo-electrochemical reduction process could be one of the demanding approaches not only for the quest of renewable energy sources but also to alleviate the concentration of atmospheric CO<sub>2</sub>. We have synthesized a series of polypyridyl



*Bioinspired Molecular Catalysts for Carbon Dioxide Reduction*

Ruthenium catalysts which can electrocatalytically and selectively reduce CO<sub>2</sub>. By investigating the interplay between steric and electronic effects caused by ligand modifications within a series of Ruthenium complexes, we have shown the efficacy of such complexes as highly efficient CO<sub>2</sub> reduction catalysts.

**15. Research Highlights 3] from Prof Tarun's group**

A highly efficient and green process for the synthesis of  $\alpha$ -aminophosphonates has been developed, through a one-pot three-component reaction of various aldehydes, amines, and phosphine oxide in the presence of indium complexes as competent catalysts under the neat condition at room temperature. The indium complexes were synthesized by the reaction of protic ligand  $\beta$ -ketoimine with an equivalent amount of lithium hexamethyldisilazide followed by the addition of indium trichloride in toluene. The catalytic method offers an efficient approach with a broad range of  $\alpha$ -aminophosphine oxide derivatives in excellent yields with good functional group tolerance. Density functional theory-based mechanistic studies demonstrate energetically affordable pathways at room temperature for the indium catalyzed aminophosphorylation of benzaldehyde, phenylamine, and diphenylphosphine oxide. [see T. K. Panda et al. Inorganic Chemistry Frontiers, 2021, 8, 1142 - 115]

*Indium promoted C(sp<sup>3</sup>)-P bond formation by Domino A3-coupling method - A combined experimental and computational study*



# »» Department of Civil Engineering

The Department of Civil Engineering focuses on both basic and applied research to provide sustainable solutions to drive the future evolution of Civil Engineering (CE). Industry interaction and academic exchanges are integral characteristics of our department. The Department offers a Bachelor of Technology (BTech) program in Civil Engineering, and two-year and three-year Master of Technology and sponsored MTech programs in four specializations: Environmental Engineering, Hydraulics and Water Resources Engineering, Geotechnical Engineering, and Structural Engineering. The department also offers a Doctor of Philosophy (PhD) program in five specializations: Environmental Engineering, Geotechnical Engineering, Structural Engineering, Transportation Engineering, and Water Resources Engineering. CE faculty are committed to delivering knowledge and expertise in the broad spectrum of civil engineering and are actively involved with research that caters to societal needs in general. Our faculty and graduate students are actively involved in several sponsored projects from various funding agencies that include the Ministry of New and Renewable Energy, National Highway Authority of India, Ministry of Environment & Forests, and Ministry of Education. Our mission is to prepare the next generation of civil engineers to address a broad spectrum of problems that are central to the sustainability and economic growth of the country. The department's vision is to become a pioneering department in the country for teaching, research, and consultancy in existing and emerging areas of Civil Engineering.

## Highlights

- »» Received industry-sponsored research projects to the tune of two crores.
- »» State of the art laboratory facilities for teaching and research.
- »» Our faculty represent editorial boards of reputed journals and national committees of various agencies.



Earth provides enough to satisfy every man's need but not every man's greed. – Mahatma Gandhi



## Faculty



### S Suriya Prakash

PhD – Missouri University of Science & Technology – Rolla, USA

#### Professor & HOD

**Research Areas:** Precast Systems; Prestressed Concrete; Structural Concrete Behavior; Structural Strengthening



### K V L Subramaniam

PhD – Northwestern University, USA

#### Professor

**Research Areas:** Concrete Material and Structures; Structural Health Monitoring; Material Characterization



### S Sireesh

PhD – IISC Bangalore

#### Professor

**Research Areas:** Pavement Geotechnics; Geosynthetics; Recycled Materials; Ground Improvement



### Amirtham Rajagopal

PhD – IIT Madras

#### Professor

**Research Areas:** Fracture/ Damage Mechanics; Blast effect on Reinforced Concrete Structures; Computational Solid Mechanics



### B Umashankar

PhD – Purdue University, USA

#### Professor

**Research Areas:** Foundation Engineering; Reinforced Soil; Soil-Structure Interaction; Recyclable Materials in Geotechnics



### Shashidhar

PhD – IIT Madras

#### Professor

**Research Areas:** Bio-remediation; Contaminant Hydrology; Hydraulic Transients; Hydro Climate; Hazardous Waste Management; Wastewater Treatment; Remote Sensing and GIS Applications



### Mahendrakumar Madhavan

PhD – University of Alabama – Birmingham, USA

#### Associate Professor

**Research Areas:** Affordable Housing; Sustainable Materials; Cold-Formed Steel; Structural Steel Design; Cold-Formed Steel Wall Panels; CFRP Retrofitting of Steel Structures; Cold-Formed Steel (CFS) Connections; Composite (Steel-Concrete) Construction



### Asif Qureshi

PhD – Swiss Federal Institute of Technology, Switzerland

#### Associate Professor

**Research Areas:** Environmental Science, Biogeochemistry, and Public Health

**K B V N Phanindra**

PhD – New Mexico State University, USA

**Associate Professor**

*Research Areas:* Groundwater Modeling; Soil-Water-Plant Interactions; Remote Sensing & Gis; Eco-Hydrological Processes

**Debraj Bhattacharyya**

PhD – University of New Brunswick, Canada

**Associate Professor**

*Research Areas:* Water & Wastewater Treatment; Solid Waste Management; Renewable Energy (Biofuel)

**B Munwar Basha**

PhD – IISC Bangalore

**Associate Professor**

*Research Areas:* Unsaturated Soil Mechanics; Reliability Based Design; Geotechnical & Geoenvironmental Engineering; Computational Geomechanics; Municipal Solid Waste Landfills; Soil Dynamics and Earthquake Resistant Design; Retaining Structures; Reliability Analysis of Pavement Geotechnics; Rock Mechanics

**Anil Agarwal**

PhD – Purdue University, USA

**Assistant Professor**

*Research Areas:* Structural Fire Engineering; High-Temperature Testing; Large-Scale Testing; Collapse Prevention; Structural Design for Extreme Conditions; Steel Structures; Composite Structures; Earthquake Resistant Design; Structural Strengthening

**Surendra Nadh Somala**

PhD – California Institute of Technology, USA

**Assistant Professor**

*Research Areas:* Earthquake Protection using Metamaterials; Active and Passive Structural Vibration Control; Seismic Resilience; Structural Health Monitoring Engineering Seismology; Computational Fracture Mechanics

**Digvijay S Pawar**

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**Assistant Professor**

*Research Areas:* Driver and Pedestrian Behavioral Modeling; Traffic Safety and Accident Analysis; Traffic Operation and Simulation; Intelligent Transportation Systems; Statistical Modelling and Classification Technique; Naturalistic Driving Study And Human Factors

**Satish Regonda**

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**Assistant Professor**

*Research Areas:* Urban and Rural Flood Modeling; Climate Sciences; Data Sciences; Statistical Modeling Techniques; Ensemble Forecasting; Tools and Products Development; Gis; R; Shiny

**Seetha N**

PhD – IISC Bangalore

**Assistant Professor**

*Research Areas:* Transport of colloids in Porous Media; Multi-Scale Modeling; Upscaling of transport processes; Co-transport of multiple colloids

**Pritha Chatterjee**

PhD – IIT Kharagpur  
**Assistant Professor**

*Research Areas:* Waste Treatment; Resource Recovery from Waste; Bioenergy; Bioelectro Chemical Systems; Anaerobic Digestion

**Sk Zeeshan Ali**

PhD – IIT Kharagpur  
**Assistant Professor**

*Research Areas:* Turbulent flows, sediment transport, applied hydrodynamics

**Ambika S**

PhD – IIT Madras  
**Assistant Professor**

*Research Areas:* Environmental Nanotechnology; Low Cost Wastewater Treatment; Resource Recovery from Waste; Life Cycle Analysis; EIA and Sustainability Analysis; Industrial Waste Management; Fate and Transport of Colloids and Pollutants

**Mullapudi Ramya Sri**

PhD – IIT Kharagpur  
**Assistant Professor**

*Research Areas:* Pavement Materials, Analysis and Design of Pavements, Evaluation and Rehabilitation of Pavements, Pavement Management Systems (PMS)

**D Chandrasekharam**

PhD – IIT Bombay  
**Visiting Professor**

*Research Areas:* Groundwater Pollution; Geothermal Energy

**Madhira R Madhav**

PhD – IISc Bangalore  
**Honorary Professor**

*Research Areas:* Pile foundations, Rock mechanics, Seepage through dams, Reinforced earth, Granular piles, Analysis of settlement of foundations, Ground improvement methods

**Rao Surampalli**

PhD – Iowa State University, Ames, Iowa  
**Honorary Professor**

*Research Areas:* Water and wastewater treatment, Soil and groundwater Remediation, Greenhouse gas emissions and climate change mitigation, Production of biodiesel bioplastics, biopesticides from biosolids or waste



### Patents Filed/Granted

1. Bhattacharyya, D & Kurilla, K.K, An Improved Sequential Batch Reactor For Wastewater Treatment, 24-07-2020, 202041031706.

### Book/Book Chapter

1. Sireesh. Saride, Umashankar Balunaini and Deepti Avirneni (eds.). Advances in Geotechnical and Transportation Engineering. Springer Lecture Notes in Civil Engineering Series, DOI <https://doi.org/10.1007/978-981-15-3662-5>, 2020, ISBN 978-981-15-3664-9.
2. Saride, S and Rayabharapu, V.K. [2020]. 'Chapter: Design of Geocell-Reinforced Pavement Bases', Geocells-Advances and Applications, Edts. Sitharam, T. G., Hegde, A., Kolathyar, S. Springer Transactions in Civil and Environmental Engineering, pp. 225-255.
3. K.A.Gomathi, A.Rajagopal, [2020] Numerical Damage Modelling of RC Slabs Under Blast Loading Using K&C Concrete Model, Recent Advances in Computational Mechanics and Simulations, 103, 529- 541.
4. Nasedkin Andrey., Nasedkina Anna., and Rajagopal Amirtham, [2020]. Finite Element Investigation of Effective Moduli of Transversely Isotropic Thermoelastic Materials with Nanoscale Porosity, Advanced Materials- Proceedings of the International Conference on "Physics and Mechanics of New Materials and Their Applications", PHENMA 2019., 325-337, 2020, Springer, Cham.
5. Bhagath Singh, G. V. P., & Subramaniam, K. V. L. [2020]. Estimation of Fly Ash Reactivity and Dissolution Characteristics. In K. V. L. Subramaniam & M. A. Khan (Eds.), Advances in Structural Engineering [Vol. 74, pp.

- 67-72]. Springer Singapore. [https://doi.org/10.1007/978-981-15-4079-0\\_6](https://doi.org/10.1007/978-981-15-4079-0_6).
6. Vemuri, J., & Subramaniam, K. V. L. [2020]. Seismic Fragility Assessment of Unreinforced Masonry Shear Walls. In K. V. L. Subramaniam & M. A. Khan (Eds.), Advances in Structural Engineering [Vol. 74, pp. 1-14]. Springer Singapore. [https://doi.org/10.1007/978-981-15-4079-0\\_1](https://doi.org/10.1007/978-981-15-4079-0_1).
7. Lakavath, C., Bhosale, A., & Prakash, S. S. [2020]. Experimental Investigation on Crack-Arresting Mechanism of Steel Fibre-Reinforced Concrete Prism Specimens Using DIC and AE Techniques. Advances in Structural Engineering, 51-65. [https://doi.org/10.1007/978-981-15-4079-0\\_5](https://doi.org/10.1007/978-981-15-4079-0_5).
8. Chobe, G. S., & Madhavan, M. [2020]. Investigation of Cold-Formed Steel Members Subjected to Extreme Low Temperatures Relevant to the Arctic Environment. Advances in Structural Engineering, 41-50. [https://doi.org/10.1007/978-981-15-4079-0\\_4](https://doi.org/10.1007/978-981-15-4079-0_4).
9. Krishna Chaitanya N., Tripathi, A., Chatterjee, P. [2020] Microbial electrosynthesis: Recovery of high-value volatile fatty acids from CO<sub>2</sub>, Elsevier.
10. Parhi, P. S., & Umashankar, B. [2020]. MASW Survey to Map Soil Layers and Rock Profiles in a Construction Site. In M. Latha Gali & R. R. P. (Eds.), Geotechnical Characterization and Modelling [Vol. 85, pp. 481-491]. Springer Singapore. [https://doi.org/10.1007/978-981-15-6086-6\\_39](https://doi.org/10.1007/978-981-15-6086-6_39).

### Publications (Journal)

1. Jallu, M., Arulrajah, A., Saride, S., & Evans, R. [2020]. Flexural fatigue behavior of fly ash geopolymer stabilized-geogrid reinforced RAP bases. Construction and Building Materials,

- 254, 119263. <https://doi.org/10.1016/j.conbuildmat.2020.119263>.
2. Peddinti, P. R. T., Munwar Basha, B., & Saride, S. [2020]. System Reliability Framework for Design of Flexible Pavements. *Journal of Transportation Engineering, Part B: Pavements*, 146(3), 04020043. <https://doi.org/10.1061/JPEODX.0000186>
3. Saride, S., & Jallu, M. [2020]. Effect of Fly Ash Geopolymer on Layer Coefficients of Reclaimed Asphalt Pavement Bases. *Journal of Transportation Engineering, Part B: Pavements*, 146(3), 04020033. <https://doi.org/10.1061/JPEODX.0000169>.
4. Goud, N, Ramu, B., Balunaini, U., Mouli, S., Saride, S., and Madhav M R [2020] Evaluation of layer coefficient ratios for geogrid-reinforced flexible pavements, *Road Materials and Pavement Engineering, T&F*, <https://doi.org/10.1080/14680629.2020.1812424>.
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### Publications [Conference]

1. Krishna, M., & Saride, S. (2019, January 31). Determination of Groutability Ratio Through Image Processing. [https://doi.org/10.1007/978-981-15-6086-6\\_5](https://doi.org/10.1007/978-981-15-6086-6_5).
2. Saride, S., & Kumar, V. V. (2019, October 18). Performance of geosynthetic-interlayered asphalt layers under cyclic loading. 16th Asian Regional Conference on Soil Mechanics and Geotechnical Engineering, ARC 2019, 2020.
3. Kumar, A., & Saride, S. (2020). Mandel-Cryer Effect in Vacuum Consolidation—A Numerical Study (pp. 997–1004). [https://doi.org/10.1007/978-981-15-6086-6\\_80](https://doi.org/10.1007/978-981-15-6086-6_80).
4. Dhaladhuli Pranavi, Amirtham Rajagopal, Nonlocal diffused approach to model delamination in composites, 3rd Structural Integrity Conference and Exhibition [SICE 2020 e-Conference], India, 2020.
5. K.A.Gomathi, A.Rajagopal, Dynamic performance of RC slab under blast and impact loading, 3rd Structural Integrity Conference and Exhibition [SICE 2020 e-Conference], India, 2020.
6. Selvaraj, S., Madhavan, M. (2020). Cold-formed steel built of columns: Experimental investigation, Proceedings of the 9th International Conference on Advances in Steel Structures, ICASS 2018.
7. Basha, B. M., Gautham, A., & Moghal, A. A. B. (2020). Reliability-Based Optimum Design of Anchored Rock Slopes Considering Rock Bolt and Rock Mass Interaction. 379–387. <https://doi.org/10.1061/9780784482810.040>.
8. Raghuram, A. S. S., Raviteja, K. V. N. S., Basha, B. M., & Moghal, A. A. B. (2020). Reliability-Based Design Charts for Spatially Variable MSW Landfill Slopes. 696–706. <https://doi.org/10.1061/9780784482797.068>.
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10. Banoth, Ira and Agarwal, Anil (2020). Bond-behavior between reinforcing steel bars and concrete at elevated temperatures. 11th International Conference on Structures in Fire [SiF2020], Online, 30 November - 2 December 2020. Brisbane, Australia: The University of Queensland. <https://doi.org/10.14264/cb71fc6>.
11. Natesh, Priya S. and Agarwal, Anil (2020). The role of end conditions on the behavior of steel-concrete composite beams in a fire. 11th International Conference on Structures in Fire [SiF2020], Online, 30 November - 2 December 2020. Brisbane, Australia: The University of Queensland. <https://doi.org/10.14264/9d748da>.
12. Chinthapalli, Hemanth Kumar and Agarwal, Anil (2020). Post-earthquake fire assessment of reinforced concrete columns. 11th International Conference on Structures in Fire [SiF2020], Online, 30 November - 2 December 2020. Brisbane, Australia: The University of Queensland. <https://doi.org/10.14264/4c04cb2>.
13. Banoth I., Agarwal A. (2020) Effect of Heating Rate on Bond Behavior

- Between Steel and Concrete at Elevated Temperatures. In: Subramaniam K., Khan M. [eds] *Advances in Structural Engineering. Lecture Notes in Civil Engineering*, vol 74. Springer, Singapore. [https://doi.org/10.1007/978-981-15-4079-0\\_8](https://doi.org/10.1007/978-981-15-4079-0_8).
14. Singh S., Agarwal A. [2020] Numerical Analysis of Post-earthquake Fire Resistance of concrete-filled Tubular Steel Columns. In: Subramaniam K., Khan M. [eds] *Advances in Structural Engineering. Lecture Notes in Civil Engineering*, vol 74. Springer, Singapore. [https://doi.org/10.1007/978-981-15-4079-0\\_12](https://doi.org/10.1007/978-981-15-4079-0_12).
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  17. Magdum, S. S., Franklin, A., Tamma, B. R., & Pawar, D. S. [2020]. SafeNav: A Cooperative V2X System using Cellular and 802.11p based Radios opportunistically for Safe Navigation. 2020 IEEE 23rd International Conference on Intelligent Transportation Systems (ITSC), 1–6. <https://doi.org/10.1109/ITSC45102.2020.9294348>.
  18. Malaghan, V., & Pawar, D. S. [2020]. Operating Speed Differential Model for Heavy Vehicles using GPS Driving Data. *Transportation Research Procedia*, 48, 3706–3716. <https://doi.org/10.1016/j.trpro.2020.08.072>.
  19. Y. Sai Rama Krishna, N. Seetha, Predicting Colloid Deposition Parameters at the Column Scale, AGU Fall Meeting, 2020.
  20. T. Reshma Mohan, N. Seetha, L. Rao, M.S. Mohan Kumar, Numerical Simulation of Hydrodynamics and Bio-Chemical Membrane Fouling in Porous Media, AGU Fall Meeting, 2020.
  21. J Indu, Argha B, Karthikeyan Lanka, Neha Khandekar, Satish Regonda, N. Seetha, Conceptualization of Spatial and Temporal Scale Issues in Indian Hydrology, AGU Fall Meeting, 2020.
  22. Asams MA, Latha P, Chatterjee P, Statistical study of growth rate and lipid content of microalgae, Abstract accepted for presentation at 10th Algal biomass, biofuels and bioproducts conference, Pittsburgh, USA, December 2020.
  23. Fathima J., Chatterjee P., Impact of growth conditions on harvesting techniques for mixed microalgal culture. Abstract accepted for presentation at 10th Algal biomass, biofuels and bioproducts conference, Pittsburgh, USA, December 2020.
  24. Prabhakara, B. K. K., & Balunaini, U. [2020]. Fly Ash-Granulated Rubber Mixture as Lightweight Geomaterial. *Geo-Congress 2020*, 115–123. <https://doi.org/10.1061/9780784482827.013>

### Funded Research Projects

1. Prof S Sireesh, Expert opinion and vetting the design parameters including dynamic soil properties for a nearshore structure, Sarathy Geotech & Engineering Services Pvt. Ltd., Sep 25, 2020, 11.21L.

2. Dr Seetha N, Assessing the environmental fate and transport of a mixture of nanoparticles through the soil, DST, Sep 1, 2020, 25.10L.
3. Prof S Suriya Prakash, Teachers Associateship for Research Excellence [TARE] - Shri Sunil Raiyani, SERB, Jan 22, 2021, 27L.
4. Prof Shashidhar, AMR Flows: Antimicrobials and resistance from manufacturing flow to people: joined-up experiments, mathematical modeling, and risk analysis, DBT, Dec 11, 2020, 186.53L.
5. Dr Ambika S, Development of Solar Light-Driven Photocatalytic Membrane Reactor for Agricultural Return Water Treatment-A New Horizon in Tackling Membrane Fouling and Emerging Contaminants, SERB, Dec 29, 2020, 31.11L.
6. Prof S Sireesh, Evaluation of TechCell®-Reinforced Marginal Aggregates as Pavement Bases, M/s TechFab [India] Industries Ltd., Jan 2021, 11.00L.
7. Dr Debraj Bhattacharyya, Dynamic Evaluation of pharmaceutical Contamination and antibiotic bacteria in Indian river, DST-JSPS, 01-01-2021, 4.7L.
8. Prof S Suriya Prakash, Validating of FRP rebars For Infrastructure Applications Carborundum Universal Ltd., Nov 20, 2020, 2.95L.
9. Prof K V L Subramaniam, Development and test of a portable non-destructive sensor to assess short and long-term properties [such as setting, hardening, and strength gain] of in-situ concrete, Lafarge Centre De Recherche, Mar 23, 2021, 85.80L.
10. Prof B Umashankar, Evaluation of soil stabilized base courses with cement and StabilRoad additive, Vishwa Samudra Engineering P Ltd, Mar 20, 2021, 15.91L.

## Workshops Conducted

1. NMAMLD 2020, Nonlocal Mechanics Approaches for Modeling Localized Deformations, Sponsored by CSIR, DRDO, and DSS Simulia., 19 -21 February 2020, IIT Hyderabad.
2. Awareness Workshop on Mercury as a Global Pollutant, Manipur University, 30 Jan 2020.
3. Awareness Workshop on Mercury as a Global Pollutant, NIT Jalandhar, 23 Oct 2020.
4. Awareness Workshop on Mercury as a Global Pollutant, Presidency Higher Secondary School, Guna, 4 Feb 2021.
5. Awareness Workshop on Mercury as a Global Pollutant, KL University, 5 Feb 2021.
6. Dr Harinarayan Tiwari, Managing Director, Floodkon Consultants LLP: Flood Concepts and Tools of Practice, 13-Jan-21.
7. Mr Bikas Chaudhuri, Technical advisor, Dredging Corporation of India [DCI]; Retired Chief Hydraulic Engineer, Kolkata Port Trust: Management of a tidal navigational channel, set up in alluvium with special reference to Hugli Estuary in the eastern coast of India: problems, prospects, and challenges, 20-Jan-21.
8. Dr Tirumaleswara Reddy, Technical Director, DHI [India] Water & Environment Pvt Ltd: Application of Mathematical Models-Ports & Harbours, 3-Feb-21.
9. Dr Sat Kumar Tomer, Co-founder, CEO, Satyukt Analytics Private Limited: Bringing precision farming to smallholder farmers: Application of satellite remote sensing, 4-Feb-21.
10. Dr Pandith Madhnure, Director, Ground Water Department, Irrigation & CAD, Govt. of Telangana: Participatory Groundwater Management and Managed

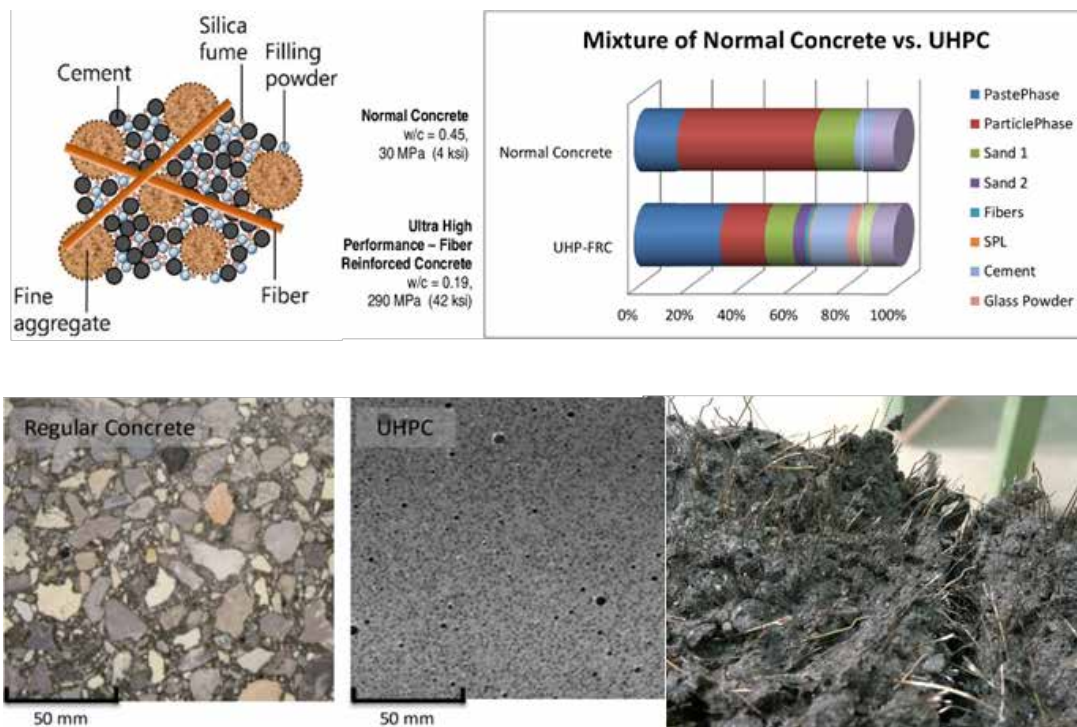
- Aquifer Recharge - A Case Study from Telangana, 10-Feb-21.
11. K Sri Harsha, Co-founder & Director, Kritsnam technologies: Internet of Things (IoT) instrumentation for water resources management, 17-Feb-21.
  12. Dr Ajay Pradhan, President, Consulting Engineers Association of India, Water Resources Planning and Climate Change – Modelling Tools, 24-Feb-21.
  13. Dr H D Chandewar, Chief Consulting Engineer, Hitbhav Engineers: Design of Sweet Water Reservoir in Desert Area-A case study, 3-Mar-21.
  14. Mr Amit Mishra, marketing expert, Vassar labs: Technology towards sustainable water resources management, 10-Mar-21.
  15. Lessons learned from numerical modeling of MSE walls by Prof Richard Bathurst, Professor Emeritus of Civil Engg. at the Royal Military College of Canada, Golden Jubilee Conference and Lecture Series Grant on Urban Issues/ Sustainability theme. 23rd March 2021.
  16. Foundations of Critical Civil Infrastructure (FOCI)- Theory to Design, 5-Day Faculty Development Program (FDP), AICTE Training and Learning (ATAL) Academy, 1st Oct.-5th Oct. 2020.
- Member, Indian Concrete Journal.
4. Prof S. Suriya Prakash, Professor, has received the Young Scientist Award for 2020 from Indian Concrete Institute, India.
  5. Prof S. Suriya Prakash, Professor, received Teaching Excellence Award for 2020, from IIT Hyderabad.
  6. Mr Chandrasekhar Lakavath has received a PMRF fellowship to pursue PhD.
  7. Ms Keerthi Katam (student), has received Research Excellence Award at IIT Hyderabad.
  8. Ms K.L. Subhavana (graduating PhD student), received the Academic Research Excellence award from IIT Hyderabad (2020).
  9. Ms Akila M (PhD Student), received the Swiss Government Excellence Scholarship (2020-21).
  10. Dr Anil Agarwal, Assistant Professor, received the Young Turk of Composites Award 2019-20 by FRP Institute, Chennai and TAACMA (Telangana and Andhra Composites Manufacturers Association).
  11. Mr Vinayak Malaghan, a PhD student, received the Research Excellence award by IITH.
  12. Dr Seetha N, Assistant Professor, has been inducted as Review Editor in the Environmental Water Quality, Frontiers in Water.

### Awards and Recognitions

1. Prof K.V.L. Subramaniam, Professor, has delivered the G. K. Reddy Endowment Lecture, Institution of Engineers (India) – 2020.
2. Prof S. Suriya Prakash, Professor, has been inducted into the Editorial Board Member, ASCE Journal of Composites for Construction.
3. Prof S. Suriya Prakash, Professor, has been inducted into the Editorial Board
13. Mr Y. Sai Rama Krishna received Virtual Student Travel Grant, American Geophysical Union Fall Meeting, 2020.
14. Dr B Umashankar, Professor, was awarded 'Lecture Grant' under Golden Jubilee Conference and Lecture Series Grant (GJCLSG) for the year 2020-21 instituted by Shastri Indo-Canadian Institute (SICI).

## Civil Engineering *Highlights* //////////////////////////////////////

1. Ultra-High-Performance Concrete (UHPC) is an advanced and promising cementitious material. UHPC has great potential in improving the resilience and sustainability of civil infrastructure facilities that are vulnerable to extreme loading conditions like earthquakes and blasts. The aim of this research is to develop UHPC for blast resistance applications and to understand the behavior under high strain rate loading using Split Hopkinson Pressure Bar (SHPB) test setup.



### *Ultra-High-Performance Concrete (UHPC) For Blast Resistance Applications*

2. An immense study on cold-formed steel (CFS) structures has been done and respective and code accepted design guidelines for efficient design of steel members have been suggested. Various fields of research have been elevated from experimental works like novel composite light-weight flooring systems, Hybrid columns, CFS wall panels, and CFS member connections.



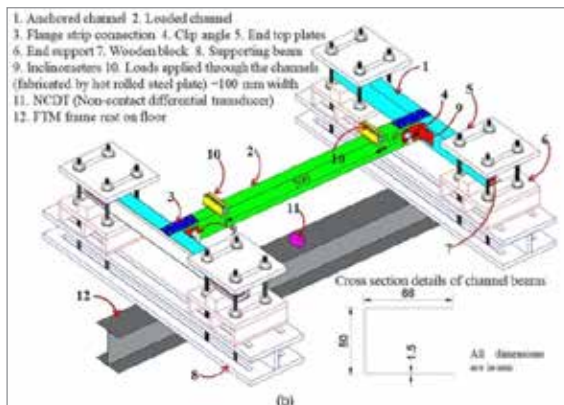


Figure 1. CFS beam-to-beam connection with clip-angle and flange-strip

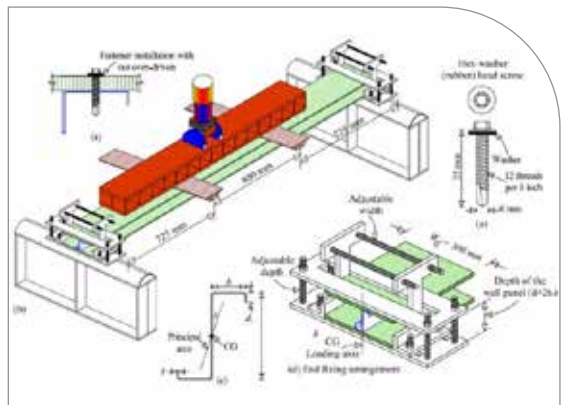


Figure 2. Composite CFS wall panel experimental study

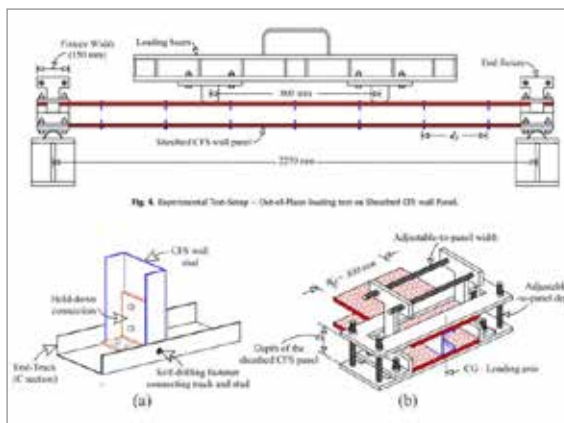


Figure 3. Experimental analysis of CFS sheathed wall panel

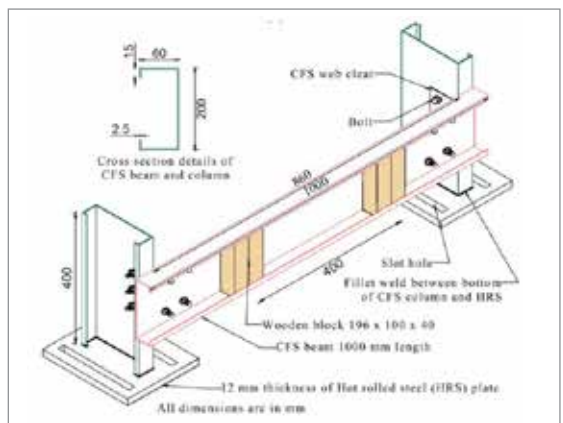


Figure 4. Experimental study of Beam-to-Column connection by bolted clip-angle

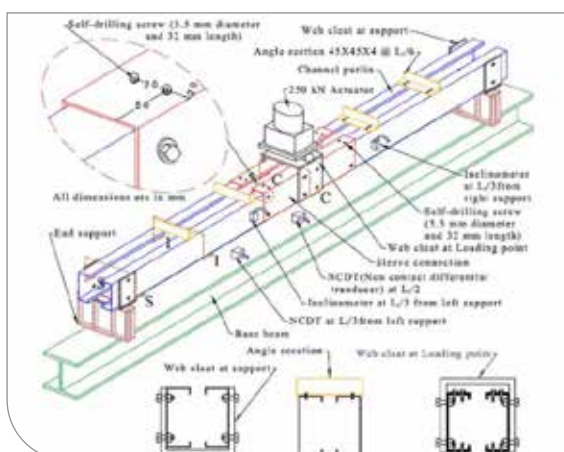


Figure 5. Study of built-up CFS section under flexure

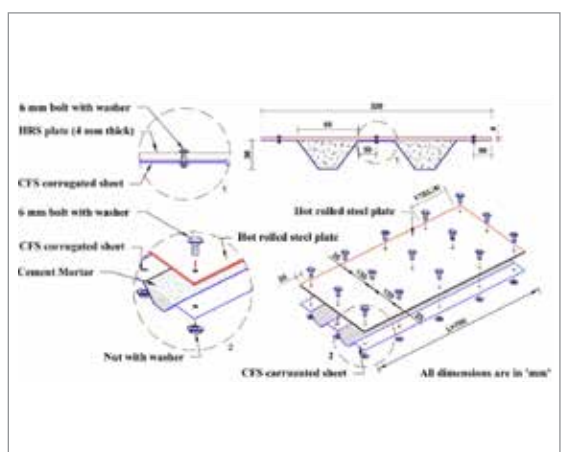


Figure 6. Composite light-weight flooring system study

3. **Improved Sequential Batch Reactor (SBR) for wastewater treatment:** SBR is an established technology for wastewater treatment. However, conventional SBRs have issues related to the maintenance, sludge wasting, and decanting of the treated water. The improvements made by our group have significantly reduced the above issues. A pilot-scale prototype has been tested on the field with real wastewaters under real conditions. The prototype has given satisfactory performance.



*Improved Sequential Batch Reactor (SBR) for wastewater treatment*

4. **Wastewater treatment using microalgae:**

Wastewater treatment using conventional activated sludge process is energy-intensive and costly due to high aeration requirements. Moreover, they are usually designed to remove only organic carbon from wastewater. Removal of nutrients requires additional bioreactors which make the conventional treatment process complex. Our group has been working for some time on wastewater treatment using a mixed culture of activated sludge and microalgae. The system is capable of giving a comparable performance at a lower cost.

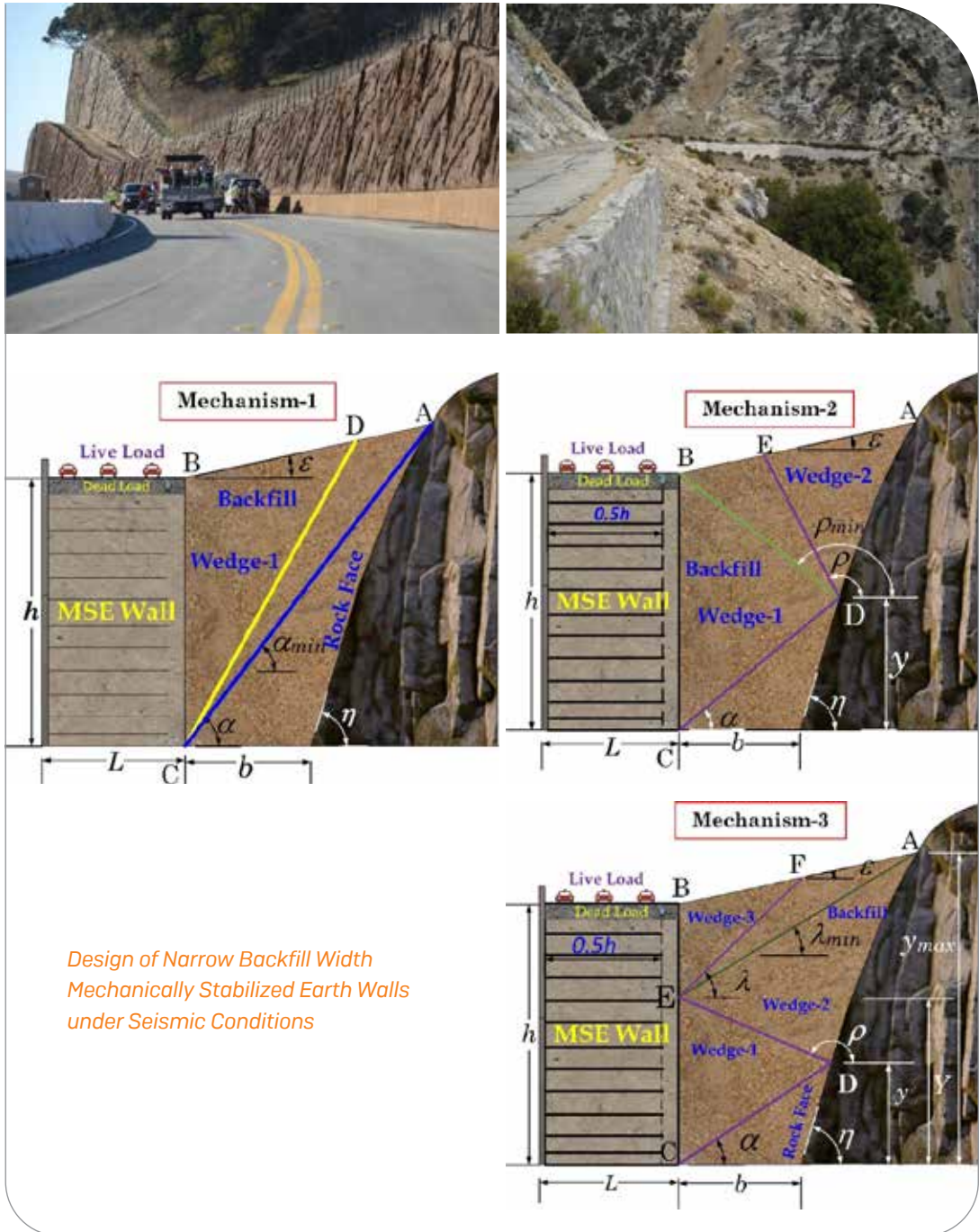


*Wastewater treatment using microalgae*

Moreover, simultaneous removal of organic carbon and nutrients can be achieved in a single bioreactor. Greenhouse gas emissions and energy input are also less. A prototype is currently under development.

## 5. Design of Narrow Backfill Width Mechanically Stabilized Earth Walls under Seismic Conditions

The major cost associated with the widening of roads mainly depends on the availability of space on the right-of-way at the job site. However, to avoid the land acquisition problem and to minimize the cost of the project on the addition of right-of-way, where the availability of space is limited, there is a need to construct earth retaining walls within a constrained space as shown in the following figures.





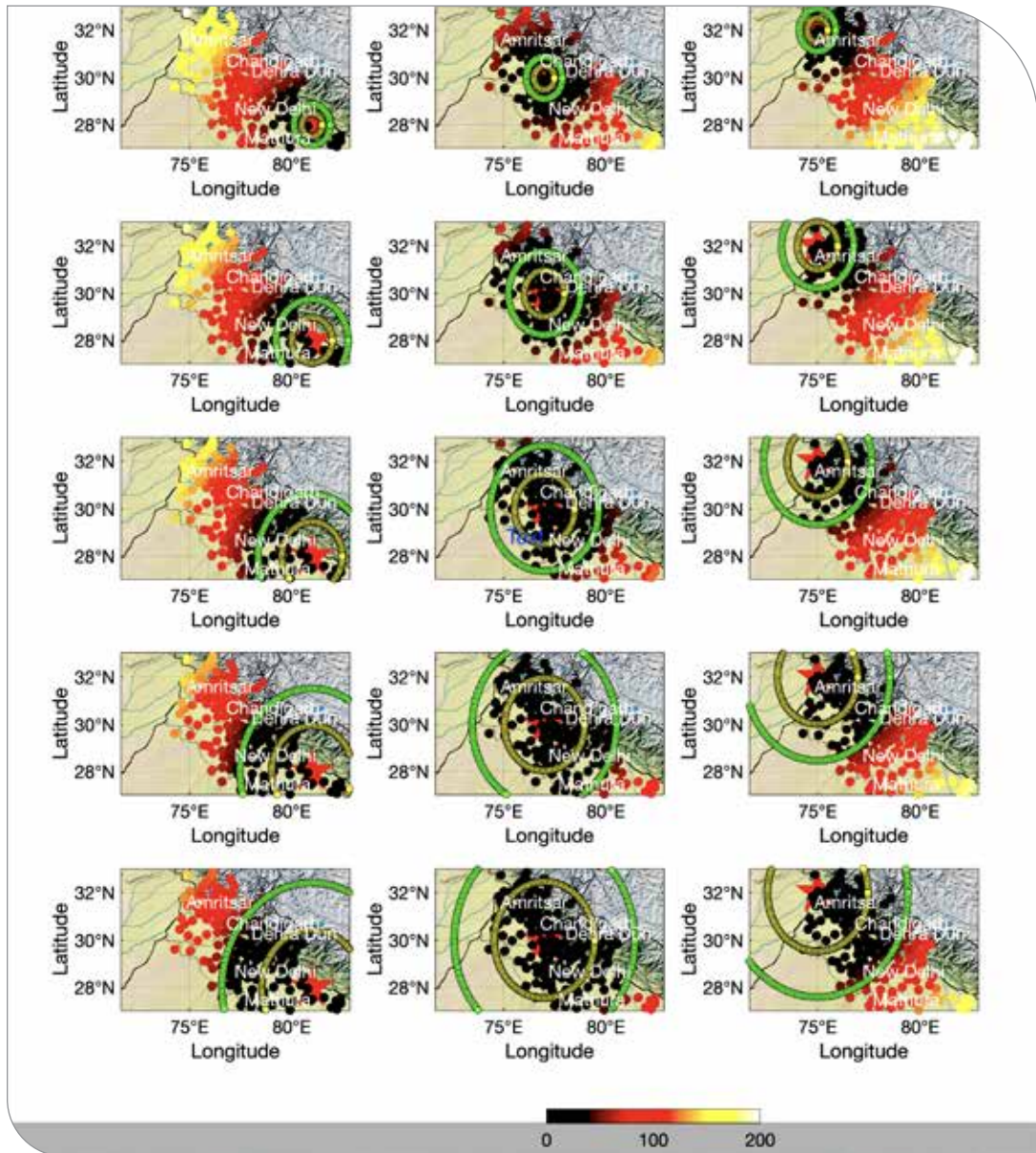
Under various options, one of the options is to build an MSE Wall in front of rock faces. Various aspects need to be considered while designing narrow backfill width MSE walls, such as the flexibility in construction, economic optimization (cost analysis), logistics, reliability, aesthetic, and safety aspects. Therefore, there is a need to construct narrow backfilled width retaining (NBWR) walls. The behavior of NBWR walls under seismic conditions is also an important issue due to their wide applications in several infrastructural applications. The design methodology for earth retaining structures placed in front of a stable slope or rock faces with limited space is unclear at present. The design and construction of narrow MSEW are not addressed in the FHWA guidelines. The design of narrow backfill width MSE retaining walls is different from conventional gravity walls, as the earth pressures are different from conventional gravity walls due to the wall geometry and inadequate development of active thrust (failure) wedge.

The existing earth pressure theories do not consider the effect of rock face adjacent to the MSE retaining walls. The evaluation of seismic active earth pressure acting on narrow backfilled retaining walls is more essential during earthquake loading to ascertain safety and economical design. An analytical procedure is needed to evaluate the static and seismic active earth pressure for narrow backfill width retaining walls using the limit equilibrium method under static and earthquake loading. The existence of rock behind the retaining wall that affects the size and shape of the failure wedge in narrow backfill soil is considered. The study also accounts for the strain-softening behavior (strain localization) under earthquake loading by considering the change in shear strength due to the reduction in friction angle from peak to residual along the bilinear failure slip surfaces in backfill soil. The formation of multiple failure surfaces due to multiple failure wedges as shown in Fig. 2 in the narrow backfill soil is considered.

The formulation is proposed for the computation of seismic active earth pressure and point of application of total thrust when MSE walls are built near rock faces considering strain localization, post-peak reduction in shear strength of narrow backfills, the distance of rock face from the wall, and formation of reflective shear bands in narrow backfills for the design of narrow backfill MSE walls. The cost is reduced significantly which is associated with the construction of MSW walls near rock faces in terms of optimized length of the geosynthetic reinforcement for the satisfactory performance of MSE walls against external and internal stability.

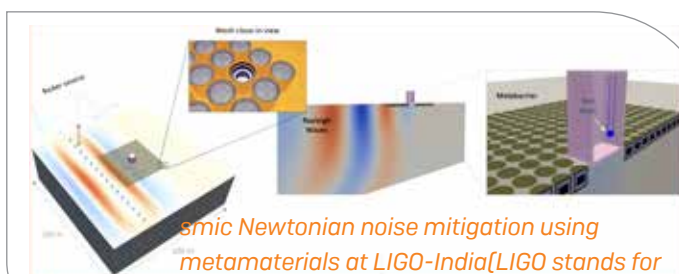
## **6. Earthquake Early Warning for the Himalayas using Artificial Intelligence**

Dr Somala's group has been using Artificial Intelligence to estimate the feasibility of earthquake early warning in the Himalayas. Future epicenters of earthquakes are unknown apriori. So, multiple scenarios are simulated and blackout zones are marked along with potential warning time. Deep learning and transfer learning are being used on scenario earthquake simulations for a real-time alert to fellow Indians living near the Himalayas.



*Advanced Newtonian noise suppression for futuristic Laser Interferometric Gravitational Observatories (LIGO)*

In collaboration with Caltech and IUCAA, Dr Somala's group at IITH has come up with buried resonator designs that can suppress Rayleigh waves within the frequency band of interest to LIGO. This

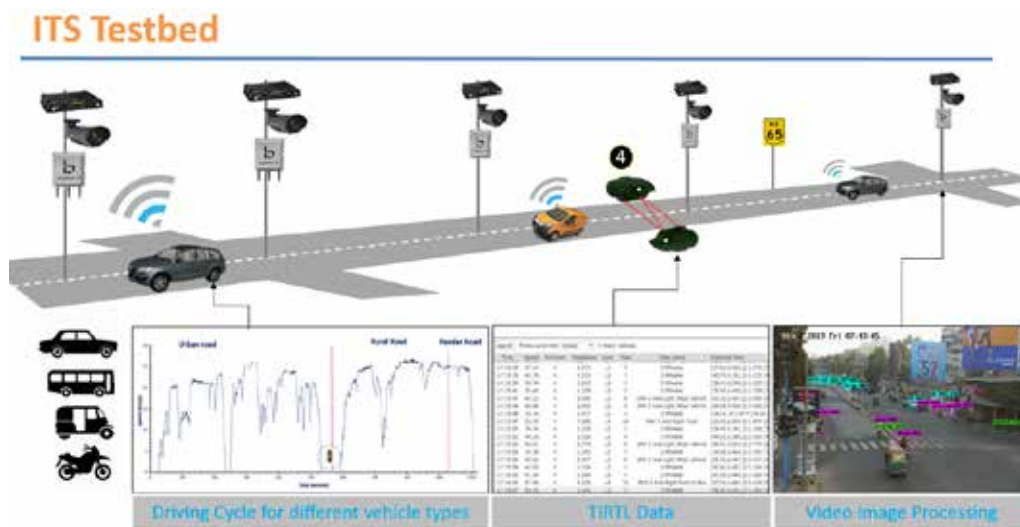


*Seismic Newtonian noise mitigation using metamaterials at LIGO-India (LIGO stands for Laser Interferometric Gravitational Observatory)*

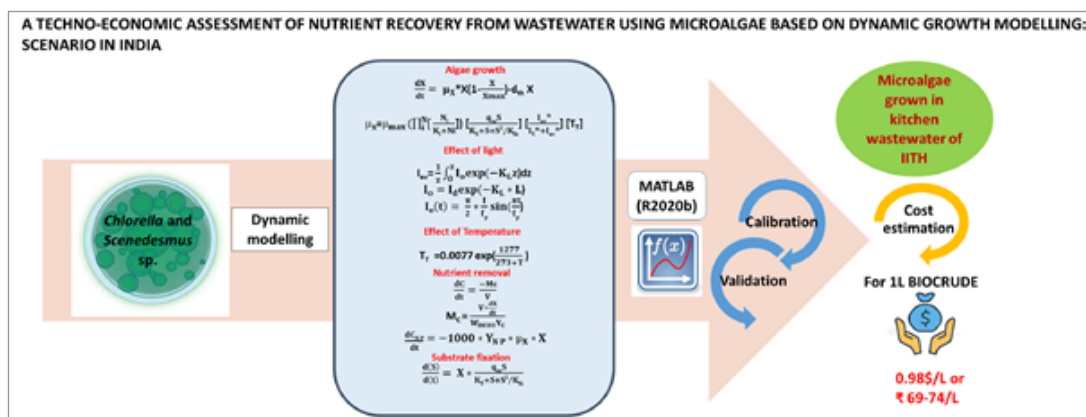
allows for pushing the limits of the detector towards lower frequencies and thereby improving the sensitivity further. This concept is also being explored in the context of the upcoming LIGO-India detector, which is only going to be the 3rd of its kind in the world, apart from the 2 other detectors in the US.



7. Dr Pawar deployed several ITS technologies such as a driver warning system at intersections and for safe merging, sensors such as TIRTL, Radar, Virtual loop, Bluetooth and WiFi on local roads and National Highway for collecting traffic data to improve safety and travel time prediction in the prestigious project “Multimodal smart transportation” funded by JICA, Japan. Recently, he also played a key role in designing the CAVs tested-bed at IIT Hyderabad under the prestigious project Technology Innovation Hub on Autonomous Navigation and Data Acquisition Systems, funded by DST, which will be a first of its kind facility across India for testing Autonomous and Connected Vehicles.



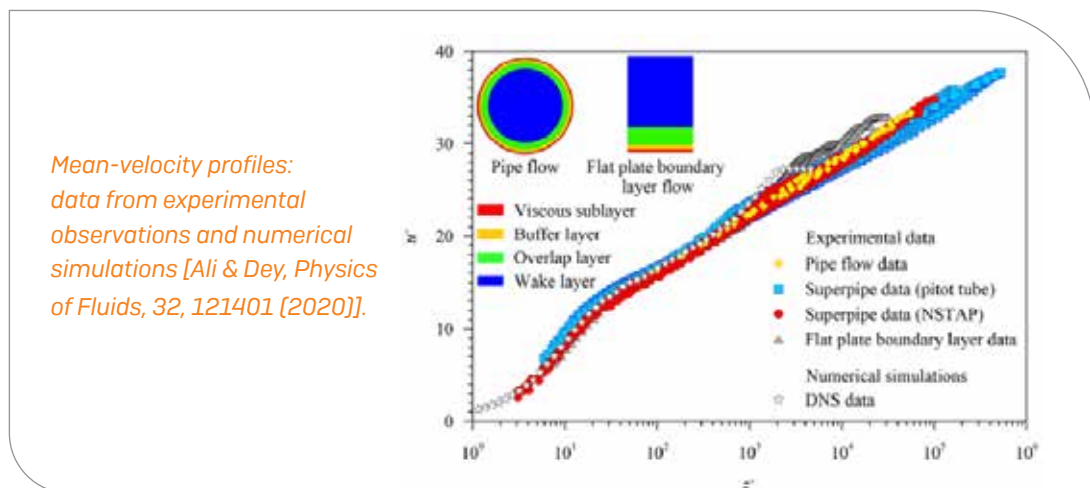
8. To determine the potential of microalgae-based wastewater treatment modeling of microalgae growth based was carried out. Techno-economic evaluation for microalga-based nutrient recovery and wastewater treatment scheme for implementation in a warm, arid climate was also assessed. The break-even selling price of \$0.558/kg is obtained for the algal biomass. The cost of production of 1 L bio-crude from microalgae grown in kitchen wastewater in IITH was 0.98 \$ (Rs 69-74) which is comparable with crude oil cost.



*A Techno-Economic Assessment of Nutrient Recovery from Wastewater using Microalgae based on Dynamic Growth Modelling*

## 9. Perspective on the law of the wall

The law of the wall predicts the mean-velocity profile in a wall-bound flow. For about nine decades, the underlying physics of the law is deemed to be governed by an ad hoc mixing-length hypothesis. We seek the origin of the law, for the first time, with the aid of a new hypothesis, which we call the mixing-instability hypothesis. The hypothesis states that the turbulent mixing produces disturbances that transmit in the form of waves, causing a continuous stretching and shrinking of turbulent eddies. It reveals the previously unknown universal scaling behavior for the amplitude of turbulent waves within the overlap layer and accurately maps the experimental data for moderate to extremely large Reynolds numbers. The mixing-instability hypothesis offers a new mechanism of the momentum transfer in a turbulent wall-bound flow, calling for a revision of the conventional mixing-length hypothesis, which has persisted in standard textbooks on turbulence for many decades.



10. The emphasis of Dr Ambika's research and teaching are on clean technologies and sustainable development in water quality engineering and energy-environmental management. Her current research is focused on.

- sustainable and cleaner technologies in civil and environmental engineering,
- applications and implications of nanotechnology,
- industrial waste management focusing waste to wealth/energy concepts, and
- Optimization of Systems and Strategies in Contaminated-Site Remediation.

She has handled more than 25 consultancy projects dealing with.

- Environmental and Energy Audit of Industry.
- Vetting of water treatment plants.
- Vetting of design, monitoring, performance evaluation, and Augmentation of STPs.
- Design Verification of Sewer Network.
- Industrial wastewater treatment, waste management, and resource recovery.

## »» Department of Computer Science & Engineering

The Computer Science and Engineering (CSE) department has grown leaps and bounds since its inception in 2008. The department faculty comprises 24 faculty members with a good representation in the areas of theoretical computer science, artificial intelligence/machine learning, and computer systems areas. The CSE department has already graduated around 30 PhDs with many of the PhD graduates taking positions in top R&D labs and academic institutes - including other IITs. The department faculty and students consistently publish in top-tier conferences and journals. The undergraduate program has been consistently preferred by the top-ranked JEE performers - as evidenced by the improving opening and closing ranks. Our industry engagement has also been very strong with the MDS program providing an opportunity for the industry professionals to stay up-to-date with the latest R&D developments in the area of data science. The CSE department also collaborates with various other industry and R&D labs including Samsung, Intel, Microsoft, Google, AMD, DRDO, Honeywell, KLA, IBM, Adobe, Suzuki Motors, Fujitsu AI, Weather News Inc. to name a few.



Everybody in this country should learn to program a computer, because it teaches you how to think. – *Steve Jobs*



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## Patents Filed/Granted

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- Manifold Mixup for Few-shot Learning. 2020 IEEE Winter Conference on Applications of Computer Vision (WACV), 2207–2216. <https://doi.org/10.1109/WACV45572.2020.9093338>
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  61. Fomin, F. V., Lokshtanov, D., Panolan, F., Saurabh, S., & Zehavi, M. [2020]. ETH-Tight Algorithms for Long Path and Cycle on Unit Disk Graphs. In S. Cabello & D. Z. Chen (Eds.), 36th International Symposium on Computational Geometry [SoCG 2020] [Vol. 164, p. 44:1-44:18]. Schloss Dagstuhl–Leibniz-Zentrum für Informatik. <https://doi.org/10.4230/LIPIcs.SocG.2020.44>.

### Funded Research Projects - 2020-2021

1. Dr Saurabh Joshi, Auto Grade Linux, Suzuki Motor Corp., 1st April 2020, 31.97L.
2. Prof C Krishna Mohan, Video Analysis in Mobile Device, Oppo Mobiles Private Ltd, Apr 20, 2020, 13.16L.
3. Dr Kotaro Kataoka, Automotive Grade Linux Project, Suzuki Motor Corporation, May 1, 2020, 31.98L.
4. Dr Vineeth N Balasubramanian, MSR - Post Doctoral Fellowship @ IIT Hyderabad - Unrestricted Research Gift Microsoft Research Lab India Pvt. Ltd Jun 15, 2020, 20.00.
5. Dr M V Panduranga Rao, Quantum Network Simulator, Qulabs Software [India] Pvt. Ltd, Aug 12, 2020, 42.88L.
6. Dr Ch Sobhan Babu, IT Initiatives at ESIC Medical College Hyderabad-Santusht Mobile App, ESIC Medical College & Hospital, 14.51L.
7. Dr Ramakrishna Upadrasta, Compiler Technology for Deep Learning, Intel Technology India Pvt Ltd, Sep 1, 2020, 4.42L.
8. Dr Kotaro Kataoka, V2X and Road Safety Project, Suzuki Motor Corporation, Sep 14, 2020, 61.00L.
9. Dr Kotaro Kataoka, Cold Chain Project, DENSO Corporation, Sep 15, 2020, 59.00L.
10. Dr A Antony Franklin, V2X a Road Safety Project, Suzuki Motor Corporation, Sep. 15, 2020, 61.00L.
11. Dr Vineeth N Balasubramanian, Unrestricted gift intended for Department of Computer Science and Engineering, IIT Hyderabad in support of research activities conducted by the Institute, Adobe Systems, Sep 30, 2020, 5.25L.
12. Dr Ch Sobhan Babu, IT support for flood relief distribution, GHMC, Hyderabad, Nov 20, 2020, 2.25L.
13. Dr Ch Sobhan Babu IT support for Sanitation Drive, GHMC, Hyderabad, Dec 10, 2020, 1.50L.
14. Dr Vineeth N Balasubramanian, Accumulated Fund through Interactions and Communications with Academic Community, Huawei Technologies India Private Limited, 2.00L, Dec 29, 2020.
15. Dr Vineeth N Balasubramanian, Research on the viability of deep learning-based techniques on BBP images and Data, KLA Tencor Corporation, Dec 29, 2020, 18.00L.
16. Dr Kotaro Kataoka, Rural-Urban Energy Supply Ecosystem using Connected Battery, All India Disaster Mitigation Institute, Jan 1, 2021, 13.85L.
17. Dr Vineeth N Balasubramanian, Learning with Limited Labeled Data: Solving the Next Generation of Machine Learning Problems, DST-JSPS Joint Research Project [Indo-Japan Cooperative Science Programme, Co-PI: Tatsuya Harada, Univ of Tokyo], Jan 2021, 8.18L.
18. Dr Subrahmanyam Kalyanasundaram, A Quasi-Random Theory for  $\epsilon$ - $\Delta$ -Regular Graphs, SERB, Jan 12, 2021, 6.6L.
19. Dr Kotaro Kataoka, Current Status and Issues of Technological Cooperation and Human Resource Exchange between Japan and India, New Energy and Industrial Technology Development Organization, Feb 1, 2021, 20.00L.
20. Dr Vineeth N Balasubramanian, 3D Imaging-based Vein Intrusion Guide System for Pediatric and Geriatric Healthcare, SreePVF Research Grant Award [Co-PI, PI: Vandana Sharma], Feb 2021, 230.00L.
21. Dr Sathya Peri, Parallel and Fault-resilient Programming Primitives and Algorithms for Temporal Graph Processing, IISc, Bangalore, Mar 12, 2021, 28.48L.



22. Dr A Antony Franklin, Autonomous driving enabling fog computing platform with edge cloud orchestration and edge analytics, DST, Mar 12, 2021, 37.30L.
23. Dr Ch Sobhan Babu, Identifying Anomalous Dealers in GST using Big Data Analytics, MEITY, Mar 19, 2021, 79.6L.
24. Prof C Krishna Mohan, Design and Development of Machine Learning Algorithms for Traffic analytics, SERB, Mar 30, 2021, 36.06L.
25. Dr Vineeth N Balasubramanian, Causal Perspectives in Feature Subset Selection in Time Series Data, Adobe Research Gift, Mar 2021, 3.70L.
26. Dr Sathya Peri, Indigenous Intelligent and Scalable Neuromorphic Multi-Chip for AI Training and Inference Solutions, MeitY, Gol, 23 March 2021, 450L.
27. Dr Sathya Peri, Design and Development of a Unified Blockchain Framework for offering National Blockchain Service, MeitY, Gol, 23 March 2021, 102L.
7. Co-organizer, AAAI Journal-sponsored Workshop on Trustworthiness of AI systems and its impact on Society in Developing Nations, Jan 2021. <https://aiw.iiitd.ac.in/>
8. Co-ordinator, AI/ML theme, Vaibhav Summit, Oct 2020. <https://vaibhav.gov.in/v2.php>.
9. Deep Learning for Computer Vision, NPTEL course, Sep-Dec 2020 [8559 registrants]. [https://onlinecourses.nptel.ac.in/noc20\\_cs88/preview](https://onlinecourses.nptel.ac.in/noc20_cs88/preview).
10. Introduction to AI/ML for Computer Vision and Explainable AI, Qualcomm Training, Jun-Oct 2020.
11. Tutorial on Object Detection and Semantic Segmentation, ISRO VSSC, Sep 2020.
12. RAISE Summit (organized by NITI Aayog, Govt of India) sessions on Explainable AI and Regulations for Responsible AI, Oct 2020. <https://raise2020.indiaai.in/>.
13. NVIDIA GTC, Neural Network Attributions: A Causal Perspective, Oct 2020.

### Workshops Conducted

1. TEQIP program on "Advanced Algorithms" conducted on November 28, 29, December 05, 06 & 12, 2020
2. AIET (Artificial Intelligence and Emerging Technologies) program
3. Organized the Conference on Algorithms and Discrete Applied Mathematics [CALDAM 2020] during Feb 13-15, 2020. This was also preceded by an Indo-French school on Algorithms and Combinatorics during Feb 10-11, 2020.
4. Japan Day, JETRO/JICA/IITH, October 2020.
5. Dr Gaurav Srivastava, Google, AI For Fraud Detection and Prevention in Online Advertising, 14-Dec-2020.
6. Amartya Sanyal, University of Oxford, How benign is benign overfitting in deep neural networks? 18-Aug-2020.
14. CII-IITH Power Talks 2.0, Towards Explainable and Robust AI Practice, Oct 2020
15. NPTEL Special Lecture Series, Towards Explainable AI, Apr 2020 .
16. INS Valsura Webinar on AI for Data-Driven Navy, Introduction to Deep Learning and Recent Trends, Oct 2020.
17. DX21: Digital Transformation Summit DU Kerala, Explainable AI in Industry 4.0 and Digital Transformation, Feb 2021.
18. Montreal Institute of Learning Algorithms [MILA] Tea Talk series, Neural Network Attributions: A Causal Perspective, Feb 2021
19. Microsoft Hyderabad, Addressing Next-generation Machine Learning Challenges: Learning from Limited Labeled Data, May 2020.

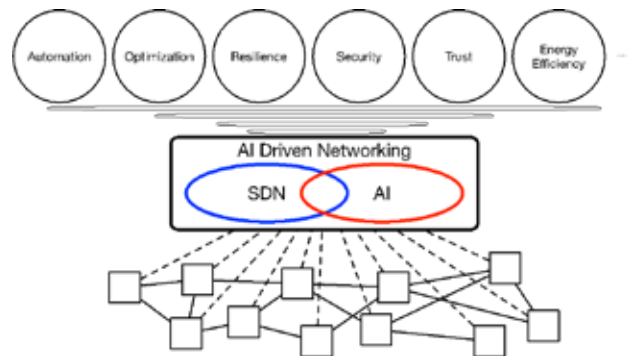
20. 5G from Theory to Practice (5GToP) Workshop in conjunction with 5G World Forum 2020.
21. Professional Certification Program in AI and Emerging Technologies.
22. Co-ordinator, NLP theme, VAIBHAV summit organized by Gol, Oct 2020. <https://vaibhav.gov.in/v2.php>.
23. Speaker at the NLP session in VAIBHAV summit organized by Gol. <https://vaibhav.gov.in/v2.php>.
24. 5th Indian SAT+SMT School (held virtually) with Saurabh Joshi as co-organizer.
6. Ms Hari Chandana Kuchibhotla (PhD student) received Prime Minister's Research Fellowship, 2020-24.
7. Arghya Pal (PhD student) has been selected for presentation at Doctoral Consortium, IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR), 2020.
8. Anirban Sarkar (PhD student) has been selected for presentation at Doctoral Consortium, IEEE/CVF Winter Conference on Applications of Computer Vision (WACV), 2021.
9. Dr Vineeth N Balasubramanian, Associate Professor, has been Elevated as Senior Member, IEEE.

### Awards and Recognitions

1. Mr Sriram Bhyravarapu, Paper authored by Subrahmanyam Kalyanasundaram and Sriram Bhyravarapu titled "Combinatorial Bounds for Conflict-Free Coloring on Open Neighborhoods" won the "Best Student Paper" award of the International Workshop on Graph-Theoretic Concepts in Computer Science (WG 2020).
2. Dr Vineeth N Balasubramanian, Associate Professor, received Best Paper Award Runner-up, ACM CODS-COMAD 2020.
3. DrVineethNBalasubramanian,Associate Professor, received the Outstanding Reviewer Award, British Machine Vision Conference (BMVC) 2020.
4. Dr Vineeth N Balasubramanian, Associate Professor, received the Outstanding Reviewer Award, European Conference on Computer Vision (ECCV) 2020.
5. Mr Abbavaram Gowtham Reddy (PhD student) received Prime Minister's Research Fellowship, 2020-24.
10. DrVineethNBalasubramanian,Associate Professor, inducted as Associate Editor, Elsevier Pattern Recognition journal [Impact factor: 7.2].
11. Mr Chaitanya Devaguptapu Shastri has been selected for Indo-Canadian Student Research Fellowship (2021).
12. Dr Maunendra Sankar Desarkar, Assistant Professor, received Teaching Excellence Award from IITH.
13. Dr Maunendra Sankar Desarkar, Assistant Professor, has been Selected as IEEE Senior Member.
14. Mr Kaushal Kumar Maurya has received Suzuki Foundation Fellowship.
15. Mr Kaushal Kumar Maurya has received SIGIR 2020, Travel Grant.
16. Mr Akash Banerjee, Eti Chaudhary, and Saurabh, Pinaka stands 2nd in ReachSafety-Floats, 2nd in ReachSafety-Loops, 3rd in ReachSafety-Combinations subcategories, and is placed 7th in ReachSafety category in SVCOMP 2021.

## 1. AI-Driven Networking

Softwarization enables various beneficial characteristics in modern networks including automation, optimization, security, trust, resilience, energy efficiency, etc. However, there are also many challenges to take the advantage of network softwarization including the increased and broader demands to network services, the resource limitation,

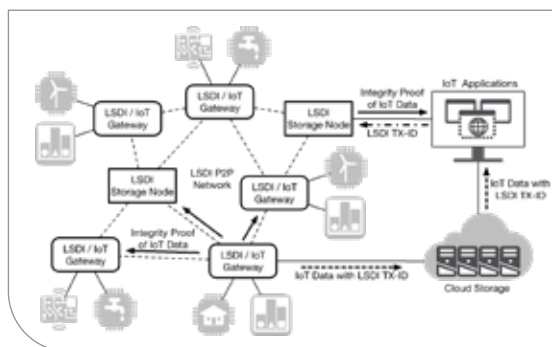


*The overview of AI-Driven Networking*

the computational complexity of algorithms. AI-Driven Networking addresses these challenges through the integration of Software Defined Networking (SDN) and Artificial Intelligence (AI). AI produces the optimal decisions to actuate the network using the intelligence cumulated through SDN, and SDN deploys such decisions to actuate the network and achieve the desired goals of networks.

## 2. IoT Blockchain and its deployment

Data Integrity is an important aspect of the Internet of Things (IoT) for IoT-enabled systems. While the Blockchain introduces the very high resistance against the data tampering in Distributed Ledger Technology, transaction throughput, storage limitation, and the long finality are a challenge. Lightweight and Scalable Blockchain for IoT Data Integrity (LSDI) has been prototyped to address these challenges since 2019. This project explores the further improvement and deployment of LSDI as well as the development of real-world use case applications to enhance the trustworthiness of broad IoT-based systems.



*The overview of IoT Blockchain using LSDI*



*The demonstration of LSDI using Raspberry Pi in CEATEC 2019, Japan*

# »» Department of Design

Department of Design – IIT Hyderabad offers a vibrant environment for learning, practicing and exploring several facets of design. The department envisions to creatively engage in the space between technologies and people. This involves facilitating innovation in the key emergent areas such as Participatory and collaborative Design, Artificial Intelligence, AR/VR/, Professional Ethics/ Sustainability, Product Systems and Services, Design and education, Wellness

## Highlights

- »» M des. [Visual design] Sponsored | Self Sponsored | Online Executive
- »» B Des. | Product Design, Visual Communication & User Experience Design
- »» PhD. in Design (Full time / Part time) Practice based and Practice led research
- »» Design Minor for Btech
- »» PG Certificate program

## New Specializations at Mdes program

- »» Product Design
- »» Interaction Design
- »» Visual Design

## Strength

- »» 2021: 225 Students [B Des, M des, Ph D], 9 Faculties,
- »» 4 Full time Design Staff, 2 Shared Administration Staff

## Labs

- »» AV Lab, Rapid Prototyping Lab, Perfect binding and Print Lab, IoT Lab, Mix Reality Lab photography lab.



The whole purpose of education is to turn mirrors into windows.  
– Sydney J. Harris



## Faculty



**Deepak John Mathew**

PhD – MS University of Baroda

**Professor & HoD**

**Research Areas:** Photography; Elements of Design; Aesthetics; History of Design



**Prasad S Onkar**

PhD – IISC Bangalore

**Assistant Professor**

**Research Areas:** Product Design; Computer Aided Conceptual Design; 3D Sketching; Virtual Reality; Haptics; Interaction Design



**Neelakantan P K**

PhD – IIT Bombay

**Assistant Professor**

**Research Areas:** Architectural Design; Early Stage Design Process; Aesthetics; Experiential Installations; Urban Planning; Art and Performance Studies



**Delwyn Jude Remedios**

**Assistant Professor**

**Research Areas:** Animation; Film; Virtual Reality; Children Story Books; Graphic Novels; Illustrations; e-Learning



**Shiva Ji**

PhD – IIT Guwahati

**Assistant Professor**

**Research Areas:** Design for Sustainability; Sustainability Assessment Methods; LCA; Environmental Planning and Design; Virtual and Augmented Reality



**Seema Krishnakumar**

**Assistant Professor**

**Research Areas:** Information Design; Data Visualization; Interactive Storytelling; Journalism Design; Photo Documentary; Multimedia Storytelling



**Mohammad Shahid**

PhD – IIT Hyderabad

**Assistant Professor**

**Research Areas:** Typography, Visual Culture, Visual Branding, Design Research



**Ankita Roy**

**Assistant Professor**

**Research Areas:** Neuromodulation; Publication and Book Design; Ancient Scripts; Tessellations & Geometrical Patterns; Kufi c Calligraphy; Design Pedagogy; Innovation Design; UX and UI Design; Pop-Up Book Design; Environmental Graphics; Cartographic Info-Graphics; Perspective Drawing; Architectural Reconstruction; Illustration





**Srikar A V R**

**Assistant Professor**

*Research Areas:* Product Design, Furniture Design, System Design, Social Impact, Advanced Materials, Workplace Design and Ethnography



**Ambarish Kulkarni**

Manufacturing Futures  
Research Institute, Swinburne

**Adjunct Professor**

*Research Areas:* Augmented & Virtual Reality, Mixed Reality Development, Clinical Trials.



**Chakravarthy B K**

IIT Bombay

**Adjunct Professor**

*Research Areas:* Product Styling and Perception, Creativity and Innovation



**Ajith Abraham George**

Freelancer

**Adjunct Professor**

*Research Areas:* Sound Mixing Engineer, Music Mixing/Editor

### Publications (Journal)

1. Kumar, Shylesh., Ji, Shiva. 2020. Exploring 3D Modelling of Architectural Plan using Camera Tracing. Science and Technology Journal Vol. 8 Issue 2 July 2020 ISSN: 2321-3388, pp 40-43. <https://doi.org/10.22232/stj.2020.08.02.07>.
6. Understanding and finding issues related to root-canal treatment procedure from a design perspective Priyabrata Rautray<sup>1</sup>, Dr Vikas Sahu<sup>2</sup>, Nibedit Dey<sup>2</sup>, and Deepak John Mathew<sup>1</sup>, <sup>1</sup> IIT Hyderabad, <sup>2</sup> Aidia Health Pvt. Ltd, Hyderabad

### Publications (Conference)

1. Ramana, G. K., & Onkar, P. S. (2020). On How Designers Communicate the Functionality of Articulated Product Concepts in Sketches. DS 101: Proceedings of NordDesign 2020, Lyngby, Denmark, 12th - 14th August 2020, 1-12. <https://doi.org/10.35199/NORDDSIGN2020.41>
2. Delwyn Jude Remedios, Exploring Comic Diary as a research method to study parent-child relationship, Conference: ComIN20, International Conference on Indian Comics, 2020, Organized by Department of Design IIT Delhi, Page 113-123.
3. Sharma, B., Roy, A., & Rautray, P. (2020). A practice-based approach to design education. DS 101: Proceedings of NordDesign 2020, Lyngby, Denmark, 12th-14th August 2020, 1-10.
4. Bio-Bricks: Circular economy and new products Priyabrata Rautray<sup>1</sup>, Avik Roy<sup>2</sup>, Deepak John Mathew<sup>1</sup>, and Boris Eisenbart<sup>3</sup> <sup>1</sup> IIT Hyderabad, <sup>2</sup> KIIT Bhubaneswar, <sup>3</sup> Swinburne University Melbourne, 2020.
5. Understanding and evaluating the needs of a respiratory assessment device for community health Nibedit Dey<sup>1</sup> and Priyabrata Rautray<sup>2</sup> <sup>1</sup> IIT Hyderabad, <sup>2</sup> Indian Institute of Technology, Hyderabad, India.

### Funded Research Projects

1. Dr Shiva Ji, Creating Digital Heritage of Representative Architectural Marvels from Each State of North East India, DST, 11 Sept 2020, 50L.
2. Dr Prasad S Onkar, Development of Sketch-based Immersive Environment for Articulated Product Concept Exploration, SERB, Mar 10, 2021, 28.42L.

### Workshops Conducted

1. Dr Shiva Ji, Assistant Professor, was the Key Speaker at e-FDP Parametric, Digital Design & Artificial Intelligence, titled Transformation of Visual Perceptual Spaces through Virtual Reality - its Applications in Design, 22 June 2020, FoA, APJ AKTU, Lucknow.
2. A seminar on the topic "From Classroom To Board Room- Design For Business" [ 9th September.2020], By Indraneel Kumar Das - Leads L&D for KOHLER India, was held at South Asia, SSA & ME.
3. "Design for Enterprise' seminar by Abhishek Nandan - Design Manager at Mind Tickle, was held on 16th September 2020.
4. "Designerly Aspirations and Academia" seminar by Dr. Subir Dey - Assistant Professor, Department of Design, IIT Delhi was held on 23rd September.2020
5. "Practicing mindfulness through Art/ Rappaport to cope up with stress issue during trying times seminar" by Pranjoli

- Mukherjee – Bridge International, was held on 30th September 2020.
6. "Design for Disability" seminar by Dr. Shilpa Das - Principal Faculty, Interdisciplinary Design Studies, NID Ahmedabad, was held on October 14, 2020
  7. "UX or UI or Both" seminar by Ritika Singh - UX designer, ServiceNow in Hyderabad was held on 24th October 2020.
  8. "Art, crafts, and design in the Sri Lankan context" Seminar by Ms. E. A. Jayamuthu Sandamali Edirisinghe - Senior Lecturer attached to the Faculty of Computing NSBM Green University Town, Homagama (Sri Lanka), was held on 28th October 2020.
  9. "Character Treatment and Role of Research in films", Ms. Karthika Raj - Creative consultant at Viral Fetch, Los Angeles, USA was held on 6th November 2020.
  10. "Suggestions to Young Designers" seminar by Kadambari - SVP design at ValueLabs, was held on 10th November Tuesday, 2020.
  11. "How Car Design Works" seminar by Devabrat Borgohain - Automobile Designer Design Lead in TCS, was held on 25th November Wednesday, 2020.
  12. TEQIP workshop titled "Visual Tools and Techniques for Effective Communication" was held from 16-18 November 2020.
  13. NPIU TEQIP conducted a 5-day workshop on "3D Printing and Design", from 28th November to 2nd December 2020.
  14. Dr Shiva Ji, Assistant Professor, was the Key Speaker during Urban Thinkers Campus 2020 talk on Think innovAte aCT For Urban Climate Change titled Climate Change and Design Innovation, 09 Dec 2020, vNIT Nagpur.
  15. Dr Shiva Ji, Assistant Professor, was the Key Speaker at Distributed Innovation Design International Dialogue 2020 at Wuhan University of Technology, China, titled Need for Innovation in Design Process, 26-27 December 2020.
  16. Dr Shiva Ji, Assistant Professor, was the Resource Person at AICTE Sponsored Short Term FDP Course under Opportunities & Challenges in Sustainable Construction Practices titled "Vision of New India and our Preparedness for Sustainability Assessment of Built-Environments" at IIT BHU Varanasi, 01-06 Feb 2021.
  17. Workshop Chair titled Design with One Sustainable Strategy at A Time: "Design for Re-Purposability" held at International Conference on Research into Design, organized by Indian Institute of Science, Bangalore held at IIT Bombay, 7-10 January 2021.
  18. NPTEL course workshop was held on "Strategies for Sustainable Design": 1972 students registered in Jan-Apr 2021 session: [https://onlinecourses.nptel.ac.in/noc21\\_de07/preview](https://onlinecourses.nptel.ac.in/noc21_de07/preview).
  19. Handholding workshop for DIC Spokes of DIC-IITH, Design Innovation Centre, Ministry of Education, 2020.
  20. Sitar National Camp 2019 (Directorate of Higher Secondary Education, Government of Kerala), 2020
  21. National Webinar on Visual Arts, 2020.
  22. National Conference on Innovation in Visual Arts (NCIVA '18), 2020.
  23. Workshop on Advertising Photography, Raja Ravi Verma, College of Fine Arts, 2020.
  24. Wacom Design Challenge 2020 [National Design Challenge collaboration with Wacom India], 2020.
  25. Webinar series Futurescape, 2020.

## Awards and Recognitions

1. Dr Delwyn Jude Remedios, Assistant Professor, Film Title: Save Our Species is the Winner of Best in Excellence Award in International Public Advertisement Film Festival, Seoul, 2020.
2. Dr Delwyn Jude Remedios, Assistant Professor, Film Title: Save Our Species is the Winner of Excellence Award in Nature Without Borders International Film Festival, Delaware, United States, 2020.
3. Dr Delwyn Jude Remedios, Assistant Professor, Film Title: Save Our Species, is Nominated for Industry Excellence Award in Character Animation in Manchester Animation Film Festival, UK, 2020.
4. Dr Delwyn Jude Remedios, Assistant Professor, Film Title: Save Our Species got Official Selection in Arica Nativa Rural Film Festival, Chile, 2020.
5. Dr Delwyn Jude Remedios, Assistant Professor, Film Title: Save Our Species got Official Selection in Calcutta International Short Film Festival, India 2021.
6. Dr Delwyn Jude Remedios, Assistant Professor, Film Title: Save Our Species got Official Selection in Science on Screen Film Festival, Ireland, 2020.
7. Dr Delwyn Jude Remedios, Assistant Professor, Film Title: Save Our Species got Official Selection in Indic Film Utsav, India, 2020.
8. Dr Delwyn Jude Remedios, Assistant Professor, Film Title: Save Our Species got Official Selection in New Jersey International Short Film Festival (NJISFF), 2021.
9. Dr Delwyn Jude Remedios, Assistant Professor, Film Title: Save Our Species got Official Selection at North Dakota Environmental Rights Film Festival, 2021.
10. Dr Delwyn Jude Remedios, Assistant Professor, Film Title: Save Our Species got Official Selection at Italia Green Film Festival, 2021.
11. Dr Delwyn Jude Remedios, Assistant Professor, Film Title: Save Our Species got Official Selection at PIAFF, Paris International Animation Film Festival, 2021.
12. Dr Delwyn Jude Remedios, Assistant Professor, Film Title: Save Our Species got Official Selection at International Nature Film Festival Gödöllő - Nature, and Environmental Protection Festival, Hungary 2021.
13. Dr Delwyn Jude Remedios, Assistant Professor, Film Title: Save Our Species got Official Selection at ANIMATIBA – Festival Internacional de Animação de Curitiba, Brazil 2021.
14. Mr Sumit Yempalle's film Ek Cup Chaha, Guided by Dr Delwyn Jude Remedios, got Official Selection at the 6th Rajasthan International Film Festival, 2020.
15. Mr Sumit Yempalle's film Ek Cup Chaha, Guided by Dr Delwyn Jude Remedios, got Official Selection at the 6th Rajasthan International Film Festival, 2020.
16. Mr Sumit Yempalle's film Ek Cup Chaha, Guided by Dr Delwyn Jude Remedios, is the Winner of the Best Animated Film Award in the 7th Goa Short Film Festival 2020.

17. Mr Sumit Yempalle's film Ek Cup Chaha, Guided by Dr Delwyn Jude Remedios, got Official Selection in 9th Delhi Shorts International Film Festival-20, India, 18 October 2020.
18. Mr Sumit Yempalle's film Ek Cup Chaha, Guided by Dr Delwyn Jude Remedios, got Official Selection in Pune Short Film Festival, India, November 2020.
19. ilm Titled Nakab(SRFTI student film) Directed by Sharad Uikey, Asthita, Bhuvan, Rishi Bhaumik, Sopaan Pundalik, Guided by Dr Delwyn Jude Remedios got Official Selection at 17th Frames Film Festival 2020.
20. ilm Titled Notun Fasal (SRFTI student film) Directed by Sovan Dutta, Anindita Dutta, Sawanti Das Guided by Dr Delwyn Jude Remedios is the Winner of the Best Animated Short in Huntington Beach Cultural Cinema Showcase 2020.
21. Film Titled Notun Fasal (SRFTI student film) Directed by Sovan Dutta, Anindita Dutta, Sawanti Das Guided by Dr Delwyn Jude Remedios, is the Finalist in Jing Chan Classic, Cultural and Arts Awards, 2020.
22. Film Titled Notun Fasal (SRFTI student film) Directed by Sovan Dutta, Anindita Dutta, Sawanti Das Guided by Dr Delwyn Jude Remedios, got Official Selection at Premis Animalcoi, 2020.
23. Film Titled Notun Fasal(SRFTI student film) Directed by Sovan Dutta, Anindita Dutta, Sawanti Das Guided by Dr Delwyn Jude Remedios, got Official Selection 17 Films, 2020.
24. Film Titled Notun Fasal (SRFTI student film) Directed by Sovan Dutta, Anindita Dutta, Sawanti Das Guided by Dr Delwyn Jude Remedios, got Official Selection U/WPG online film festival, 2020.
25. Film Titled Notun Fasal (SRFTI student film) Directed by Sovan Dutta, Anindita Dutta, Sawanti Das Guided by Dr Delwyn Jude Remedios, got Official Selection List-off Global Network Sessions, 2020.
26. Film Titled Notun Fasal (SRFTI student film) Directed by Sovan Dutta, Anindita Dutta, Sawanti Das Guided by Dr Delwyn Jude Remedios, got Official Selection List-off First Time Filmmaker Sessions, 2020.
27. Film Titled Notun Fasal (SRFTI student film) Directed by Sovan Dutta, Anindita Dutta, Sawanti Das Guided by Dr Delwyn Jude Remedios, got Official Selection HE Care Film Festival, 2020.
28. Dr Delwyn Jude Remedios, Assistant Professor, Winner of Digital Illustration Contest Create Happiness with Huion, 2020.
29. Dr Shiva Ji, Assistant Professor, was Awarded 3rd winner in Click! Japan Photo Contest 2020 by Embassy of Japan & Japan Foundation.
30. Ms Shreya Balakrishnan, MDes 2019-2021 Batch got Shortlisted for Microsoft Design Challenge - Student Guided Project - Data collection application to study and generate trends of the after-effects of COVID-19 in recovered patients. User Interface Design.



## Department of Design *Highlights* //

1. Emotion in Conceptual Graphic Design Inspiration: This research work explores the role of emotion in conceptual design inspiration and ideation. This work contributes to this interdisciplinary bridge-building by formalizing the emotion construct in conceptual design inspiration. In design contexts, inspiration sources are understood as any kind of stimuli that is internal or external to the designers, that directly or indirectly influences their thinking process leading up to the framing of the problem or the generation of a solution. The analysis of inspirational stimuli denotes the designers' engagement with various types of information. This analytical process could be significantly influenced by aspects such as the perceived affective quality of stimuli.

It develops a mapping of psychological models of emotion to the design inspiration to clearly delineate the design inspiration contexts. Further, qualitative methods are developed to capture emotion in the analysis of stimuli. This was evaluated through data collected from design students'

conceptual design tasks. It was observed that design students ascribe value to stimuli and specific visual elements through perceived affective qualities. The unique modes of emotional engagement induced by different media of access such as virtual reality are also



*Descriptive and interpretive phenomenology*

studied. These emotional engagements with inspirational stimuli significantly influence the ideation of design students. Such qualitative descriptions are developed by employing methods such as descriptive and interpretive phenomenology.

## 2. **Save Our Species** (Stop Motion Animation Short Film)

Director: Delwyn Jude Remedios

Save Our Species is a short experimental stop motion animation film. The film expresses the harm done to our planet's species with relation to poaching, pollution, and deforestation. The endangered species are depicted through natural material, while the man-made materials are depicted through industrial waste. This project was done as a part of



academic activity to introduce students to an animation course. The students learned the process of animation by assisting the professor in a live project. The film, Save Our Species is an outcome of this collaboration.

## 3. **Comic Diary as a Research Method**

Sketching and Illustration are emerging research areas as they offer new perspectives to a subject. A parent-child relationship is considered as one of the most meaningful relationships in human life. Observational approaches in studying parent-child relationships have limitations due to the influence of a specialist observer or the environment in which the subjects are studied. A diary is effective as a social research method as it allows access to knowledge in areas that are considered difficult to investigate. Social media represents a modern-day diary. Studies on social media suggest that short comics represented on social media networks provide scope for user interactivity. This study adopts a practice-

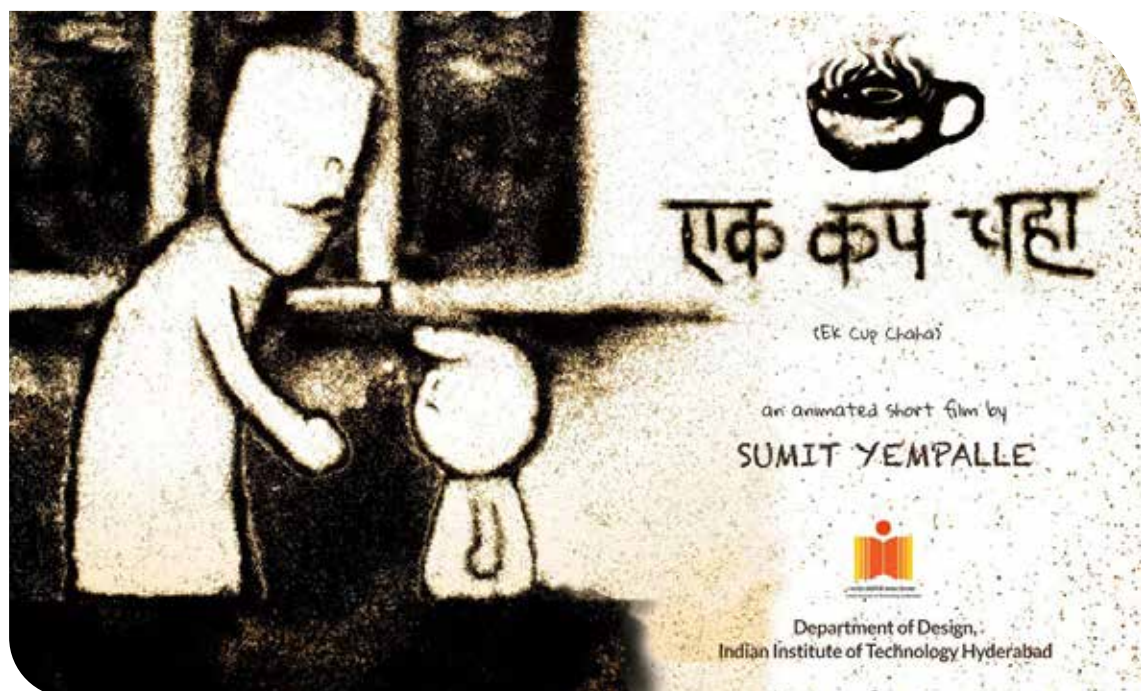


led approach to explore Comic Diary as a method to generate a unique perspective on a parent-child relationship.

#### 4. **Ek Cup Chaha** [IITH/ Student film / Tea Powder]

Director: Sumit Yempalle, Guide: Delwyn Jude Remedios

Ek Cup Chaha is an outcome of an MDes course 'Moving Images' conducted at the Department of Design, IIT Hyderabad, completed in 2019. The film is about a conversation between a father and son over a cup of tea as they discover new truths which are about to change their life.

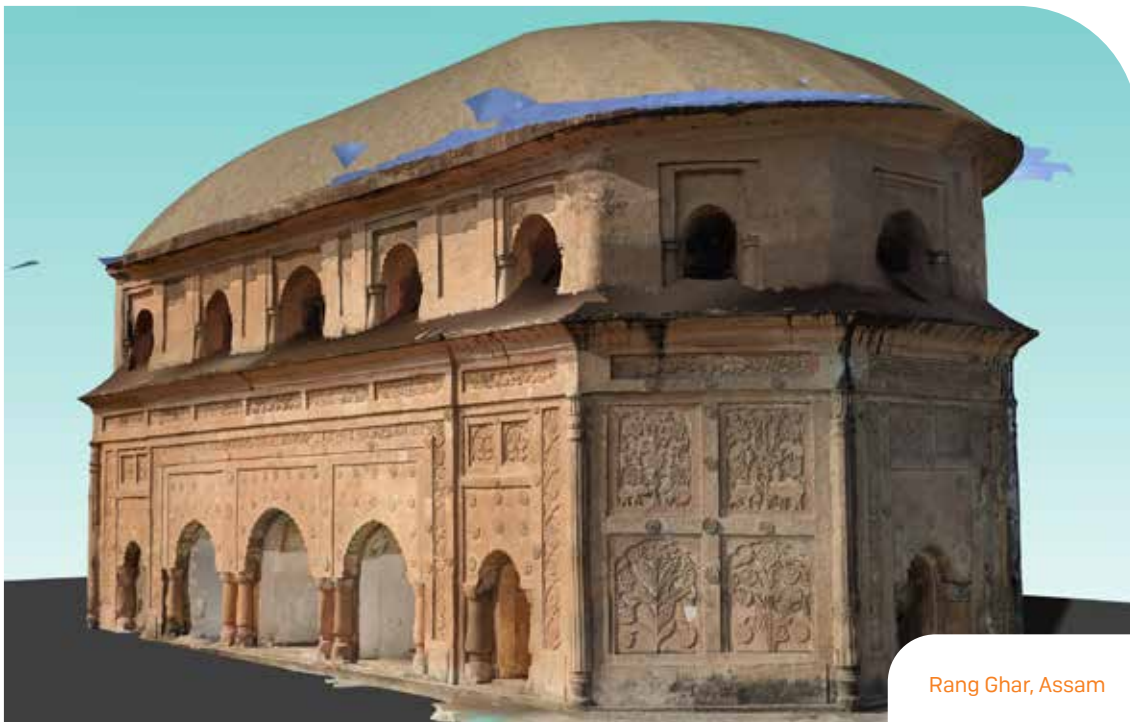




5. Rang Ghar, Assam. The central unit of the ground plan is rectangular and annexed with small structures of trapezoid ends making the entire ground plan like an octagon. The roof of the structure is parabolic which is supported by rows of massive columns and semi-circular arches. A unique pleasure boat with reptile emblems on either side marks the outer beauty of the structure and a trefoil arch canopy rests at the top of the structure.

6. The Palace of Kangla is an old palace at Imphal in the Manipur state of India. It was situated on both sides [western and eastern] of the bank of the Imphal river. But now it remains only on the western side of the bank. Only the ruins remain now. Kangla means "dry land" in old Meetei. It was the traditional seat of the past Meetei rulers of Manipur.

7. Chang Ghar is an age-old tribal housing structure; It is a collective term for houses on stilts in the forest, by the river, or on the hills. Mising and Karbi tribes are common dwellers of Chang Ghar.



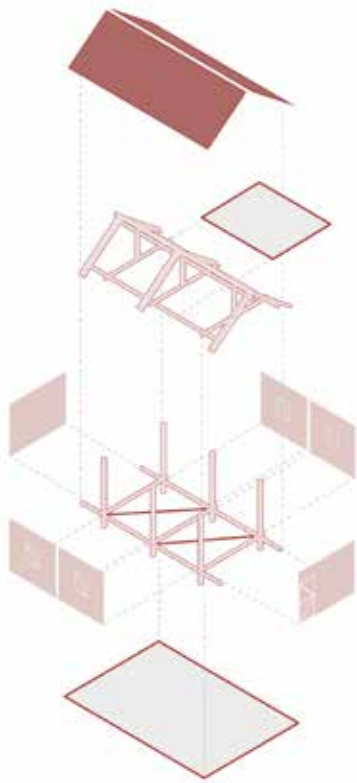
Rang Ghar, Assam



Palace of Kangla



Karbi Traditional dwelling



Chang Ghar

8. The Karbi traditional dwelling house is called 'Chang-Ghar', made up of wood, bamboo, and thatch. The house rests on a bamboo floor raised a few feet above the ground well supported by wooden posts called 'Nujok'.

9. A Tribute to Bundela Painting - Author & Publication Design by Ankita Roy

Situated amidst an idyllic landscape surrounded by forested hillocks and nurtured by the placid waters of River Betwa, Orchha, is special for its religious and cultural importance not only in Bundelkhand but in the whole of Indian Sub-Continent. In addition to its enchanting natural setting and enormous architectural edifices, paintings form an integral part of the Bundela visual culture. As artistic embellishments, these depictions play a vital role in conveying narratives – both sacred and secular. These wall paintings not only impart a special character to the edifices but also remain to be the only repositories of the now lost Bundela Kalam.

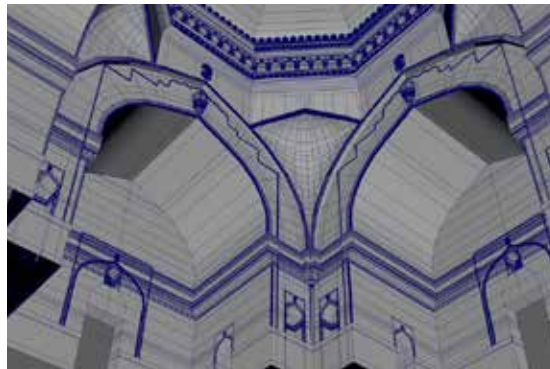




10. Digitization Indian Heritage Monuments  
In Virtual & Augmented Reality, Digital  
Documentation, 3D repository

11. Tangible and Intangible Heritage of  
Telangana - A visual documentation and  
design Intervention

- » Audio Visual Documentation of  
Dandari Gussadi Dance.
- » Documentation of Nagoba Jatara  
festival at Keslapur Village.
- » In-Depth Focused Interview of  
Craftsman Uika Inderjeet.
- » Interviews of Professor Bhangya  
Bhukya and Former Journalist Mr.  
Harpal Singh.
- » 360 documentation of Dokra  
Artefacts.
- » Field Visit to Kala Ashram and  
Dokra Craftsmen workshop.
- » Field Visit to Gondi Village Belsari  
Rampur in Adilabad District.



12. Prof Deepak group highlights of 2020:

- » Established Online design  
certification program .
- » Established M Des Executive  
Program.
- » 2020, Logo Design for MDMS,  
Indian Council of Medical Research,  
Government of India.
- » 2020, Logo Design for CKM-VIGIL,  
IIT Hyderabad.
- » ICoRD 2020, Session Chair.

13. Design Education, Extended Reality Technologies in Education.



Telangana cultural heritage documentation



*Descriptive and interpretive phenomenology*

## List of Major Equipment

### 1. **Virtuose 6D:** Haption 6DOF Haptic Device

Haption Virtuose 6D is a six degree of freedom (dof) of haptic device capable of tracking 6 dof and also providing force and torque feedback. The maximum force that can be rendered is around 35 N with a peak torque of 3.1 Nm. The workspace for manipulation is around 1330 x 575 x 1020 mm with a position resolution of 0.016 mm. It can be used to simulate the manual assembly and design tasks in virtual environments. Plugins are available for CAD software [SolidWorks, Catia, 3D Experience].



Haption 6DOF Haptic Device

# »» Department of Electrical Engineering

The Department of Electrical Engineering (EE) at IIT Hyderabad offers a vibrant environment for undergraduate, post-graduate education and research in many areas of Electrical Engineering. We are a team of 36 faculties (30 full-time + 1 Emeritus + 2 Distinguished + 3 Adjunct), 412 students: 168 BTech, 71 MTech, and 173 PhD (10th July 2021), and 12 staff members (11 Technical + 1 Administration) engaged in cutting edge research and teaching in several frontier areas of Electrical Engineering. With multiple offers in hand, our BTech students are well placed across different top-notch MNCs. Moreover, offers for higher studies in Ivy league universities have become commonplace for our undergraduate toppers. Placements for Masters and PhD programs have also been consistently lucrative. A couple of our research scholars have become faculty in IITs and NITs. Last but not the least, the emphasis on practical work and state-of-the-art research work has led to the incubation of four start-ups. Two of these start-ups have revenue in-flow and will pretty soon be getting Series-A funding. We at EE aim to be pioneers rather than peers.

## Highlights

- » Unique Contribution in 5G and 6G (Prof. Kiran Kuchi).
- » Product Developed: Massive MIMO Prototype, 5G gNB, and UE Prototype, NB IoT Soc.
- » Muscope: An On-chip Miniature Microscope (Dr Shishir Kumar)
- » Enabled Open Source VLSI on Android Platform (Prof. GVV Sharma)
- » COVIHOME: India First Electronics Rapid Covid-19 RNA Test kit (Prof Shiv Govind Singh)
- » Prototype: RAJHANSE: Alternative Technology for Milk Quality Check .



Education is the transmission of civilization. – Will Durant



## Faculty



**K Sri Rama Murty**

PhD – IIT Madras  
**Associate Professor & HoD**

*Research Areas:* Signal Processing; Speech Analysis, Recognition & Synthesis; Machine Learning



**Mohammed Zafar Ali Khan**

PhD – IISC Bangalore  
**Professor**

*Research Areas:* Coding and Signal Processing for 6G, Theory of Cyber Physical Systems and Commensal Radar



**Kiran Kumar Kuchi**

PhD – University of Texas at Arlington, USA  
**Professor**

*Research Areas:* Wireless Communications; Signal Processing; 5G Tested Development; Development of Global Standards



**Soumya Jana**

PhD – UIUC, USA  
**Professor**

*Research Areas:* Biomedical Image and Signal Analysis; Air Quality Analysis; Network Information Theory; Computer Vision; Artificial Intelligence; Radar and Sonar Imaging and Signal Processing



**Shiv Govind Singh**

PhD – IIT Bombay  
**Professor**

*Research Areas:* 3DIC, Biosensors, Gas sensors, MEMS and Lab on Chip



**Ketan Detroja**

PhD – IIT Bombay  
**Professor**

*Research Areas:* Research Areas: Control Theory; State Estimation; Fault Diagnosis



**P Rajalakshmi**

PhD – IIT Madras  
**Professor**

*Research Areas:* Cyber Physical Systems/Internet of Things (CPS/IoT); Autonomous Navigation Terrestrial/Aerial; Artificial Intelligence; Computer Aided Diagnosis; UAV-based sensing for agriculture/transportation



**Ashudeb Dutta**

PhD – IIT Kharagpur  
**Associate Professor**

*Research Areas:* Analog and Radio Frequency Vlsi Chip Design; Receiver; Phase Locked Loop; Low Noise Amplifier; Energy Harvesting Research



**Vaskar Sarkar**

PhD – IIT Bombay  
**Associate Professor**

*Research Areas:* Wide Area Monitoring and Control; Grid Integration of Renewables; Power Market Design

**Siva Kumar K**

PhD – IISC Bangalore  
**Associate Professor**

*Research Areas:* PPM Induction Motor Drives; Multi-Level Inverters; Micro-Grids

**G V V Sharma**

PhD – IIT Bombay  
**Associate Professor**

*Research Areas:* Wireless Communications; Physical Layer Modulation; Synchronization Techniques; Channel Coding Techniques

**Sumo hana Channappayya**

PhD – The University of Texas at Austin, USA  
**Associate Professor**

*Research Areas:* Image and Video Quality Assessment; Biomedical Image Processing; Machine Learning

**Sushmee Badhulikha**

PhD – University of California, USA  
**Associate Professor**

*Research Areas:* Flexible and Wearable Nanoelectronics; Nanomaterials Based Devices and Circuits; Eco-Friendly Electronics; Paper Electronics; Electrochemical Sensors and Supercapacitors

**Ravikumar Bhimasingu**

PhD – IISC Bangalore  
**Associate Professor**

*Research Areas:* Computer aided Power System analysis; Power System protection improvements; AI techniques applications to Power Systems; Integration of Renewable Energy Sources

**Siva Rama Krishna V**

PhD – IISC Bangalore  
**Associate Professor**

*Research Areas:* Biosensors; Electrochemistry; MEMS; 3D-IC

**Amit Acharyya**

PhD – University of Southampton, UK  
**Associate Professor**

*Research Areas:* VLSI Systems Resource-Constrained Applications; Low Power Design Techniques; Machine Learning Hardware Design; Signal Processing Algorithm and VLSI Architectures; Digital Arithmetic; Hardware Security;





**Abhinav Kumar**

PhD – IIT Delhi

**Associate Professor**

*Research Areas:* Resource Allocation for 5G; Visible Light Based Communications; Security and Privacy in Wireless Networks; Cellular Operation in the Unlicensed Spectrum



**Pradeep Yemula**

PhD – IIT Bombay

**Associate Professor**

*Research Areas:* Smart Grids; Power System Control Centers; Information Technology Architectures; Ontologies for Power System Events; Common Information Model (CIM); Interoperability and Standards



**Kaushik Nayak**

PhD – IIT Bombay

**Assistant Professor**

*Research Areas:* Electronic Devices Physics; Mesoscopic Electronics



**Emani Naresh Kumar**

PhD – Purdue University, West Lafayette Campus, USA

**Assistant Professor**

*Research Areas:* Nanophotonics; Photovoltaics; Optoelectronic Devices and Nanofabrication



**Seshadri Sravan Kumar**

PhD – IISc Bangalore

**Assistant Professor**

*Research Areas:* Grid Connected Renewable Energy Systems; Micro Grids; Voltage Stability; Electric Vehicles



**Rupesh Ganpatrao Wandhare**

PhD – IIT Bombay

**Assistant Professor**

*Research Areas:* Power Electronics; Electric Drives; Renewable Energy Sources; Distributed Energy Generation; Standalone and Hybrid Energy Generation; Micro grid



**Shishir Kumar**

PhD – Trinity College, Dublin

**Assistant Professor**

*Research Areas:* Micro-nanofluidics; Nanopores; 2D Materials; Bio-chemical Sensors



**Oves Mohamed Hussein Badami**

PhD – Università Degli Studi di Udine, Udine, Italy

**Assistant Professor**

*Research Areas:* Semiconductor Device; Physics, Computational Nanoelectronics



**Lakshmi Prasad  
Natarajan**

PhD – IISc Bangalore  
**Assistant Professor**

*Research Areas:* Modulation and Coding for Communications



**Gajendranath Chowdary**

PhD – IIT Delhi  
**Assistant Professor**

*Research Areas:* Analog and Mixed Signal Circuit Design



**Abhishek Kumar**

PhD – IIT Madras  
**Assistant Professor**

*Research Areas:* Analog and Radio-Frequency IC Design; Full-Duplex Wireless Communication



**Shashank Vatedka**

PhD – IISc Bangalore  
**Assistant Professor**

*Research Areas:* Information theory and Coding; Physical Layer Security



**Aditya Siripuram**

PhD – Stanford University, USA  
**Assistant Professor**

*Research Areas:* Graph Signal Processing; Mathematical Aspects of Sampling; Adversarial Machine Learning transportation



**Sundaram Vanka**

PhD – University of Notre Dame, Notre Dame, Indiana, USA  
**Associate Professor**

*Research Areas:* Mathematical Modeling Simulation, and Prototyping Of Wireless Systems and Networks, Especially Low Power Applications



**Saidhiraj Amuru**

**Adjunct Assistant Professor**

*Research Areas:* Wireless Communications; Applications of AI and Machine learning in Wireless Communications



**Nixon Patel**

**Adjunct Professor**

*Research Areas:* Wireless Communications; Applications of AI and Machine learning



**Uday B Desai**

**Professor  
Emeritus Faculty**

*Research Areas:* Wireless Communication; Cognitive Radio; Wireless Sensor Networks and Statistical Signal Processing; Multimedia; Image and Video Processing; Artificial Neural Networks; Computer Vision; and Wavelet Analysis

### Patents Filed/Granted

1. Design and microfabrication of electrode for multi-analyte chemical sensing [Application- No:202041030698]. July 2020[filed].
2. Fabrication of PCB substrate-based low-cost multichannel device for biosensing [Application- Number:202041030699]. July 2020[filed].
3. Conductive nanofiber-based chemiresistive sensors for biosensing [Application- No:202041030697], July 2020[filed].
4. Kumar, Ekta Prajapati, Srikanth Manepally, MINIATURIZED MICROSCOPE DEVICE AND METHOD THEREOF, July 18, 2020, 202041030727, [Provisional] [filed].
5. P. Rajalakshmi, Shreeshan S, "A Method for Detecting Flight Path for Unmanned Aerial Vehicles based Imaging", August 2020, TEMP/E- 1/36911/2020-CHE. [filed].
6. A non-invasive system for detection of at least one analyte [Application- No: 202041037641], Sep 2020[filed].
7. Non-invasive system for detection of at least one severe acute respiratory syndrome coronavirus 2 [SARS-CoV-2] analyte. [Application- No: 202043039581]. Sep 2020[filed].
8. Shanti Swarup Medasani, Sumohana S Channappayya, Venkatanath Neeluri, Maruthi Chandrasekhar Bhatlapenumarti, "Automated system and method of retaining images based on a user's feedback on image quality," 5th October 2017, 10607326[Granted].
- R. Prakash [Eds.], Nanobiomaterial Engineering: Concepts and Their Applications in Biomedicine and Diagnostics [pp. 165–180]. Springer. [https://doi.org/10.1007/978-981-32-9840-8\\_9](https://doi.org/10.1007/978-981-32-9840-8_9) [Book Chapter] .
2. Pavan Kumar, Y. V., & Bhimasingu, R. [2020]. Modern Control Methods for Adaptive Droop Coefficients' Design. In P. Ray & M. Biswal [Eds.], Microgrid: Operation, Control, Monitoring and Protection [pp. 111–148]. Springer. [https://doi.org/10.1007/978-981-15-1781-5\\_4](https://doi.org/10.1007/978-981-15-1781-5_4)[Book Chapter].

### Publications (Journal)

1. Bhati, S., Nayak, S., & Kodukula, S. R. M. [2020]. Unsupervised Speech Signal-to-Symbol Transformation for Language Identification. Circuits, Systems, and Signal Processing, 39(10), 5169–5197. <https://doi.org/10.1007/s00034-020-01408-8>
2. K,A.,Taparia,M.,Madapu,A.,Rajalakshmi, P., Marathi, B., & Desai, U. B. [2020]. Discrimination of filled and unfilled grains of rice panicles using thermal and RGB images. Journal of Cereal Science, 95, 103037. <https://doi.org/10.1016/j.jcs.2020.103037>.
3. Jogdand, A., Alvi, S. B., Rajalakshmi, P. S., & Rengan, A. K. [2020]. NIR-dye-based mucoadhesive nanosystem for photothermal therapy in breast cancer cells. Journal of Photochemistry and Photobiology B: Biology, 208, 111901. <https://doi.org/10.1016/j.jphotobiol.2020.111901>.
4. Amarlingam, M., Durga Prasad, K. V. V., Rajalakshmi, P., Channappayya, S. S., & Sastry, C. S. [2020]. A Novel Low-Complexity Compressed Data Aggregation Method for Energy-Constrained IoT Networks. IEEE

### Book/Book Chapter

1. Tripathy, S., Supraja, P., & Singh, S. G. [2020]. Electrochemical Nanoengineered Sensors in Infectious Disease Diagnosis. In P. Chandra &

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### Funded Research Projects

1. Prof Kiran Kumar Kuchi, Feasibility study of co-existence of 5MHz spectrum in 700 MHz band for Railway Requirements, National Capital Region Transport Corporation, 4.72L.
2. Prof Shiv Govind Singh, Affordable deep learning-based point of care cardiac monitoring for heart attack survivors powered by lab-on-chip technology, MEITY, May 4, 2020, 145.62L.
3. Prof Soumya Jana, Affordable deep learning-based point of care cardiac monitoring for heart attack survivors powered by lab-on-chip technology, MEITY, 145.62L, Mar 4, 2020.
4. Dr K Sri Rama Murty, Voice Authentication for Command Control System, DRDL Jun 2, 2020, 19.95L.
5. Dr Emani Naresh Kumar, Development

- of silicon photoics platform for sensing at mid-IR wavelengths, MoE-STARS, Jun 10, 2020, 50.00L.
6. Dr K Sri Rama Murty, Automatic Speech Recognition in Indian English, Tamil, Hindi, and Text to Speech Synthesis for conversational speech in Indian languages, in particular Hindi, Tamil, and Indian English, MEITY, Jun 11, 2020, 16.00L.
  7. Dr Abhinav Kumar, Low-Altitude UAV Communication and Tracking (LUCAT), DST [International Bilateral Cooperation Division], Sep 25, 2020, 31.87L.
  8. Prof Shiv Govind Singh, Abdul Kalam Technology Innovation, National Fellowship INAE-SERB, Oct 1, 2020, 57.00L.
  9. Prof Shiv Govind Singh, Point of care device for COVID 19 detection, DBT, Oct 6, 2020, 46.18L.
  10. Dr Sushmee Badhulikha, Flexible, surface engineered substrates based multifunctional bioelectronic sensor-enabled with AI/ML to monitor vital physiological parameters, CARS, DRDO, Oct 7, 2020, 43.21L.
  11. Dr Amit Acharyya, Indigenous Solution to Prevent REVerse ENgineering ATtack on SOC (I-PREVENT), Centre For Development of Advanced Computing, Oct 16, 2020, 115.69L.
  12. Dr Sumohana S. Channappayya, Surveillance Camera Obstruction Detection, Honeywell Technology Solutions Lab (P) Ltd, Oct 22, 2020, 5.20L.
  13. Dr Shashank Vatedka, Local processing of coded data for large scale storage, SERB, Dec 28, 2020, 17.74L.
  14. Dr Abhishek Kumar, Compact scalable full-duplex front-end in CMOS for multi-antenna wireless systems, SERB, Dec 30, 2020, 33.00L.
  15. Dr Amit Acharyya, Intelligent and Proactive RTL Assessment Tool (IP-RAT), Taiwan Semiconductor Manufacturing Co. Ltd, Feb 26, 2021, 70.215L.
  16. Prof Shiv Govind Singh, e-GUNA: Sensory assessment for quality of fermented foods from North-East India" [2021-2023], MEITY, March 2021, 358.6L.
  17. Prof Kiran Kumar Kuchi, 5G+/6G Converged Terrestrial and Satellite IoT [5G+/6G-slot], MEITY, Mar 10, 2021, 1300.00L.
  18. Dr Amit Acharyya, Indigenous Intelligent and Scalable Neuromorphic Multi-Chip for AI Training and Inference Solutions, MEITY, Mar 23, 2021, 473.67L.
  19. Palla, N., & Kumar, V. S. S. [2020]. Coordinated Control of PV-Ultracapacitor System for Enhanced Operation Under Variable Solar Irradiance and Short-Term Voltage Dips. IEEE Access, 8, 211809–211819. <https://doi.org/10.1109/ACCESS.2020.3040058>

### Awards and Recognitions

1. Prof Shiv Govind Singh, Professor, INAE-Abdul Kalam Technology Innovation National Fellowship.
2. Mr Dendi Sathya Veera Reddy [Student] received IEEE ICASSP Travel Grant Award.
3. Mr Nagabhushan Eswara[Student] received Best Thesis Award IEEE Graduate Congress GraTE'7'
4. Mr Dendi Sathya Veera Reddy [Student] received Qualcomm Innovation Fellowship [QIF] Super Winner.
5. Mr Parimala Kancharla[Student] was selected as Qualcomm Innovation Fellowship [QIF] Super Winner.
6. Mr Bhavanam Srinadh Reddy[Student] received TCS RSC Fellowship.



7. Dr Sumohana S. Channappayya, Associate Professor, received Best Thesis Supervisor IEEE Graduate Congress GraTE'7'.
8. Dr Sumohana S. Channappayya, Associate Professor, was inducted as IEEE Senior Member
9. Dr Kaushik Nayak, Assistant Professor, was selected for Senior Member Grade, IEEE, and IEEE Electron Devices Society.
10. Mr Kumar Prashant [EE16RESCH11010] Won the Best Student Paper in category award, Kumar Prashant, Yerragudi Pullaiah, Dinesh Gupta and Kaushik Nayak, "Atomistic Modeling to Engineer Ohmic Contacts between Monolayer MoS<sub>2</sub> and Transition Metals", Presented in IEEE International Interconnect Technology Conference (IITC) 2020, San Jose, California, USA, October 5-8, 2020.
11. Dr Shashank Vatedka, Assistant Professor, received Best paper award honorable mention, 2020 International Conference on Signal Processing and Communications (SPCOM), IISc, Bangalore.
12. Dr Shashank Vatedka, Assistant Professor, received the Best poster award, 2021 Stanford Compression Workshop.

1. AI-based Aerial/Terrestrial traffic sensing using LiDAR point cloud processing - Object Detection and Tracking which involves: Object segmentation [clustering], Classification of objects, Finding vehicle count, Speed detection, Intrusion detection. High Throughput Crop Phenotyping using UAV based sensors like Hyperspectral, multispectral and RGB camera that involves: Standard operating Procedure for capturing of images from UAV, AI/ML techniques for calculation of phenotypic traits [LAI, plant count, 50% flowering, plant height, tassel detection, etc.], Weed/Crop segmentation, Nutrient and water stress classification, IoT network for monitoring soil moisture and soil temperature.

The brain-controlled IoT environments (BCE) provides the communication between the brain and the external world and involves: Developing sophisticated AI-based algorithms to detect the performed MI task by the user, Efficiently Communicating the intelligent decision engine's command to actuate the surrounding environments by using a low power IoT network. IoT enabled artificial intelligence-based guided and automated diagnostic systems for ultrasound imaging systems which ensure that a semi-skilled person with minimum expertise can provide non-invasive imaging diagnostic in remote healthcare.

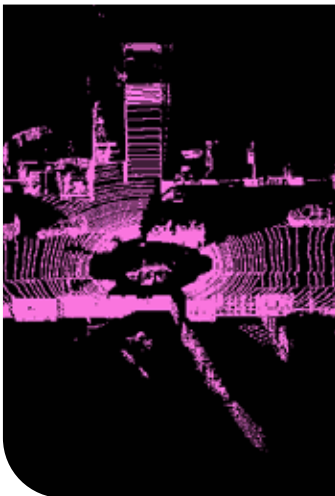


Fig: (right) Lidar mounted on UAV (left) Lidar point cloud



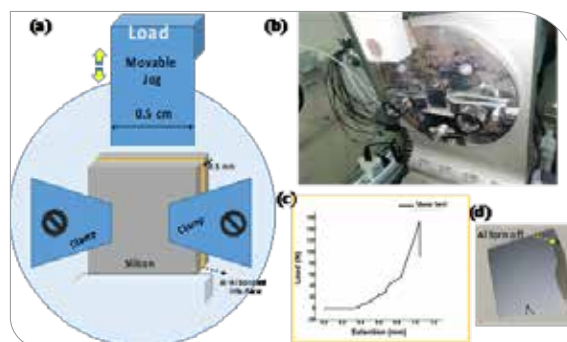
Fig: (a) RGB, MSI cameras on Drone, (b) HSI sensor on Drone, (c) Soil moisture sensors deployed

2. Prof Singh has done highly impactful fundamental investigations in the areas of nanotechnology, MEMS, and next-generation packaging technology. One of the most noteworthy contributions CHIPS lab, the nation needed innovation the most for countering the COVID-19 pandemic. Prof Singh single-handedly developed an innovative, rapid, cost effective Nucleotide based COVID-19 electronics test kit by 6th June 2020 because of his technological preparedness and got the kit clinically tested at ESIC hospital at Hyderabad. The highlight of the developed test kit is RT-PCR free diagnosis of SARS-CoV-2 using a portable bioelectronics platform, comprising low-cost multi-probe chemiresistive biochips, a portable-electronic-readout, an android application for data acquisition with machine-learning-based decision-making. The proposed platform performs the desired diagnosis from standard oral swabs (both on extracted and non-extracted RNA samples) without amplifying the viral load. Being an RT-PCR-free technology, the proposed approach offers inexpensive, fast (time-to-result:  $\leq 30$  minutes) and facile diagnosis, as opposed to most of the existing SARS-CoV-2 diagnosis protocols. Further, the availability of the handheld readout and the android-application based simple user interface facilitates easy accessibility and portable applications. Besides, by eliminating viral-RNA-extraction from oral swabs as a pre-requisite for specific detection, the proposed approach presents itself as an ideal candidate for point-of-care SARS-CoV-2 diagnosis. His novel device is under got validated by CCMB (ICMR validation partner).



COVID-19 electronics test kit

3. Low-Temperature Low-pressure Metal- Metal, Si-metal- Si, Si-Metal- Glass bonding for 3D IC Metal-Metal diffusion bonding was reassuring for micro electro mechanical system (MEMS) packaging and three-dimensional (3D) integration. Despite copper and gold, aluminum (Al) is also proficient for wafer-level bonding due to its CMOS compatibility. One of the main needs of 3D IC development is to achieve low pressure and thermal budget



Quantifying the interface strength of low temperature and low-pressure aluminum-aluminum bonded interface

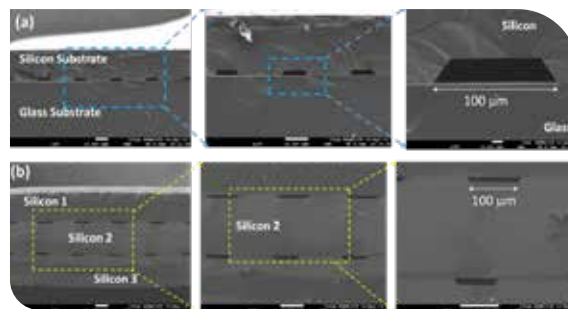
metal-metal bonding. To start with, efforts were concentrated on utilizing ultra-thin Pd as an effective passivation layer towards achieving low pressure and temperature Al-Al bonding and reported in the first time. As of now, a successful bonding reported with a temperature requirement is  $>300$  °C, due to chemically unwavering surface oxide on the aluminum surface. In this work, a facile method of successful Al-Al bonding at a low temperature and pressure by passivation Al surface with another ultrathin noble metal has been reported by optimizing ultrathin passivation layer leads low temperature ( $\sim 250$  °C)

and pressure [ $\sim 3$  MPa] with good interface quality and reliability. This proposed bonding technique is promising to use at the wafer-level, to integrate high-performance chip stack interconnects and facile packaging methods for micro-electro-mechanical systems.

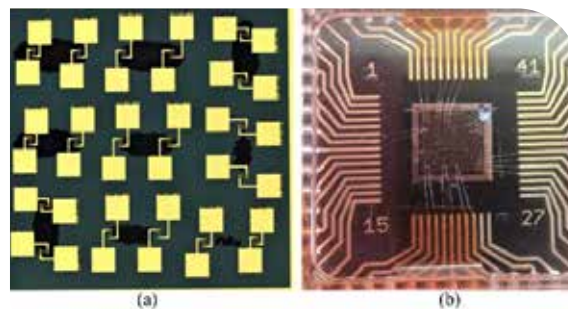
- a) Schematic of shear strength measurement.
- b) Sample mounting procedure for the bond strength inspection.
- c) Bond strength during interface delamination.
- d) Bonded interface after blade insertion.

4. Multi Stack Micro Channel Fabrication for Electronic Cooling Application in 3D IC Implementation of liquid-cooled paths is a need of hours but very challenging in 3D IC. Thus far, researchers have proposed optimization models on micro-channel designs for effective cooling. The practical realization of inter-die liquid microchannel cooling for 3D and 2D ICs was implemented either with adhesive interlayer bonding or with sophisticated plasma activation methods. These methods have limitations either in reliability concern, or the requirement of sophisticated instruments, and high thermal budgets due to annealing. Our developed technology will address all the concerns.

- a) The inspection across the glass and silicon bonded interface.
- b) The inspection across the tri-layer silicon interface stack.



*Cross sectional FE-SEM inspection of inter-layer micro-fluidic channels. A screenshot of a computer Description automatically generated with medium confidence*



*a) Fabricated Thermal sensor chip, and [b] wire-bonded Thermal sensor chip on a PCB.*

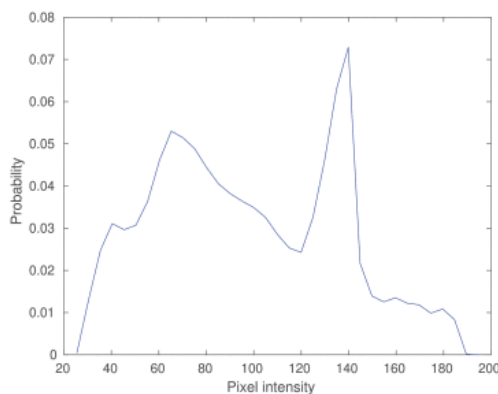
5. Single Pixel Microbolometer - There has been an enormous effort, since time immemorial, towards enhancing the visibility to see through the darkness and under blurred visibility conditions due to the necessity to perform all daytime activities seamlessly, even during the dark hours. It could be for sports, business, work, particularly actions concerning safety and defense. The best possible solution that can fix this problem is through infrared thermal imaging technology. Therefore, Thermography had an exciting influence on how we observe our surroundings and has led to many exciting applications. Traditionally, intended for defense and security applications [like systems for identification and monitoring, air-air missiles, anti-tank missiles, tank sight systems, etc.]. However, momentum for peaceful applications started in the last decade of the 20th century. As per the prediction, the commercial market for Thermal imaging is around 70% in volume and 40% in value, mainly for volume production of uncooled imagers. So therefore there

is a strong need to develop a thermal imaging device. This is the first step to develop a single-pixel micro-bolometer.

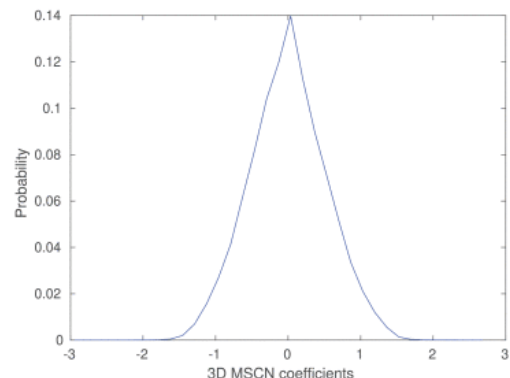
6. Natural Spatio-temporal Scene Statistics - We discovered that the local statistics of mean subtracted contrast normalized (MSCN) Spatio-temporal volumes of natural videos follow a unimodal distribution. We proposed an Asymmetric Generalized Gaussian Distribution (AGGD) to model the statistics of these local spatio-temporal volumes. Additionally, we demonstrated the utility of this model in a video quality assessment application.



(a) Frame from a pristine video ( $b_{f_{org}}$ ) in the LIVE Mobile VQA dataset [51].



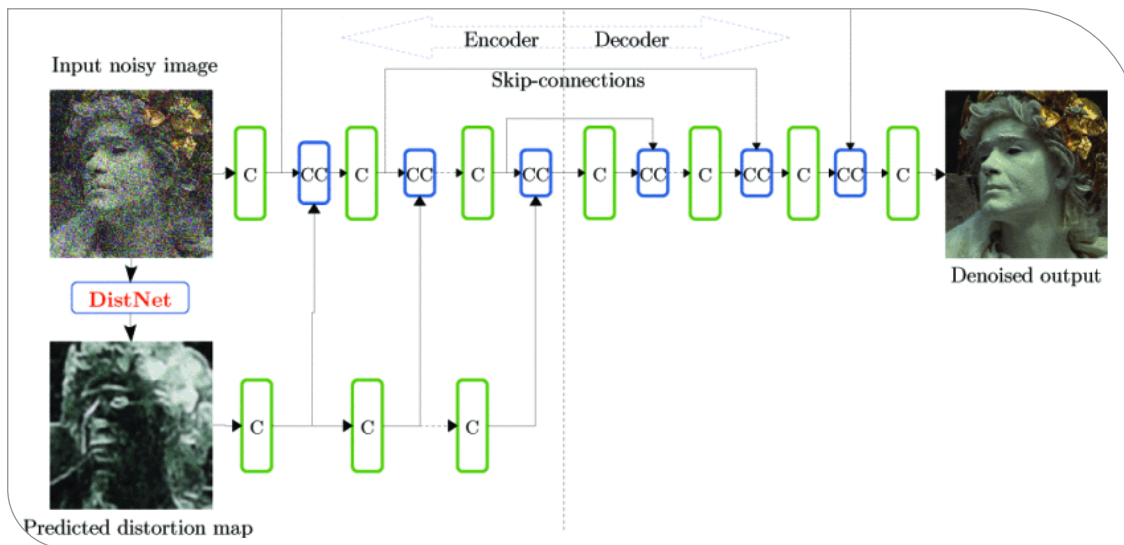
(b) Density curve of a natural pristine video ( $b_{f_{org}}$ ) from the LIVE Mobile VQA dataset [51].



(c) Density curve of 3D-MSCN coefficients of a natural pristine video ( $b_{f_{org}}$ ) from the LIVE Mobile VQA dataset [51].

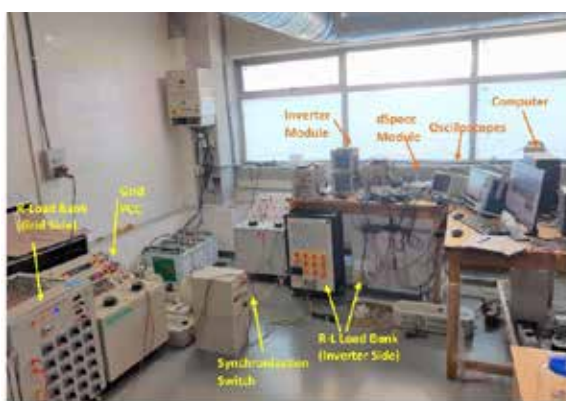
7. Perceptually Guided Image Denoising - We believe that one of the primary reasons for image denoising to be a challenge is the spatially varying perception of noise. It is well-known that the perception of noise is influenced by the local signal strength [or local signal variance]. For example, if we apply additive white Gaussian noise (AWGN) noise uniformly to a pristine natural image, the human visual system (HVS) will not perceive distortions equally across the image. High texture regions of an image mask distortions due to noise to a greater extent compared to low texture regions. This perceptual property of the HVS provides us the motivation for our work. We hypothesize that image denoising that is guided by local quality [or distortion] estimates is much more effective than using global cues such as noise standard deviation.





8. Virtual Synchronous Generator control scheme for RES grid integration: - Developed from the IITH and EMR/2016/003957 project fund support. The objectives of the proposed virtual electrical machines control schemes are,

- ▶ To act as an alternative controller to conventional PI logics-based droop-voltage-current (DVA) controller to reduce the dependency on PI controllers.
- ▶ Improving the system power quality by enabling smooth and robust control of voltage and frequency similar to synchronous generator-based conventional power plants.
- ▶ Improving the system resiliency through the injection of the necessary moment of inertia.
- ▶ Salient features of the proposed VSG (Virtual Synchronous Generator) control scheme
- ▶ The scheme perfectly mimics the behavior of conventional electric machines based on power plant operation in Microgrid.
- ▶ Due to the closed-loop control, the system can cope up and tolerate the real-time uncertainties.
- ▶ The emulation of the dynamic behavior of electrical machines improves the moment of inertia of the REM. This enhances the capability of loads to stay connected with local or utility grid power supply during the uncertainties.



Laboratory test setup made for testing the two control methods (DVA and VSG) during islanded and grid connected mode of operations.



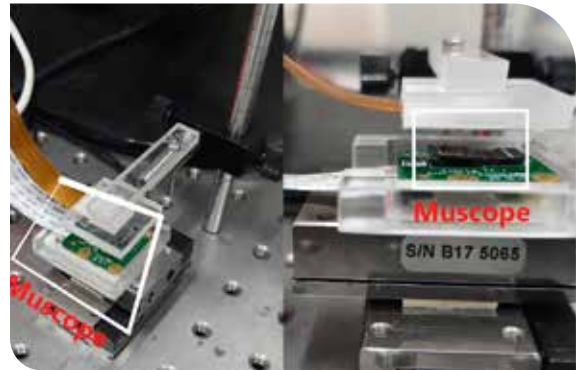
Another view of laboratory test setup for synchronizing inverter with DC motor driven SG made for islanded and grid connected mode of operations.

9. Nine Switch Boost Inverter (NSBI) suitable for Six Phase Induction Motor- Experimental setup of the NSBI fed to a six-phase motor is implemented using SPARTAN-6 XC6SLX9 FPGA control board.

The main features of the proposed NSBI are as follows:

- » Provides six-phase boost ac outputs in a single-stage conversion;
- » Continuous input currents and dc-link voltage;
- » Higher ac and dc voltage gains;
- » Can be used for variable frequency operations;
- » Can be operated during winding failure conditions as a reduced phase operating induction machine;
- » Improves the input dc-link voltage utilization

10. We have developed Muscope, a miniature lensless holographic microscope suitable for on-chip integration. The prototype of Muscope measures approximately only 7 mm x 4 mm x 4 mm, yet was capable of imaging micron-sized objects. We have used, for the first time, a microLED display as the light source in a microscope. The individual pixels of the microLED display chip are used as programmable, microscopic, and intense LEDs which can be spatially moved in a two-dimensional plane with a 5  $\mu\text{m}$  pitch. This unique feature set of the display was used to implement computational super-resolution and wide-field imaging without any extra hardware, unlike many other lensless microscopes. Muscope surpasses the existing lensless microscopes in compactness, scalability for production, automated operation, and system integration. It provides exciting opportunities for a new class of devices with in-built optical imaging, monitoring, and/or sensing capabilities.



## »» Department of Liberal Arts

The Department of Liberal Arts at IITH is a leading center for the study of a highly diverse range of subjects including Cognitive Science, Cultural Studies, Development Studies, Economics, English (Literature and Language), Linguistics, Psychology, Sociology, and Social Anthropology. While its primary focus remains world-class research in the fields of humanities and social sciences, the department is also deeply committed to teaching innovative and intellectually stimulating courses to undergraduate and post-graduate students of the institute. In addition, Liberal Arts at IIT Hyderabad places a lot of importance on interdisciplinary collaborations through projects of national and international importance. Currently, the department offers undergraduate courses at the institute and also has a strong post-graduate program that confers MA in Development Studies and PhD in all disciplines listed. Currently, the department has 19 faculty members, 57 PhD and 17 M.A students. Unique in its constitution and vision, the department of Liberal Arts at IIT Hyderabad strives to pursue excellence in teaching and research to benefit students, academics, and the wider society. The department aspires to enrich the academic and creative life of the institute, encourage cutting-edge scholarship, and cultivate a deeper understanding of humanity at large.

The M.A [Development Studies] program was started in 2019. The curriculum of the above program is designed to provide equal emphasis on both a strong theoretical foundation as well as developing research skills. The M.A program also provides a unique platform to pursue research in any of the areas mentioned above. The PhD program has been running successfully for more than ten years. The aim of our PhD program is to produce highly sought after and knowledgeable researchers for pursuing careers in academia, industry, and government.



Education is a capital to the poor man, and an interest to the rich man.  
– Horace Mann



## Faculty



**Haripriya Narasimhan**  
PhD – Syracuse University  
- NY, USA  
**Associate Professor & HOD**  
*Research Areas:* Media;  
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**Badri Narayan Rath**  
PhD – ISEC Bangalore  
**Professor**  
*Research Areas:* Economic  
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International Economics  
Energy Economics and Applied  
Econometrics



**Indira Jalli**  
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University  
**Associate Professor**  
*Research Areas:* Nation and  
Culture



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Workplace Bullying; Cross-  
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**Srirupa Chatterjee**  
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**Associate Professor**  
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**Aalok Khandekar**

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*Research Areas:* Environment; Disaster; Climate Change; Science Technology and Society Studies [STS]; Urban Studies; Cultural Anthropology

**Neeraj Kumar**

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*Research Areas:* Sensorimotor Learning, Motor Memory Consolidation, Stroke Rehabilitation, and Brain stimulation

**Chandan Bose**

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**Assistant Professor**

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*Research Areas:* Labour Studies, Gender Studies, Social Inequality, Development Studies, Public Policy



**Paresh Kumar Narayan**

Alfred Deakin Professor of Finance

**Assistant Professor**

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**Nimmi Rangaswamy**

Researcher, Microsoft Research Labs India

**Adjunct Professor**

*Research Areas:* Sociology of Digital Media; ICT for Development



**Kathryn Hummel**

**Visiting Assistant Professor**

*Research Areas:* Narrative Ethnography; Arts-based Research; Cultural and Media Studies; Poetry and Poetics

## Book/Book Chapter

1. "Caste [ing] Gender: Caste and gender in ancient Indian Jurisprudence", Color Struck.

## Publications (Journal)

1. Padhan, R., & Prabheesh, K. P. (2020). Business cycle synchronization: Disentangling the direct and indirect effect of financial integration in the Indian context. *Economic Modelling*, 85, 272–287. <https://doi.org/10.1016/j.econmod.2019.10.010>
2. Vidya, C. T., & Prabheesh, K. P. (2020). Implications of COVID-19 Pandemic on the Global Trade Networks. *Emerging Markets Finance and Trade*, 56(10), 2408–2421. <https://doi.org/10.1080/1540496X.2020.1785426>
3. Prabheesh, K., & Laila, N. (2020). ASYMMETRIC EFFECT OF CRUDE OIL AND PALM OIL PRICES ON ECONOMIC GROWTH: EVIDENCE FROM INDONESIA. *Buletin Ekonomi Moneter Dan Perbankan*, 23(2), 253–268. <https://doi.org/10.21098/bemp.v23i1.1304>
4. Prabheesh, K. P., & Garg, B. (2020). Testing deviations from PPP and UIP: Evidence from BRICS economies. *Studies in Economics and Finance*, ahead-of-print(ahead-of-print). <https://doi.org/10.1108/SEF-10-2019-0411>
5. Shareef, A. O., & Prabheesh, K. P. (2020). Do foreign banks in India respond to global monetary policy shocks? A SVAR analysis. *Studies in Economics and Finance*, ahead-of-print(ahead-of-print). <https://doi.org/10.1108/SEF-10-2019-0417>
6. Vidya, C. T., Prabheesh, K. P., & Sirowa, S. (2020). Is Trade Integration Leading to Regionalization? Evidence from Cross-Country Network Analysis. *Journal of Economic Integration*, 35(1), 10–38. <https://doi.org/10.11130/jei.2020.35.1.10>
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8. Akram, V., & Rath, B. N. (2020b). Optimum government size and economic growth in case of Indian states: Evidence from panel threshold model. *Economic Modelling*, 88, 151–162. <https://doi.org/10.1016/j.econmod.2019.09.015>
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### Publications [Conference]

1. Patthi, S. and Mondal, P. [2020]. A Cognitive Model of Sound Representations in Children with Speech Sound Disorders. In Stewart, T.C. [Ed.]. Proceedings of the 18th International Conference on Cognitive Modeling (pp. 187– 193). University Park, PA: Applied Cognitive Science Lab, Penn State.

### Funded Research Projects

1. Dr Aalok Dinkar Khandekar, Cool Infrastructures: Life with Heat in the Off-Grid City, Economic, and Social Research Council, UK, 01.04.2020, 495.8637966.

2. Dr Amrita Deb, Resilience program for students in higher education in India, Shastri Programme Development Grant [SPDG], Shastri Indo-Canadian Institute, Award date: April 17, 2020, 3L.
3. Dr Gaurav Dhamija, Data Quality Assessment - During and Post Data Collection, Population Council of India [PIC], 22/01/2021, 4.95L.
4. Dr Anindita Majumdar, 'Children in Between: Disruptions in Transnational Surrogacy in the Times of Covid-19' [co-PI with Anika Konig, [PI] Freie Universitat, Berlin and Heather Jacobson, University of Texas Arlington], Volkswagen Stiftung Grant, March 2021, 100L INR approx. with Co-PI getting funding for reimbursements.
5. Dr M P Ganesh, Nurturing Interest in Science Education among Female High School Children through Training and Mentoring through CSR funding program, RAMKY, Mar 10, 2021, 5.50L.
6. Dr Shubha Ranganathan, Disability, family, and care in the time of COVID-19, ICSSR, Mar 12, 2021, 6.93L.
7. Dr Mahati Chittem, Homework in the time of COVID-19: A longitudinal qualitative study of lockdown on mothers in Hyderabad, Telangana ICSSR, Mar 12, 2021, 4.20L.

### Workshops Conducted

1. Resilience Program for students in higher education in India, funded by Shastri Programme Development Grant, Shastri Indo-Canadian Institute, January 11-13, 2021.
2. "Only Skin Deep? Fairness Bias, Embodiment, and Narratives on Indian Womanhood." For panel titled "Conceptualizing the Body: Identity,



Intimacy, and Intervention.” Virtual NeMLA 2021 Convention. [Host university: University of Buffalo, New York, USA], March 10-14, 2021.

3. An online weekend workshop titled “Leadership Skills for Performance Management for senior and middle-level managers [held from 21st November to 6th December 2020].
4. Offered an NPTEL course titled Organizational Behaviour during July 2020

### Awards and Recognitions

1. Badri Narayan Rath, Professor, Vaseem Akram, and Bhushan Praveen Jangam have received the 2020 Emerald Literati Award for their paper being selected as a highly commended paper.
2. Badri Narayan Rath, Professor, Pradipta Kumar Sahoo, and D. Tripathi Rao have received recognition for their paper being one of the top-cited articles in Economic Papers: A journal of applied economics, published by Wiley.
3. Dr Badri Narayan Rath, Professor, was selected as the Subject Editor, Emerging Markets Finance and Trade [Taylor and Francis].

4. Dr Badri Narayan Rath, Professor, served as a Guest Editor, Special Issue on Pandemics and their impact on the global economic and financial system [December 2020], MethodsX [Elsevier].

5. Dr Badri Narayan Rath, Professor, has been selected as the Editor, Asian Economics Letters [APAEA].

6. Dr Badri Narayan Rath, Professor, was selected as a Member of the Editorial Advisory Board of Science, Technology, and Society [Sage].

7. Dr Badri Narayan Rath, Professor, was selected as the Associate Editor of Odisha Economic Association Blogs.

8. Prakash Mondal, Assistant Professor, has been appointed as a member of the Editorial Advisory Panel of HSS Communications [Nature].

9. Ms Shweta Sureshrao Thakare [LA19MA11007] was awarded Upaya and MIT D-Labs 2021 Scale-Ups Accelerator Program.

10. Dr Aalok Khandekar, Assistant Professor, has been Selected as Editor-in-Chief, Engaging Science, Technology, and Society, the open-access journal of the Society for Social Studies of Science [4S].

1. Dr Prakash Chandra Mondal's, recent research on language-biology relations offers a critique of the neuro-centric view of language and cognition by locating it within the context of unification in cognitive science. While unity consists in the integration of the constraints, contents, and operations of various levels or scales of organization of the cognitive system, it contrasts with disunity. Disunity emanates from variations in structure and content at any level of the cognitive system that gives rise to significant and often unique differences in experience, appearance, form, and organization of a cognitive phenomenon at the given level. This happens when the given level is looked at in greater detail. For instance, the gap in the organizational character between a cognitive schema for reasoning how and whether to travel and its account in terms of neuronal activation patterns reflects disunity. Many neurobiological accounts of language aim at the integration of the cognitive organization of language with the neuronal structures at the bottom to achieve unity, but disunity arises from the special nature of the symbolic/cognitive properties of natural language which are argued to reside neither in the brain nor in the environment alone most plausibly because they are emergent patterns between designated brain states and various kinds of linguistic experience. The proposal that is advanced and then defended with special reference to language-biology relations employs Haugeland's [1978] notion of dimensions and levels, and thereby emphasizes that unity and disunity can co-exist in an explanatory union but from different perspectives and orientations.

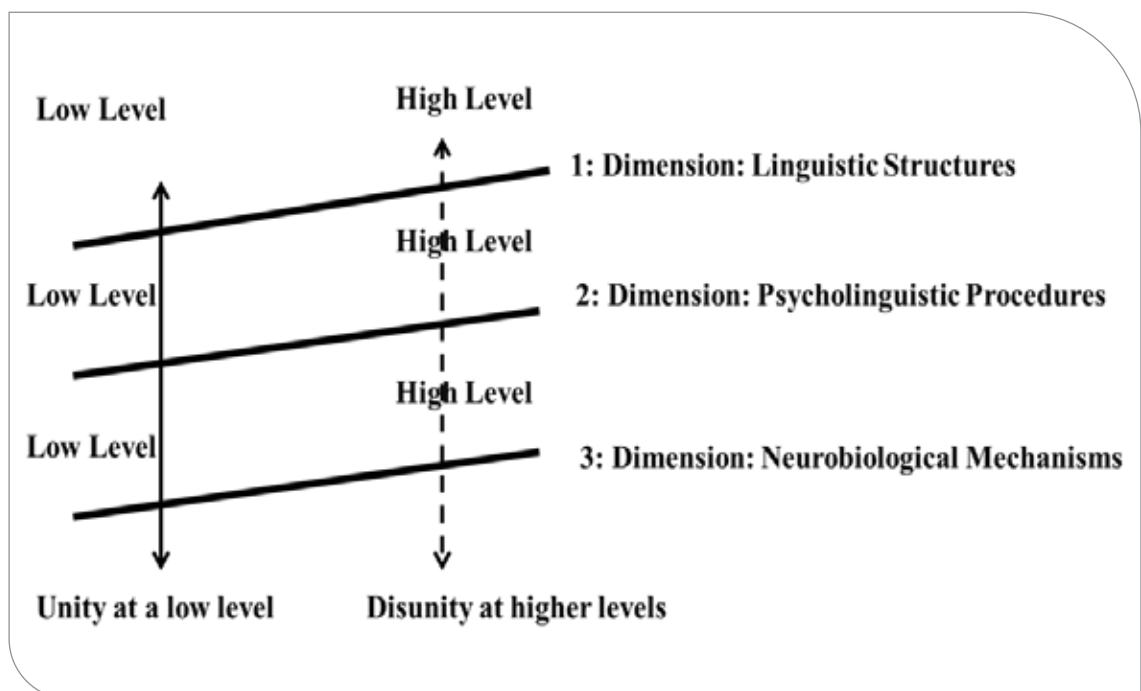


Figure: Unity and disunity in language-biology relations

## »» Department of Material Science & Metallurgical Engineering

Namaskar! The Academic year 2020-21 was eventful mainly in the form of augmentation of teaching, technical and administrative strength of Materials Science and Metallurgical Engineering (MSME). MSME is proud to be associated with Distinguished Professor Prof Pulickel M. Ajayan (Rice University, USA), three highly reputed Adjunct Professors (Prof N.R. Munirathnam retired Director General CMET Pune; Dr Dheepa Srinivasan, Chief Engineer Pratt & Whitney R&D Center Bengaluru and Prof Chennupati Jagadish, The Australian National University, Canberra), two Assistant Professors (Dr Deepu J. Babu and Dr Suresh K. Garlapati), three Technical Superintendents (Ms Y. Sravani, Mr Muriki Laxminarayana, and Mr Chinnam Sivateja), four Junior Technicians (Mr Nalam Divakar, Mr Asutya K. Biswal, Mr E.R. Jothilingam, and Ms Saimatha Gannbathula) and two Office Staff (Mr Harish Ramineni as Executive Assistant and Mr Cheemakurthi M. Subhani as Multi Skill Assistant). Two Associate Professors of the department joined as Professors (Dr Suhash Ranjan Dey and Dr Bharat B. Panigrahi) as well. Also, on 1st November 2020, Prof Suhash R. Dey took charge as Head of the MSME department from Prof Bharat B. Panigrahi. MSME also got two Research Associates (Dr Chokkakula L.P. Pavithra on a Project and Dr Dhanabal Rengasamy supported by CSIR) in Prof Suhash R. Dey's group.

MSME has established a state-of-the-art Electron Microscopy facility supported by JICA funds through the solid efforts of Dr Sai Rama K. Malladi (Assistant Professor). This Electron Microscopy facility contains a High-Resolution Cold FEG Transmission Electron Microscope and a Dual Beam Microscope (pictures are given below).

In Research and Technology, MSME Researchers have made deep impacts in several areas. A very few are mentioned here. In the high entropy alloys domain, Professor Pinaki P. Bhattacharjee's group could produce novel heterogeneous nanostructure high entropy alloys with simultaneous enhanced strength and ductility. Professor Suhash R. Dey's group fabricated high entropy alloys as nanowires of a new alloy system which is the first to report on the synthesis of one-dimensional high entropy alloys worldwide. Dr Saswata Bhattacharya's (Associate Professor) group developed a three-dimensional discrete dislocation dynamics model to unravel the mechanisms of evolution of complex dislocation networks in Nickel-base superalloys as a function of microstructure. More exciting scientific outcomes are mentioned alongside each faculty's profile in this annual report.



**There are three things extremely hard: steel, a diamond, and to know one's self. – Benjamin Franklin**



## Faculty



**Bharat B Panigrahi**

PhD – IIT Kharagpur

**Professor & HoD**

*Research Areas:* Powder Metallurgy; Sintering; Nanocrystalline Materials; High Entropy Alloys; Max Phase and Mxene; Microstructure-Properties of Steels; Titanium Alloys; Composites; Additive Manufacturing



**BS Murty**

PhD – IISC Bangalore

**Professor**

*Research Areas:* Nanocrystalline Materials; High Entropy Alloys; Bulk Metallic Glasses; Thermodynamics and Kinetics of Phase Transformations; Transmission Electron Microscopy and Atom Probe Tomography



**Pinaki Prasad Bhattacharjee**

PhD – IIT Kanpur

**Professor**

*Research Areas:* High Entropy Alloys; Thermo-Mechanical Processing; Crystallographic Texture; Mechanical Properties



**Suhash Ranjan Dey**

PhD – University Paul-Verlaine - Metz, France

**Professor**

*Research Areas:* Multi-Component Alloys; Titanium Alloys; CIGS / CZTS Solar Cells; Electrodeposition; Biomaterials; Interstitial Free Steels



**Janaki Ram GD**

PhD – IIT Madras

**Professor**

*Research Areas:* Welding and Additive Manufacturing



**Ranjith Ramadurai**

PhD – IISC Bangalore

**Associate Professor**

*Research Areas:* Multifunctional Thin Films; Piezoresponse Force Microscopy; Hybrid Piezoelectrics; Piezoelectric Sensors and Actuators



**Saswata Bhattacharya**

PhD – IISC Bangalore

**Associate Professor**

*Research Areas:* Phase-Field Modeling of Microstructural Evolution in Alloys and Oxides; Phase Transformations; Micro Mechanical Modeling



**Mudrika Khandelwal**

PhD – University of Cambridge, UK

**Associate Professor**

*Research Areas:* Cellulose Composites; Drug Delivery; In Situ Modifications; Food Packaging

**Rajesh Korla**

PhD – University of Cambridge, UK

**Assistant Professor**

*Research Areas:* Deformation Behavior of Materials at Room Temperature and High Temperature

**Chandrasekhar Murapaka**

PhD – Nanyang Technological University (NTU), Singapore

**Assistant Professor**

*Research Areas:* Nanomagnetic Materials; Spintronic Based Memory and Logic Devices

**Subhradeep Chatterjee**

PhD – IISc Bangalore

**Assistant Professor**

*Research Areas:* Phase Transformations; Electron Microscopy; Welding and Solidification Processing; Microstructural Modelling

**Mayur Vaidya**

PhD – IIT Madras

**Assistant Professor**

*Research Areas:* Diffusion deformation correlation, Nanocrystalline Materials, Diffusion Couple approach, High entropy alloys, Phase stability, Oxidation, Precipitation

**Atul Suresh Deshpande**

PhD – Max-Planck Institute of Colloids and Interfaces - Potsdam, Germany

**Associate Professor**

*Research Areas:* W Nanomaterial Synthesis; High Entropy Oxides; Super Hydrophobic Materials; Energy Storage Materials

**Shourya Dutta Gupta**

PhD – Swiss Federal Institute of Technology Lausanne

**Assistant Professor**

*Research Areas:* Plasmonics; Nanophotonics; Biosensing; Raman Spectroscopy; Nanofabrication; Active Devices; Graphene Device

**Suresh Kumar Garlapati**

PhD – Technische Universität Darmstadt and Karlsruhe Institute of Technology, Germany

**Assistant Professor**

*Research Areas:* Printed and flexible electronics, oxide semiconductors, electrolyte gating, organic electronics, gas sensors, and memristors

**Sai Rama Krishna Malladi**

PhD – Technische Universiteit Delft, The Netherlands

**Assistant Professor**

*Research Areas:* In Situ Transmission Electron Microscopy; Phase Transformations in Materials; Electrochemistry and Corrosion; Graphene Based Super Capacitors; Materials for Energy Applications

**Deepu J Babu**

PhD – TU Darmstadt, Germany

**Assistant Professor**

*Research Areas:* Nanoporous materials, Adsorption, Membranes, Active separations, Defect engineering, Carbon nanomaterials, Metal-organic frameworks, Plasma functionalization, Phase inversion, Chemical vapor deposition, Nanofluidics Information Model (CIM); Interoperability and Standards

**Munirathnam N R**

**Adjunct Professor**

*Research Areas:* Materials Science.



### Patents Filed/Granted

1. Chokkakula L.P. Pavithra, Suhash Ranjan Dey, and Kunda Siri Kiran Janardhana Reddy, High entropy alloy and quinary alloy nanowires Filing Date: Sept 28, 2020, Indian Patent, Patent of Addition to 20194103178, Application No. 202043041990. [Filed].

### Publications (Journal)

1. Mohammed, Z. A., Chadha, K., Seelam, R., Shahriari, D., Bhattacharjee, P., & Jahazi, M. [2020]. Influence of Process Parameters on Microstructure Evolution During Hot Deformation of a Eutectic High-Entropy Alloy (EHEA). *Metallurgical and Materials Transactions A*. <https://doi.org/10.1007/s11661-020-05991-y>
2. Sake, N., Saha, R., & Bhattacharjee, P. [2020]. Strain-dependent evolution of microstructure and texture in severely cold-rolled and annealed ultrafine pearlite. *Materials Characterization*, 169. <https://doi.org/10.1016/j.matchar.2020.110583>
3. Singh, V., Mondal, C., Sarkar, R., Bhattacharjee, P. P., & Ghosal, P. [2020a]. Compressive creep behavior of a  $\gamma$ -TiAl based Ti-45Al-8Nb-2Cr-0.2B alloy: The role of  $\beta$ (B2)-phase and concurrent phase transformations. *Materials Science and Engineering: A*, 774, 138891. <https://doi.org/10.1016/j.msea.2019.138891>
4. Singh, V., Mondal, C., Sarkar, R., Bhattacharjee, P. P., & Ghosal, P. [2020b]. Dynamic recrystallization of a  $\beta$ (B2)-Stabilized  $\gamma$ -TiAl based Ti-45Al-8Nb-2Cr-0.2B alloy: The contributions of constituent phases and Zener-Hollomon parameter modulated recrystallization mechanisms. *Journal of Alloys and Compounds*, 828, 154386. <https://doi.org/10.1016/j.jallcom.2020.154386>
5. Sunkari, U., Reddy, S. R., Athira, K. S., Chatterjee, S., & Bhattacharjee, P. P. [2020]. Effect of niobium alloying on the microstructure, phase stability, and mechanical properties of CoCrFeNi<sub>2.1</sub>Nb<sub>x</sub> high entropy alloys: Experimentation and thermodynamic modeling. *Materials Science and Engineering: A*, 793, 139897. <https://doi.org/10.1016/j.msea.2020.139897>
6. Sunkari, U., Reddy, S. R., Rathod, B. D. S., Kumar, D., Saha, R., Chatterjee, S., & Bhattacharjee, P. P. [2020a]. Tuning nanostructure using thermo-mechanical processing for enhancing mechanical properties of complex intermetallic containing CoCrFeNi<sub>2.1</sub>Nb<sub>x</sub> high entropy alloys. *Materials Science and Engineering: A*, 769, 138489. <https://doi.org/10.1016/j.msea.2019.138489>
7. Sunkari, U., Reddy, S. R., Rathod, B. D. S., Kumar, S. S. S., Saha, R., Chatterjee, S., & Bhattacharjee, P. P. [2020b]. Heterogeneous precipitation mediated heterogeneous nanostructure enhances strength-ductility synergy in severely cryo-rolled and annealed CoCrFeNi<sub>2.1</sub>Nb<sub>0.2</sub> high entropy alloy. *Scientific Reports*, 10(1), 6056. <https://doi.org/10.1038/s41598-020-63038-z>
8. Biswas, K., Yeh, J.-W., Bhattacharjee, P. P., DeHosson, J. Th. M. [2020]. High entropy alloys: Key issues under passionate debate. *Scripta Materialia*, 188, 54–58. <https://doi.org/10.1016/j.scriptamat.2020.07.010>
9. Cao, B., Iwamoto, T., & Bhattacharjee, P. P. [2020]. An experimental study on strain-induced martensitic transformation behavior in SUS304 austenitic stainless steel during higher strain rate deformation by continuous evaluation of relative magnetic permeability. *Materials Science and Engineering: A*, 774, 138927. <https://doi.org/10.1016/j.msea.2020.138927>

10. Jana, S., Panigrahi, G., Narayanswamy, S., Ishtiyak, M., Das, M., Bhattacharjee, P. P., Niranjana, M. K., & Prakash, J. [2020]. Synthesis, crystal structure, optical absorption study, and electronic structure of Cs<sub>3</sub>FeCl<sub>5</sub>. *Solid-State Sciences*, 100, 106064. <https://doi.org/10.1016/j.solidstatesciences.2019.106064>
11. Chakraborty, P. K., Azadmanjiri, J., Pavithra, C. L. P., Wang, X., Masood, S. H., Dey, S. R., & Wang, J. [2020]. Advancements in Therapeutics via 3D Printed Multifunctional Architectures from Dispersed 2D Nanomaterial Inks. *Small*, 16(49), 2004900. <https://doi.org/10.1002/smll.202004900>
12. Yadav, B. S., Koppoju, S., Dey, S. R., & Dhage, S. R. [2020]. Microstructural investigation of inkjet-printed Cu(In, Ga)Se<sub>2</sub> thin-film solar cell with improved efficiency. *Journal of Alloys and Compounds*, 827, 154295. <https://doi.org/10.1016/j.jallcom.2020.154295>
15. K, P., Bhat, A. P., S, A., & Ramadurai, R. [2020]. Grain to Grain Epitaxy-Like Nano-Structures of [Ba, Ca][ZrTi]O<sub>3</sub>/CoFe<sub>2</sub>O<sub>4</sub> for Magneto-Electric Based Devices. *ACS Applied Nano Materials*, 3(11), 11098–11106. <https://doi.org/10.1021/acsanm.0c02265>
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#### Publications [Conference]

1. Madhuri, K., Kannan, P. K., Chaudhari, S., Dhage, S. R., & Dey, S. R. [2020].

- Effect of Annealing Time and Heat Flux on Solvothermal Synthesis of CIGS Nanoparticles. *Materials Today: Proceedings*, 21, 1882–1887. <https://doi.org/10.1016/j.matpr.2020.01.245>
2. Kannan, P. K., Chaudhari, S., & Dey, S. R. [2020]. Effect of Anionic Substitution of S by Se in CZTSSe Films Prepared from Electron Beam Evaporation. *Materials Today: Proceedings*, 21, 1787–1792. <https://doi.org/10.1016/j.matpr.2020.01.232>
  3. Shivaram, M. J., Arya, S. B., Nayak, J., & Panigrahi, B. B. [2020]. Role of porosity on electrochemical corrosion behavior of porous Ti-20Nb-5Ag alloy in simulated body fluid. *Materials Today: Proceedings*, 33, 5257–5261. <https://doi.org/10.1016/j.matpr.2020.02.952>
  4. Dogra, A. R., Khandelwal, M., Kumar, A., Khanra, P., & Kumar, P. [2020]. Study on morphology and conductivity behavior of synthesized polyaniline. *AIP Conference Proceedings*, 2220(1), 140020. <https://doi.org/10.1063/5.0001818>
  5. Vivek Chaitanya P, Kranthi KP, DS Jagadeesh, K.S. Athira, Srinath G, S. Suryakumar, S. Chatterjee [2020]. Weld deposition of nickel on titanium for surface hardening with Ti-Ni-based intermetallic compounds. Presented in Int. Conf. Mater. Manuf. Methods [MMM2019] held in Tiruchirapalli, India, July 5-7, 2019. Published in *Materials Today: Proceedings*, vol. 27, pp. 2096-2100, 2020. <https://doi.org/10.1016/j.matpr.2019.09.075>
  2. Prof Suhash Ranjan Dey, Anti-viral coatings of electrochemically reduced metal nanoparticles for respirators, IIT Hyderabad, Jun 1, 2020, 10.00L.
  3. Dr Sai Rama Krishna, Malladi High Entropy Alloys with Multiscale Heterogeneities: A Novel class of Advanced Structural Materials, DRDO, 71.89L, July 24, 2020.
  4. Prof Pinaki Prasad Bhattacharjee, High Entropy Alloys with Multiscale Heterogeneities: A Novel class of Advanced Structural Materials [PI], DRDO, Jul 24, 2020, 71.89L.
  5. Dr Mayur Vaidya, Using diffusion multiples to investigate interdiffusion in nanocrystalline materials by spark plasma sintering, IIT Hyderabad, August 2020, 25.00L.
  6. Dr Mudrika Khandelwal, Development of antimicrobial food packaging material by using biopolymers to enhance the shelf life of strawberry, capsicum, broccoli, Indian gooseberry, guava, and okra during storage (large and small quantity) and transportation, WayCool Foods & Products Pvt. Ltd, Sep 9, 2020, 18.93L.
  7. Dr Mayur Vaidya Atomic transport and phase growth in deformed transition metals, SERB, Dec 22, 2020, 33.00L.
  8. Prof Suhash Ranjan Dey, Microstructural evolution and structure-property correlations in FeCoNi based multi-component alloy thin films, DST-VR [Indo-Swedish], Dec 23, 2020, 43.68L.
  9. Prof Pinaki Prasad Bhattacharjee, Tuning heterogenous nanostructure via strain-partition engineering for developing cobalt-free cost-effective eutectic high entropy alloys with outstanding strength-ductility synergy [PI], SERB, Dec 28, 2020, 25.84L.
  10. Dr Sai Rama Krishna, Malladi, Tuning heterogenous nanostructure via strain-

#### Funded Research Projects - 2020-2021

1. Prof Suhash Ranjan Dey, Cobalt nanowire-PEG fortified hydrogels to stimulate stem cells magnetically and deliver drugs locally for osteoarthritis patients, IIT Hyderabad, Jun 1, 2020, 10.00L.



partition engineering for developing cobalt-free cost-effective eutectic high entropy alloys with outstanding strength-ductility synergy, SERB, 25.84L. Dec 28, 2020.

11. Dr Rajesh Korla, Investigation of the high-temperature deformation and creep behavior of Fe-Mn-Al-C low-density steels, SERB, Dec 30, 2020, 43.71L.
12. Prof Bharat B Panigrahi, Post-Processing of Direct Energy Deposition Components: Need Identification and Process Selection, SERB, Dec 30, 2020, 43.49L.
13. Dr Saswata Bhattacharya, Repository of High-performance phase-field solvers for Microstructure simulation [MicroSim], IISc, Bangalore (DST-NSM), Mar 27, 2021, 20.49L.

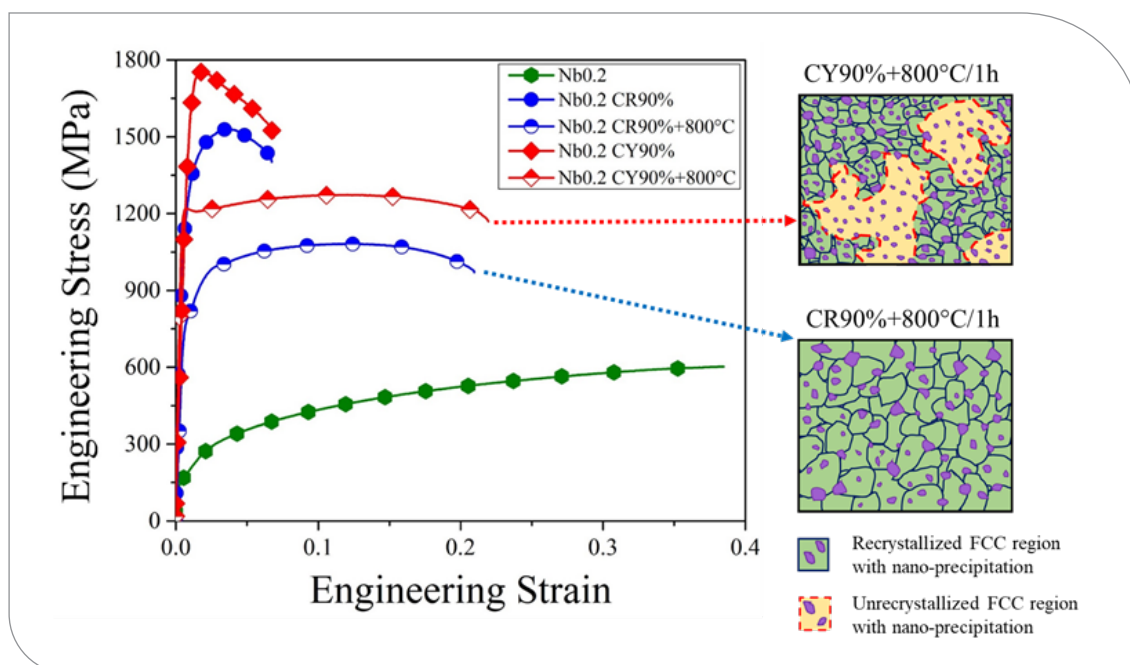
### Workshops Conducted

1. International Workshop on Integrated Computational Materials Engineering (e-ICME) on July 18 and July 23 (by Deakin-IITM-IITH Centre of Excellence) – Joint Convener

### Awards and Recognitions

1. Prof P.P. Bhattacharjee, Professor, received the Japan Society for the Promotion of Science (JSPS) Invitation Fellowship (FY 2021-22).
2. Mr Bikash Tripathi received Departmental Research Scholars' Day Award (Rank 1).
3. Dr Mudrika Khandelwal, Associate Professor, received INAE Young Engineer Award 2020.
4. Dr Mudrika Khandelwal, Associate Professor, received NASI Young Scientist Platinum Jubilee Award 2020.

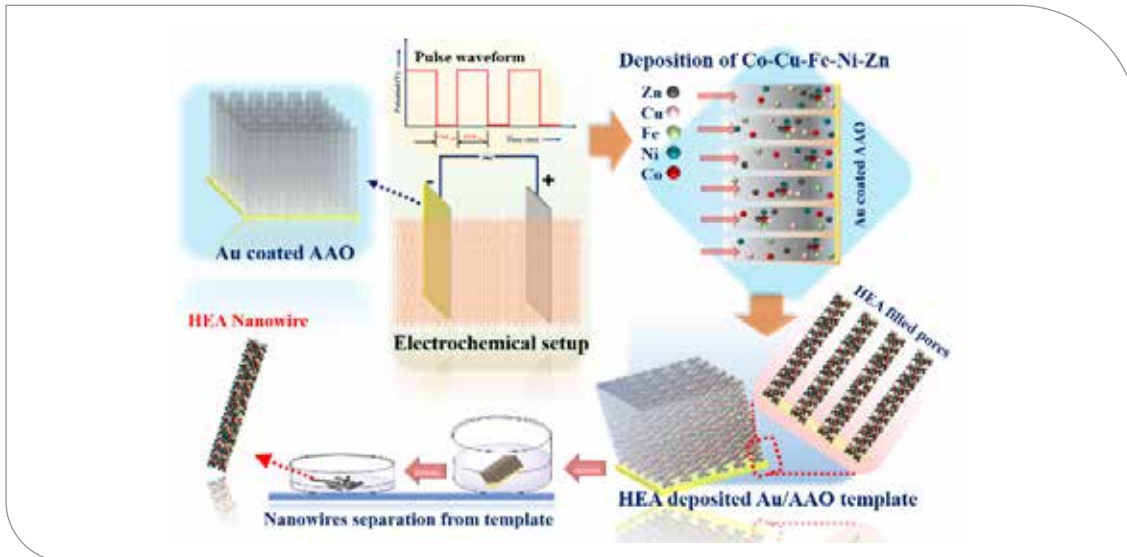
1. Brittle intermetallic containing high entropy alloys (HEAs) is considered a major challenge as far as improving their mechanical properties is considered. In our work, we overcome this challenge in complex intermetallics containing CoCrFeNi<sub>2.1</sub>Nb<sub>0.2</sub> HEAs by tailoring nanostructure using intelligent thermo-mechanical processing strategies. We have shown that tuning the relative kinetics of the two competing processes, namely heterogeneous nanoprecipitation and recrystallization, by cryo-rolling and annealing can lead to a novel heterogeneous nanostructure with simultaneous enhancement in strength and ductility.



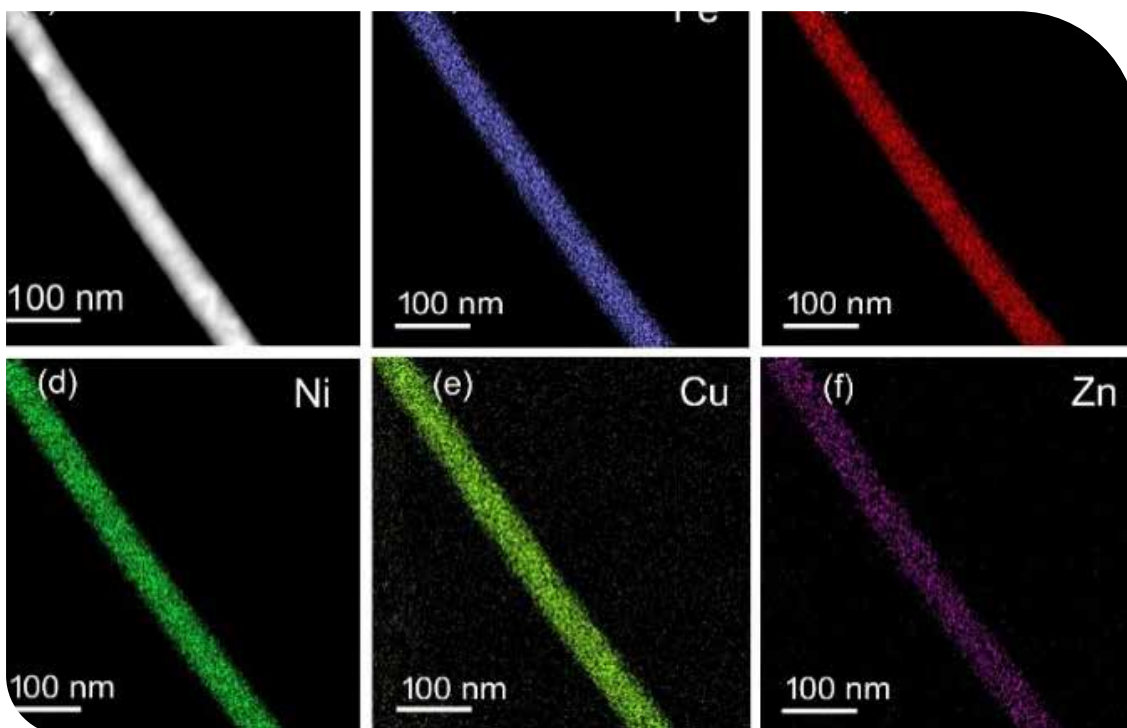
*Schematics showing heterogeneity mediated superior strength-ductility synergy in intermetallic containing CoCrFeNi<sub>2.1</sub>Nb<sub>0.2</sub> HEA [7].*

2. Prof Suhash Ranjan Dey's research group fabricated electrochemically a new high entropy alloy (HEA) nanostructures (HEA nanowires with high aspect ratio with uniform length of ~50  $\mu\text{m}$  and diameter of  $100 \pm 20$  nm) having single FCC phase with nanocrystalline features including crystalline twins along the nanowire. These one-dimensional HEA nanowires are having uniform stoichiometry and homogeneous distribution of all five elements Co, Cu, Fe, Ni, and Zn [required range for HEAs ~5-35 atom %], along the length of the wire [schematic on the synthesis and other related figures are shown below]. This is the first promising report on depositing high entropy alloy one-dimensional nanostructures (nanowires) with five principal alloying elements in a single step in an aqueous medium using an electrochemical approach. These current outcomes are a breakthrough in HEAs

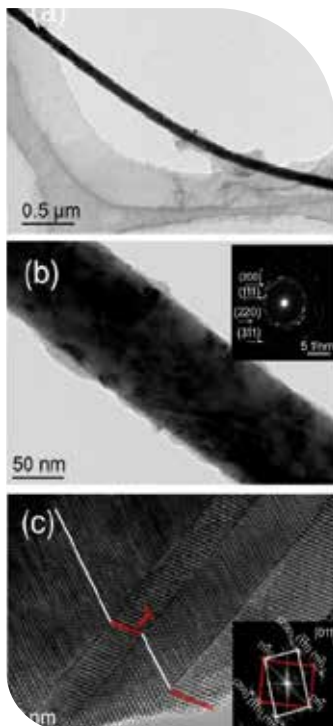
and shall enable a new strategy towards unexplored alloy systems and their nanostructures in addressing applications for various demanding problems.



*Schematic representation for the synthesis of one dimensional Co-Cu-Fe-Ni-Zn high entropy alloy nanowires from AAO*



*STEM-EDS of a nanowire. [a] HAADF-STEM image contrast. [b-f] EDS chemical mapping obtained from the region reveals [b] iron [Fe], [c] cobalt [Co], [d] nickel [Ni], [e] copper [Cu] and [f] zinc [Zn] uniformly distributed throughout the individual nanowire.*



TEM characterization of nanowires. (a) Low magnification TEM image of a nanowire. (b) Bright field TEM and corresponding SAED pattern display showing polycrystalline with FCC structure. (c) High resolution TEM image of nanotwin lamellae on {111} planes.

3. We have developed a three-dimensional discrete dislocation dynamics model to unravel the mechanisms of evolution of complex dislocation networks in Nickel-base superalloys as a function of microstructure. The simulations show the formation of a hexagonal network of immobile dislocations on particle surfaces that is in good agreement with those observed experimentally. The figure shows the development of an interfacial dislocation network on an unshearable particle as a function of active slip systems, creep strain, and average particle spacing.

Formation of Interfacial Dislocation Network Around A Gamma Prime Precipitate During Creep in Nickel-based Superalloys.

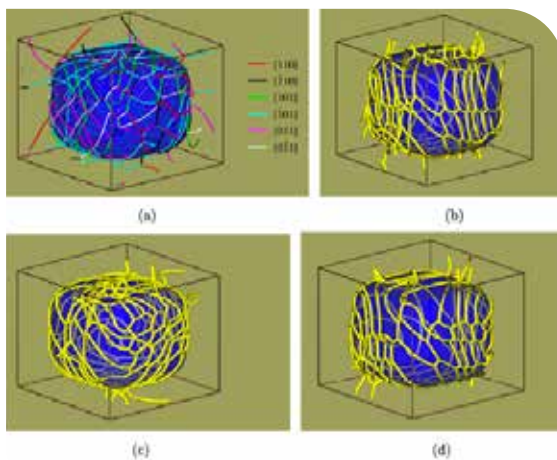
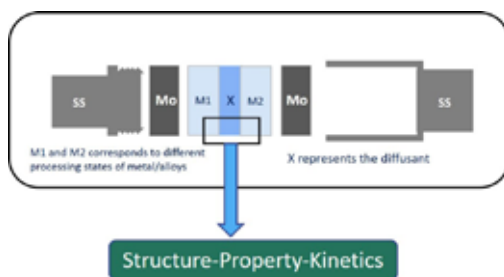


Figure (a) Dislocation network formation with eight active slip systems when the applied stress is 500 MPa along [001] direction. Various types of junctions such as glissile, Lomer, coplanar, Hirth junctions form due to dislocation core reactions Figure (b) Formation of Glissile Junctions with zero Schmid factor - two reacting slip systems  $[0\ 1\ 1]$   $[1\ 1\ -1]$  and  $[1\ 0\ 1]$   $[-1\ 1\ 1]$  Figure (c) Formation of Lomer junctions with zero Schmid factor - two reacting slip systems  $[0\ 1\ 1]$   $[1\ 1\ -1]$  and  $[1\ 0\ -1]$   $[1\ 1\ 1]$  Figure (d) Formation of Coplanar junctions with zero Schmid factor - two reacting slip systems  $[0\ 1\ 1]$   $[1\ 1\ -1]$  and  $[1\ 0\ 1]$   $[1\ 1\ -1]$



Schematic of sandwich diffusion couple experiment

4. Diffusion-couple approach to evaluate phase growth kinetics and interdiffusion in deformed and nanocrystalline materials

## »» Department of Mathematics

The Department, founded along with the Institute in 2008, aspires to evolve into an internationally acclaimed center for theoretical, interdisciplinary and applicable mathematical research, supporting and complementing the expertise extant in and around Hyderabad. As one of the basic science departments, the department remains as the fulcrum of teaching that offers a large share of the science credits for the entire community of students at IIT Hyderabad.

Our masters' students have done well in competitive exams with many of them landing doctoral positions in various IITs and other national institutes of excellence - proof enough that the department was able to mitigate the effect of the pandemic through its innovative modes of instruction and discussion.

The challenge thrown by the pandemic did not deter the department, which was quick to make up for the lost time and has kept up its research output both in terms of quantum and quality, as is visible from the impressive list of journals that have featured our submissions and the post-doctoral positions obtained by our recent graduates."

The department is proud to see the passing out of its first batch of students from the B.Tech [Maths and Computing] program, with a 100% placement record, with student remunerations far exceeding the average of the institute. We congratulate each of these pioneers who had placed their faith in us and have done us proud.



**The true spirit of delight, the exaltation, the sense of being more than Man, which is the touchstone of the highest excellence, is to be found in mathematics as surely as poetry. – Bertrand Russell**





## Faculty



**Jayaram  
Balasubramaniam**

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of Higher Learning

**Professor & HoD**

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Connectives in Multi-Valued  
Logic Manufacturing



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Representation Theory



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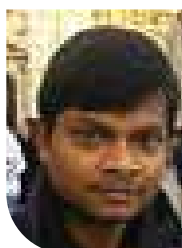


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**Assistant Professor**

*Research Areas:*  
Statistical genetics and  
computational statistics

### Book/Book Chapter

1. S. Kumaresan and D. Sukumar, FUNCTIONAL ANALYSIS A First Course, Narosa

### Publications (Journal)

1. Baczyński, M., Jayaram, B., & Mesiar, R. [2020]. Fuzzy implications: Alpha migrativity and generalized laws of importation. Information Sciences, 531, 87–96. <https://doi.org/10.1016/j.ins.2020.04.033>
2. Amarlingam, M., Prasad, K. V. V. D., Rajalakshmi, P., Channappayya, S. S., & Sastry, C. S. [2020]. A Novel Low-Complexity Compressed Data Aggregation Method for Energy-Constrained IoT Networks. IEEE Transactions on Green Communications and Networking, 4(3), 717–730. <https://doi.org/10.1109/TGCN.2020.2966798>
3. Gautam, K., Narayana, P. A. L., & Sahu, K. C. [2020]. Linear instability is driven by an electric field in the two-layer channel flow of Newtonian and Herschel–Bulkley fluids. Journal of Non-Newtonian Fluid Mechanics, 285, 104400. <https://doi.org/10.1016/j.jnnfm.2020.104400>
4. Deepika, N., Murthy, P. V. S. N., & Narayana, P. A. L. [2020]. The Effect of Magnetic Field on the Stability of Double-Diffusive Convection in a Porous Layer with Horizontal Mass Throughflow. Transport in Porous Media, 134(2), 435–452. <https://doi.org/10.1007/s11242-020-01453-6>
5. Kumar, G., Narayana, P. A. L., & Sahu, K. C. [2020]. Linear and nonlinear thermosolutal instabilities in an inclined porous layer. Proceedings of the Royal Society A: Mathematical, Physical and Engineering Sciences, 476(2233), 20190705. <https://doi.org/10.1098/rspa.2019.0705>
6. Kulkarni, S. H., & Ramesh, G. [2020]. Operators that Attain Reduced Minimum. Indian Journal of Pure and Applied Mathematics, 51(4), 1615–1631. <https://doi.org/10.1007/s13226-020-0485-6>
7. Bala, N., & Ramesh, G. [2020]. Weyl's theorem for paranormal closed operators. Annals of Functional Analysis, 11(3), 567–582. <https://doi.org/10.1007/s43034-019-00038-9>
8. Bala, N., & Golla, R. [2020]. Spectral properties of absolutely minimum attaining operators. Banach Journal of Mathematical Analysis, 14(3), 630–649. <https://doi.org/10.1007/s43037-019-00032-2>
9. Ramesh, G., & Santhosh Kumar, P. [2020]. Spectral theorem for quaternionic normal operators: Multiplication form. Bulletin Des Sciences Mathématiques, 159, 102840. <https://doi.org/10.1016/j.bulsci.2020.102840>
10. Golla, R., & Osaka, H. [2020]. Linear maps preserving  $\mathcal{AN}$ -operators. Bulletin of the Korean Mathematical Society, 57(4), 831–838. <https://doi.org/10.4134/BKMSb190494>
11. S. H. Kulkarni & G. Ramesh. Gap formula for symmetric operators; Telangana Academy of Sciences, Volume 01, the Year 2020, pages 129-133. [frontiers-in-mathematics.pdf](https://frontiers-in-mathematics.pdf) [tasc.org.in]
12. Sukumar, D., & Veeramani, S. [2020]. Continuity of a condition spectrum and its level sets. Journal of the Australian Mathematical Society, 108(3), 412–430. <https://doi.org/10.1017/S1446788719000338>
13. Sukumar, D., Veeramani, S. Level sets of (.) outer generalized pseudo spectrum. J Anal 28, 57–70 [2020]. <https://link.springer.com/article/10.1007/s41478-017-0039-4>

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18. Singh, S. P., & Davidov, O. [2020]. On Bayes and Nash experimental designs for hypothesis testing problems. *Electronic Journal of Statistics*, 14(2), 3976–4003. <https://doi.org/10.1214/20-EJS1763>
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3. Dalal, Tarun; Kumar, Narasimha: On non-vanishing of the Fourier coefficients of primitive forms, *The Special Issue of The Proceedings of Telangana Academy of Sciences*, Vol. 01, No. 01, 2020, 52–64.

### Funded Research Projects

1. Prof C S Sastry, Sparse approximations with prior support constraint and application to Interior Tomography(PI), CSIR, Dec/2020, 2.57L.
2. Dr Neeraj Kumar, Koszul Algebras and Diagonal Subalgebras, SERB, Dec 29, 2020, 6.60L.
3. Dr Dipankar Ghosh, Characterizations of local rings via homological dimensions of summands of syzygy modules, SERB, Dec 31, 2020, 13.23L
4. Prof Jayaram Balasubramaniam, Monotone Metric Spaces in Machine Learning, SERB, Jan 4, 2021, 6.6L.
5. Dr Amit Tripathi Vector bundles over projective varieties, SERB, Jan 11, 2021, 6.60L.

### Publications (Conference)

1. Kaur, A., Raj, H., & Jayaram, B. [2020]. On the Unsurprising Behaviour of Kernels in High Dimensions. 2020 IEEE 5th International Conference on Computing Communication and Automation (ICCCA), 503–508. <https://doi.org/10.1109/ICCCA49541.2020.9250782>

### Workshops Conducted

1. Advanced Functional Analysis and its Applications 2020 (Dec 16-24 2020)
2. Neil Dunningan, University of Sheffield, Congruences involving non-parallel weight Hilbert modular forms, 19/03/2021

### Awards and Recognitions

1. Dr Venku Naidu, Associate Professor, received the Teaching Excellence award in 2021.
2. Dr Narasimha Kumar/Tarun Dalal, Associate Professor, received KV Rao Scientific Society Research Award in the Category of Mathematics

Department of Mathematics

## Highlights

1. In our recent study that got published in PRS-A, we showed that oscillatory instability exists in double-diffusive convection in an inclined porous layer for a short range of the inclination angle. This has not been observed in the literature in the past. [ Dr Puranam Anantha Lakshmi Narayana].
2. In the last year, we worked with problems related to Drinfeld modular forms. We have to describe the structure of the  $R$ -algebra of Drinfeld modular forms and the structure of mod- $p$  reductions. As a result, we are able to study the properties of the weight filtration for Drinfeld modular forms of level  $T$ . Finally, as a result, we prove a result on mod- $p$  congruences for Drinfeld modular forms of level  $pT$ . Then, we proved a conjecture of Bandini and Valentino in some cases. Then, we framed this conjecture for prime, higher levels and provide some evidence in favor of it. [ Dr Venkata Ganapathi Narasimha Kumar Ch]





## Department of Mechanical & Aerospace Engineering

The Department of Mechanical and Aerospace Engineering (MAE) is a one of its kind department in India as we are the only IIT that has a single department for Aerospace and Mechanical Engineering research and teaching. We were one of the three pioneering departments at IIT Hyderabad and had a modest beginning with a batch of 40 undergraduate students in 2008. The first permanent faculty member was hired in 2009 and since then, MAE has grown to be one of the largest at IITH with 27 faculty members, a total of 200 undergraduate students, 55 post-graduate students, and about 150 PhD students.

We realized early on the need to cater to and benefit from Hyderabad's unique position as a hub for defense research in India with a number of DRDO laboratories like DMRL, DRDL, RCI, etc. located here. It was for this reason that Aerospace Engineering was added to the Department which initially started with a focus on core Mechanical Engineering. Today, our faculty members collaborate extensively with the DRDO lab and have taken funded projects from them. The MAE department through its research projects and funding has a strong footprint. The DRDO cell at IIT Hyderabad was set up to facilitate such collaboration. As of date, MAE faculty members are Principal Investigators in nearly half the projects funded under this cell accounting for nearly 40% of the total funding for FY 2020-21. A new Centre of Excellence in Additive Manufacturing, a one of its kind research excellence center in India funded by DRDO is being set up at IIT-H and is spearheaded by MAE faculty member Prof S. Surya Kumar. Apart from DRDO, our faculty members also take projects regularly from leading MNC's. The computational and experimental facilities present in the department are advanced and latest. They help us in conducting the state of art research work and industrial project consultancy. MAE department has also got a DST-FIST fund to enhance our research facilities.

In terms of teaching, the MAE department currently offers a BTech degree in Mechanical Engineering, a minor program in Aerospace Engineering. The curriculum is designed with about 30% project-work, laboratory, and hands-on component where we are confident that our undergraduates learn their theoretical fundamentals well and also the ability to apply their theoretical understanding to applications. For those UG students with an



## Faculty



### **M Ramji**

PhD – IIT Madras  
**Professor & HoD**

*Research Areas:* Composite Structures and Repair; Fundamental Fracture Mechanics; Material Characterisation; Computational Fracture and Damage Mechanics; Experimental Mechanics



### **Vinayak Eswaran**

PhD – State University of NY at Stony  
**Professor**

*Research Areas:* Computational Fluid Dynamics (Cfd) and Heat Transfer; Finite-Volume Methods for Flow and Heat Transfer in Complex Geometries; Convection Heat Transfer; Turbulence Modelling; Computation of Turbulent Combustion; Simulation of Flow and Heat Transfer in Industrial and Natural Processes;



### **N Venkata Reddy**

PhD – IIT Kanpur  
**Professor**

*Research Areas:* Deformation Processes; Predictive Models for Digital Fabrication; Integrated Product and Process Design Systems; Layered Manufacturing



### **Raja Banerjee**

PhD – University of Missouri Rolla - USA  
**Professor**

*Research Areas:* Computational Fluid Mechanics with Emphasis on Multi Phase Flow; High Fidelity Solver Development on Accelerators Like Gpu; Sloshing of Liquid In Partially



### **R Prasanth Kumar**

PhD – IIT Kharagpur  
**Professor**

*Research Areas:* Multibody Dynamics; Robotics; Control Systems



### **Suryakumar S**

PhD – IIT Bombay  
**Professor**

*Research Areas:* Metal Additive Manufacturing; 3D Printing; CAD / CAM



### **Ashok Kumar Pandey**

PhD – IISC Bangalore  
**Associate Professor**

*Research Areas:* Linear and Nonlinear Vibration; MEMS; Vehicle Dynamics



### **Chandrika Prakash Vyasarayani**

PhD – University of Waterloo, Canada  
**Associate Professor**

*Research Areas:* Nonlinear Dynamics and Control

**K Venkatasubbaiah**

PhD – IIT Kanpur

**Associate Professor**

*Research Areas:*

Computational Heat Transfer and Hypersonic Flows

**Harish N Dixit**

PhD – Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore

**Associate Professor**

*Research Areas:* Interfacial Flows – Moving Contact Lines; Drop; Bubbles and Thin Films; Hydrodynamic Stability Theory

**Venkatesham B**

PhD, Indian Institute of Science, Bangalore

**Associate Professor**

*Research Areas:* Engineering Acoustics, Sound Quality, System Design

**Pankaj Sharadchandra Kolhe**

PhD – The University of Alabama, USA

**Associate Professor**

*Research Areas:* IC Engines; Gas Turbine Engines; Alternative Fuels; Combustion and Spray Diagnostics; Sprays in Smart Farming

**Nishant Dongari**

PhD – University of Strathclyde, Glasgow, UK

**Associate Professor**

*Research Areas:* Microfluidics; Rarefied Gas Dynamics; Compressible Gas Flows; Thin Film Coatings; Molecular Dynamics; Direct Simulation Monte Carlo and Extended Hydrodynamics

**Gangadharan Raju**

PhD – IISC Bangalore

**Associate Professor**

*Research Areas:* Composite Structures; Buckling and Post-Buckling Analysis; Variable Angle Tow Composite Plates; Damage Modeling in Composite Structures; Non-Destructive Evaluation; Structural Health Monitoring

**Badarinath Karri**

PhD – National University of Singapore

**Associate Professor**

*Research Areas:* Experimental Fluid Mechanics; High-Speed Imaging; Cavitation; Bubble Dynamics

**Mahesh M. Sucheendran**

PhD – UIUC, USA

**Associate Professor**

*Research Areas:* Vibroacoustics; Aeroelasticity; Computational Mechanics; Aerodynamics; Aeroacoustics

**Saravanan Balusamy**

PhD – University of INSA of Rouen, France

**Associate Professor**

*Research Areas:* Combustion; Laser Diagnostics; Fluid Mechanics; IC Engines; Gas Turbines; Alternative Fuels

**Syed Nizamuddin Khaderi**

PhD – University of Groingen, Netherlands

**Associate Professor**

*Research Areas:* Solid Mechanics; Impact Mechanics; Fluid-Structure Interaction; Lattice Materials; Metal Foams

**Viswanath R Chinthapenta**

PhD – Brown University, USA

**Assistant Professor**

*Research Areas:* Computational Solid Mechanics

**Niranjana Shrinivas Ghaisas**

PhD – Purdue University

**Assistant Professor**

*Research Areas:* Wind Energy; Turbulent Flow Simulations; Computational Mechanics

**Sayak Banerjee**

PhD – Stanford University, USA

**Assistant Professor**

*Research Areas:* Experimental and Numerical Combustion Kinetics; Kinetic Model Reduction; Bio-fuel Combustion and Emission; Combustion Diagnostics

**Gopinath Muvvala**

PhD – IIT Kharagpur

**Assistant Professor**

*Research Areas:* Additive Manufacturing; Laser Material Processing; Under Water Laser Material Processing; Solid State Welding [Friction Stir Welding]

**Lakshmana Dora Chandrala**

PhD – IIT Kanpur

**Assistant Professor**

*Research Areas:* Compressible flows; Blast waves; multi-phase flows; Development of optical diagnostic tools Marine aerosols

**Safvan Palathingal**

PhD – IISc Bangalore

**Assistant Professor**

*Research Areas:* Nonlinear mechanics of slender structures, Compliant mechanisms, and Optimization

**Ranabir Dey**

PhD – IIT Kharagpur

**Assistant Professor**

*Research Areas:* Active soft matter- dynamics of self-propelling microswimmers; capillarity and wetting phenomena; low Reynolds number fluid mechanics

**V K Saraswat**

PhD – Osmania University

**Distinguished Professor**

[Former secretary, Dept. of Defence R&D (GoI), Scientific Advisor to Raksha Mantri, Director General of DRDO & ADA]



### Patents Filed/Granted

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2. Srinath Ellaswamy G., Suryakumar S., Venkata Reddy N. [2020]: "A Method and System to Fabricate a Component using Additive Manufacturing and Deformation Unit", Indian Patent, Application Number: 201941016062. [filed].
3. Suryakumar Simhambhatla / Mr B Sai Laxman Bharadwaj [2020]: "Reusable Respiratory Mask with Disposable Filter Element", Indian Patent Application No. 202041023866[filed].
4. Sarpras Swain, Lopamudra Giri, S. Suryakumar, Falguni Pati [2020]: "Microfluidic Devices and Methods of Fabrication Thereof", Application Number: PCT/IN2020/050601[filed].
5. Praveen K., M Sahu, N V Reddy, Om Prakash, Tool for Enhanced Accuracy in Double-Sided Incremental Forming, US Patent Filing # 16/778005, Patent filed on January 31, 2020 [Boeing supported work, Filed by Boeing]. [filed].
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7. Dr Nishanth Dongari / Mandar Ruikar; A METHOD AND SYSTEM FOR REAL-TIME THERMAL MANAGEMENT OF A BATTERY; 1/07/2020; 202041028031[filed].
8. Dr Nishanth Dongari / Mandar Ruikar; Method and System for Improving Battery Pack Design for operating in Extreme Temperature Conditions; 13/08/2020; 202041034866[filed].
9. Dr Nishanth Dongari / Mandar Ruikar / Vignesh S; Method and System for Driving Range Prediction of Electric Vehicles; 7/05/2020; 202041019404[filed].

### Publications (Journal)

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3. Saleem, A., Farooq, S., Karimi, I. A., & Banerjee, R. [2020b]. CFD Analysis of Stratification and Rollover Phenomena in an Industrial-Scale LNG Storage Tank. Industrial & Engineering Chemistry Research, 59(31), 14126–14144. <https://doi.org/10.1021/acs.iecr.0c02546>
4. Wakale, A. B., Banerjee, S., & Banerjee, R. [2020]. Estimation of NOx and soot emission from a constant volume n-butanol/n-dodecane blended spray using unsteady flamelet model based on n-dodecane/n-butanol/NOx/PAH chemistry. Journal of the Energy Institute, 93(5), 1868–1882. <https://doi.org/10.1016/j.joei.2020.04.002>
5. Saritha, G., & Banerjee, R. [2020]. Bubble dynamics of a pressure-driven cavitating

- flow in a micro-scale channel using a high-density pseudo-potential Lattice Boltzmann method. *Heat Transfer Engineering*, 41(6–7), 622–636. <https://doi.org/10.1080/01457632.2018.1546964>
6. Godbole, K., Das, C. R., Joardar, J., Albert, S. K., Ramji, M., & Panigrahi, B. B. [2020]. Toughening of AISI 410 Stainless Steel Through Quenching and Partitioning and Effect of Prolonged Aging on Microstructure and Mechanical Properties. *Metallurgical and Materials Transactions A*, 51(7), 3377–3383. <https://doi.org/10.1007/s11661-020-05809-x>
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  8. Jobin, T. M., Khaderi, S. N., & Ramji, M. [2020b]. Experimental evaluation of the strain intensity factor at the rigid line inclusion tip embedded in an epoxy matrix using digital image correlation. *Theoretical and Applied Fracture Mechanics*, 106, 102425. <https://doi.org/10.1016/j.tafmec.2019.102425>
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  10. Kolanu, N. R., Raju, G., & Ramji, M. [2020]. A unified numerical approach for the simulation of intra and inter-laminar damage evolution in stiffened CFRP panels under compression. *Composites Part B: Engineering*, 190, 107931. <https://doi.org/10.1016/j.compositesb.2020.107931>
  11. M.s, A., & Venkatasubbaiah, K. [2020]. Numerical investigation of jet impingement flows with different nanofluids in a mini channel using Eulerian-Eulerian two-phase method. *Thermal Science and Engineering Progress*, 19, 100585. <https://doi.org/10.1016/j.tsep.2020.100585>
  12. Prakash Raj, N. O., & Venkatasubbaiah, K. [2020]. Response to “Comment on ‘A new approach for the design of hypersonic scramjet inlets’” [Phys. Fluids 32, 079101 [2020]]. *Physics of Fluids*, 32(7), 079102. <https://doi.org/10.1063/5.0012513>
  13. Satish, N., & Venkatasubbaiah, K. [2020b]. Conjugate heat transfer analysis of liquid metal turbulent flow through a horizontal channel by LES. *Numerical Heat Transfer, Part A: Applications*, 78(4), 140–157. <https://doi.org/10.1080/10407782.2020.1782134>
  14. Tekure, V., & Venkatasubbaiah, K. [2020]. A new correlation of average temperature and maximum heat flux for turbulent supersonic flow in a large size channel up to Mach 5. *Aerospace Science and Technology*, 96, 105522. <https://doi.org/10.1016/j.ast.2019.105522>
  15. Satish, N., & Venkatasubbaiah, K. [2020a]. Effect of Pulsation and Acceleration of Liquid Metal Turbulent Flow Through a Horizontal Channel by Large Eddy Simulation. *Journal of Nuclear Engineering and Radiation Science*, 6(041301). <https://doi.org/10.1115/1.4046259>
  16. Assam, A., Nived, M. R., Kalkote, N. N., & Eswaran, V. [2019]. A Numerical Study of Shock and Heating With Rarefaction for Hypersonic Flow Over a Cylinder. *Journal of Heat Transfer*, 142(014501). <https://doi.org/10.1115/1.4045136>
  17. Athkuri, S. S. C., & Eswaran, V. [2020]. A new auxiliary volume-based gradient algorithm for triangular and tetrahedral meshes. *Journal of Computational*

- Physics, 422, 109780. <https://doi.org/10.1016/j.jcp.2020.109780>
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  19. Sharma, V., Eswaran, V., & Chakraborty, D. [2020a]. Determination of optimal spacing between transverse jets in a SCRAMJET engine. *Aerospace Science and Technology*, 96, 105520. <https://doi.org/10.1016/j.ast.2019.105520>
  20. Sharma, V., Eswaran, V., & Chakraborty, D. [2020b]. Determination of optimal spacing between transverse jets in a SCRAMJET engine. *Aerospace Science and Technology*, 96, 105520. <https://doi.org/10.1016/j.ast.2019.105520>
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  22. Sharma, V., Eswaran, V., & Chakraborty, D. [2020d]. Computational Analysis of Transverse Sonic Injection in Supersonic Crossflow Using RANS Models. *Journal of Fluids Engineering*, 142[061502]. <https://doi.org/10.1115/1.4045985>
  23. Akarapu, A., Nighot, R. P., Devsoth, L., Yadav, M., Pal, P., & Pandey, A. K. [2020]. Experimental and Theoretical Analysis of Drag Forces in Micromechanical-Beam Arrays. *Physical Review Applied*, 13[3], 034003. <https://doi.org/10.1103/PhysRevApplied.13.034003>
  24. Padala, M. K., Akarapu, A., Pal, P., & Pandey, A. K. [2020]. Frequency Tuning of Weakly and Strongly Coupled Micromechanical Beams," *ISSS Journal of Micro and Smart Systems*, 9[2], 117-130. <https://doi.org/10.1007/s41683-020-00058-x>
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  27. Swarnalatha, V., Pal, P., Pandey, A. K., Rao, A. V. N., Xing, Y., Tanaka, H., & Sato, K. [2020]. Systematic study of the etching characteristics of Si111 in modified TMAH. *Micro & Nano Letters*, 15[1], 52–57. <https://doi.org/10.1049/mnl.2019.0443>
  28. Swarnalatha, V., Vismaya, K. T., Rao, A. V. N., Pal, P., Pandey, A. K., Tanaka, H., & Sato, K. [2020]. Etching Mechanism Behind the High-Speed Etching of Silicon in NH<sub>2</sub>OH-added Alkaline Solutions. *IEEJ Transactions on Sensors and Micromachines*, 140[1], 24–30. <https://doi.org/10.1541/ieejsmas.140.24>
  29. Shashi Ranjan M., Syed Nizamuddin K., and Suryakumar S. "3D Printing of Components with Tailored Properties Through Hilbert Curve Filling of a Discretized Domain", in *3D Printing and Additive Manufacturing*, Vol 7[6], 2020, pp. 288-299.
  30. Veerababu, D., & Venkatesham, B. [2020]. Green's function approach for the transmission loss of concentrically multi-layered circular dissipative

- chamber. *The Journal of the Acoustical Society of America*, 147[2], 867–876. <https://doi.org/10.1121/10.0000675>
31. Vyasarayani, C. P., & Chatterjee, A. [2020]. New approximations, and policy implications, from a delayed dynamic model of a fast pandemic. *Physica D: Nonlinear Phenomena*, 414, 132701. <https://doi.org/10.1016/j.physd.2020.132701>
  32. Samukham, S., Uchida, T. K., & Vyasarayani, C. P. [2020]. Fast Generation of Stability Charts for Time-Delay Systems Using Continuation of Characteristic Roots. *Journal of Computational and Nonlinear Dynamics*, 15[111008]. <https://doi.org/10.1115/1.4048362>
  33. Vyasarayani, C. P., & Chatterjee, A. [2020]. The complete dimensional collapse in the continuum limit of a delayed SEIQR network model with separable distributed infectivity. *Nonlinear Dynamics*, 101[3], 1653–1665. <https://doi.org/10.1007/s11071-020-05785-2>
  34. Kandala, S. S., Samukham, S., Uchida, T. K., & Vyasarayani, C. P. [2020]. Spurious roots of delay differential equations using Galerkin approximations. *Journal of Vibration and Control*, 26[15–16], 1178–1184. <https://doi.org/10.1177/1077546319894172>
  35. Manikantan, R., Chakraborty, S., Uchida, T. K., & Vyasarayani, C. P. [2020]. Parameter Identification in Nonlinear Mechanical Systems with Noisy Partial State Measurement Using PID-Controller Penalty Functions. *Mathematics*, 8[7], 1084. <https://doi.org/10.3390/math8071084>
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  37. Kandala, S. S., Chakraborty, S., Uchida, T. K., & Vyasarayani, C. P. [2020]. Hybrid method-of-receptances and optimization-based technique for pole placement in time-delayed systems. *International Journal of Dynamics and Control*, 8[2], 558–569. <https://doi.org/10.1007/s40435-019-00570-5>
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  39. Samukham, S., Khaderi, S. N., & Vyasarayani, C. P. [2020]. Galerkin-Ivanov transformation for nonsmooth modeling of Vibro-impacts in continuous structures. *Journal of Vibration and Control*, 1077546320945441. <https://doi.org/10.1177/1077546320945441>
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  41. Vourganti, V., Desai, A., Samukham, S., & Vyasarayani, C. P. [2020]. Effect of nonlinear cladding stiffness on the stability and Hopf bifurcation of a heat-exchanger tube subject to cross-flow. *Meccanica*, 55[1], 49–68. <https://doi.org/10.1007/s11012-019-01114-z>
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86. H. Wu, R. Dey, I. Siretanu, D. van den Ende, L. Shui, G. Zhou, F. Mugele, Electrically controlled localized charge trapping at amorphous fluoropolymer-electrolyte interfaces, Small, 16 [2], 1905726, 2020.

### Publications [Conference]

1. Miriyala, S. S., Banerjee, R., & Mitra, K. [2020]. Uncertainty quantification using Auto-tuned Surrogates of CFD model Simulating Supersonic flow over tactical missile body. 2020 IEEE Symposium Series on Computational Intelligence [SSCI], 2885–2892. <https://doi.org/10.1109/SSCI47803.2020.9308325>
2. Krishna Prakash Yadav and R Prasanth Kumar, “Biped dynamic walker with alternate unpowered and partially powered steps in a gait cycle,” Vibroengineering PROCEDIA, Vol. 35, pp 27-32, November 2020.
3. Mangesh D Ratolikar and R Prasanth Kumar, “Optimal 5R parallel leg design for quadruped robot gait cycle,” Vibroengineering PROCEDIA, Vol. 35, pp 94-98, November 2020.
4. Veeresh Tekure and K. Venkatasubbaiah, Effect of back-pressure ratio on the shock train structures in the isolator of SCRAMJET inlet at different Mach numbers. 8th International and 47th National Conference on Fluid Mechanics and Fluid Power, December 9-11, 2020, IIT-Guwahati, Assam, India.
5. Abhijith M.S and K. Venkatasubbaiah, Eulerian-Eulerian two-phase modeling of double jet impingement flow with nanofluid in a mini-channel., 8th International and 47th National Conference on Fluid Mechanics and Fluid Power, December 9-11, 2020, IIT-Guwahati, Assam, India

6. Rao, A. V. N., Pal, P., Pandey, A. K., Menon, P. K., Tanaka, H., & Sato, K. [2020]. High-Speed Silicon Wet Bulk Micromachining of Si111 in KOH Based Solution. 2020 Symposium on Design, Test, Integration Packaging of MEMS and MOEMS [DTIP], 1–5. <https://doi.org/10.1109/DTIP51112.2020.9139140>
7. G, K., B, V., & G, R. [2020]. Vibration diagnosis of turbomachinery coupled with induction motor. *Vibroengineering PROCEDIA*, 35, 1–6. <https://doi.org/10.21595/vp.2020.21768>
8. Manikantan, R., Vyasarayani, C. P., & Manjuprasad, M. [2020]. Parameter Identification in Nonlinear Systems Using PD Controllers as Penalty Functions. *IFAC-PapersOnLine*, 53(1), 602–607. <https://doi.org/10.1016/j.ifacol.2020.06.101>
9. Hussain, J., Dasgupta, R., Dixit, H. N., Thampi, S. P., & Roy, A. [2020]. A Lattice Boltzmann Method for Electromagnetic Wave Propagation in Medium. 2020 IEEE International Conference on Computational Electromagnetics [ICCEM], 299–301. <https://doi.org/10.1109/ICCEM47450.2020.9219376>
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11. Murugan, R, Sellan, D, & Kolhe, PS. "Experimental Investigation of Flow Blurring Atomizer at Near Field Using Particle Image Velocimetry." Proceedings of the ASME 2019 Gas Turbine India Conference. Volume 2. Published Online January 24th, 2020. <https://doi.org/10.1115/GTINDIA2019-2635>
12. Murugan, R, Sellan, D, & Kolhe, PS. "Experimental Study of Flow Field Effect on Spray and Flame Structure in Swirl Stabilized Combustor." Proceedings of the ASME 2019 Gas Turbine India Conference. Volume 2. Published Online January 24th, 2020. <https://doi.org/10.1115/GTINDIA2019-2639>
13. Ghaisas, N. S. [2020]. Effect of vertical domain size on wind-turbine large-eddy simulations in a half-channel. Proceedings of the 1st Online International Conference on Recent Advances in Computational and Experimental Mechanics, FM-027, 2020, <http://icracem.org/docs/E-Proceedings%20ICRACEM%202020.pdf>.
14. Ghaisas, N. S., Bollu, B., & Dongari, N. [2020]. Regularized Geometry-Based Models for Power Prediction of Wind FarMs Proceedings of the 8th International and 47th National Conference on Fluid Mechanics and Fluid Power, FMFP2020-067, 2020.

#### Funded Research Projects

1. Dr Mahesh M. Sucheendran, Study of Cavity of Weapon Bay and a passive noise reduction approach, Aeronautical Development Agency, May 1, 2020, 34.28L.
2. Prof Raja Banerjee, Development of a Sheet Breakup Model to Simulate Atomization of Coal Slurry Spray, IITH- ID Project, 01/06/2020, 10L.
3. Dr B Venkatesham Muffler Design, Honeywell Technology Solutions Lab Pvt. Ltd, Aug 18, 2020, 12.74L.
4. Prof M. Ramji, EN26 fatigue test HCF & LCF, Euroflex Transmissions (India) Pvt Ltd, Sep 2, 2020, 5.9L

5. Dr Syed Nizamuddin Khaderi, EN26 fatigue test HCF & LCF, Euroflex Transmissions (India) Pvt Ltd, Sep 21, 2020, 5.90L.
6. Dr Syed Nizamuddin Khaderi, Development of Test Protocol for bird material characterization per SOW, Honeywell Technology Solutions Lab (P) Ltd, Dec 10, 2020, 17.52L.
7. Prof M. Ramji, Development of Test Protocol for bird material characterization per SOW, Honeywell Technology Solutions Lab (P) Ltd, Dec 15, 2020, 17.523L.
8. Prof M. Ramji, Sample preparation of fatigue testing, Euroflex Transmissions (India) Pvt Ltd, Dec 21, 2020, 0.18054L.
9. Prof Suryakumar S, Teachers Associateship for Research Excellence (TARE) - DrChinmaya Prasad Padhy, GITAM University, Hyderabad, SERB, Dec 28, 2020, 10.05L.
10. Dr Harish N Dixit, Connecting operating variables, cone/jet features and mesh properties in electrospinning: using experiments and modeling to bridge theory and applications, SERB, Dec 28, 2020, 39.53L.
11. Prof Suryakumar S, Post-Processing of Direct Energy Deposition Components: Need Identification and Process Selection, SERB, Dec 30, 2020, 43.49L.
12. Dr Chandrika Prakash Vyasarayani, Order Reduction and Stability of Some Hybrid Delay Differential Equations, SERB, Jan 11, 2021, 6.6L.
13. Dr Niranjana Shrinivas Ghaisas, Wind Turbine Wake Interactions with Surface Roughness Heterogeneities: Large Eddy Simulation and Analytical Modelling Studies, SERB, Jan 11, 2021, 32.25L.
14. Prof Suryakumar S, Additive Manufacturing of Large Size Metal Components with Wire & Powder Hybrid Direct Energy Deposition(WP-DED) Process, SERB, Jan 12, 2021, 39.97L.
15. Dr Safvan Palathingal, Nonlinear Mechanics of slender arches and shells with applications to compact piezo-actuated pump and quasi-zero-stiffness isolators, Toyota Motor Engineering & Manufacturing North America Inc, Jan 19, 2021, 13.00L.
16. Dr Mahesh M. Sucheendran, Design and Engineering Services of a BCFW deployed using an aerial platform, Tata Advanced Systems Limited, Feb 1, 2021, 85.38L.
17. Dr B Venkatesham, Prediction of Acoustic Environment in Fairing Cavity CARS, DRDO, Feb 5, 2021, 9.94L.
18. Prof M. Ramji, Teachers Associateship for Research Excellence (TARE), Dr Bhaskara Rao, SERB, Feb 10, 2021, 3.35L.
19. Dr Saravanan Balusamy, Effects of phase change, coalescence and breakup on raindrop dynamics, SERB, Feb 26, 2021, 56.14L.
20. Prof Vinayak Eswaran, Development of a Hybrid RANS-LES Solver based on a Kolmogorov's Hypothesis for Separated Flows, SERB, Mar 8, 2021, 26.84L.
21. Dr Chandrika Prakash Vyasarayani, Nonlinear Dynamics of a Parametrically Excited delay differential equation application to ship roll with the time delay control, Department of Atomic Energy, Mar 23, 2021, 9.31L.
22. Dr Niranjana Shrinivas Ghaisas, Petascale simulations of large wind farms sited on complex heterogeneous terrain, IISc, Bangalore, Mar 27, 2021, 22.99L.
23. Prof Suryakumar S, Large Area Additive Manufacturing(LAAM): Design and Development of Powder-based Directed Energy Deposition System for Direct Fabrication of Rocket Components, DRDO-DTFM, Mar 29, 2021, 839.54L.



24. Dr Syed Nizamuddin Khaderi, Sample preparation of fatigue testing, Euroflex Transmissions (India) Pvt Ltd, 0.18L.
25. Dr Ranabir Dey, Active droplets in soft microfluidic confinements [SG-93], IIT Hyderabad (seed grant), 27/04/2021, 25L.

### Workshops Conducted

1. Soft and Active Matter Seminar: Speaker: Dr Babak Vajdi Hokmabad; Affiliation: Max Planck Institute for Dynamics and Self- Organization, Goettingen, Germany; Title: Physicochemical Hydrodynamics and Collective Behavior in Active Emulsions; date: 01/06/2021
2. Fluid Mechanics Colloquium- Speaker: Prof Suman Chakraborty; Affiliation: IIT Kharagpur; Title: Flipping with the Flow – Perspectives of Puzzling Fluid Dynamics and Human Health; date 17/06/2021
3. Soft and Active Matter Seminar: Speaker: Dr Stefan Karpitschka; Affiliation: Group leader, Max Planck Institute for Dynamics and Self- Organization, Goettingen, Germany; Title: Soft Interfaces in Motion; date 06/07/2021
4. NanoMaterials and Nanomechanics and their applications towards Devices and Sensors; ATAL FDP June 28th-July2nd. [CEP]
5. Aid of demo experiments in teaching solid mechanics [Oct 26-30th 2020, TEQIP], Course Co-coordinator[CEP].
6. Arabinda Halder, Prem Pal, and Ashok Kumar Pandey, Four Days TEQIP

workshop on “Magnetic Materials for MEMS-based Devices” [29 Oct 2020 to 1 Nov 2020]”, Indian Institute of Technology, Hyderabad, 2020 [Online Virtual Workshop]. [CEP]

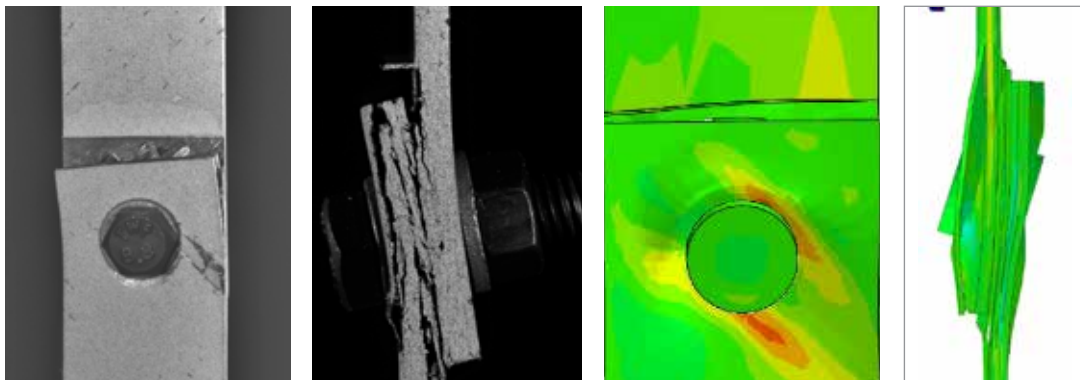
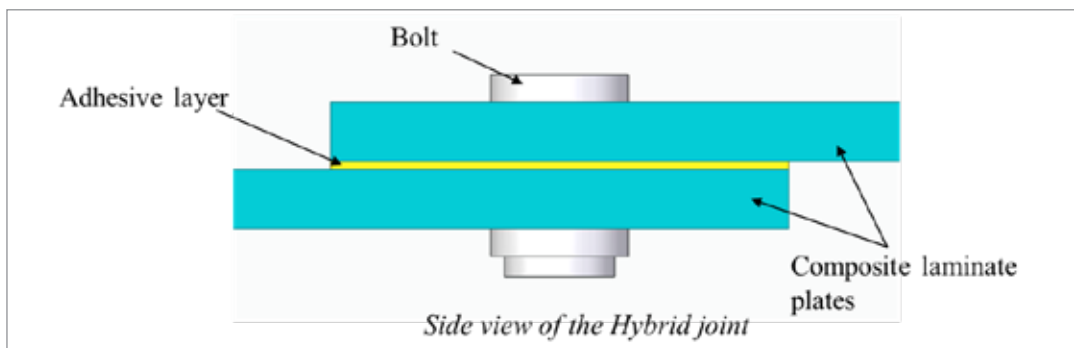
7. Tamal Das, TIFR Hyderabad, Mechanical forces govern emergent features of collective cell dynamics, 17th March 2021.
8. Prem Pal, Physics IIT Hyderabad, Silicon Wet Bulk Micromachining: A Choice of MEMS Industries, 24th March 2021
9. Sanket Goel, BITS Pilani, 3D Printed Smart Microfluidic Sensors, 31st March 2021.

### Awards and Recognitions

1. Mr Aakash Swami attended DAAD-IIT Masters Sandwich Program at TU Dresden[Ashok Kumar Pandey].
2. Dr B Venkatesham, Associate Professor, has been Recognized as the best reviewer for the Year 2020 of Noise Control Engineering Journal
3. Arkajyoti Jha received Prime Minister’s Research Fellows (PMRF) award for the PhD student who earlier worked as an intern in the SERB-SRG project
4. Arkajyoti Jha received the Best paper award in International Conference on Recent Advances in Mechanical Engineering Research and Development. PaperTitle: A study on the effect of cooling rate on evolution of microstructure in laser surface remelting of Inconel 718 [2021].

## 1. Hybrid Joints in Composite Structures

Joints in the composite structure is always been an area of interest for many researchers. Any significant increase in joint efficiency is appreciable either by improving the existing conventional joints methods or by developing some new joint techniques. The hybrid joint can be used to join the composite structures when the two laminates placed partially overlapped are bonded using adhesive material and then fastened by the bolt. Composite laminates joined using the hybrid joint method could take a higher static load and exhibits better fatigue life than conventional bonded and bolted joints. The hybrid joint is more damage-tolerant, exhibits improved joint performance, and is also a fail-safe joint. Hence, it can be used to better meet the current requirements for joint application in primary aircraft composite structures. The effectiveness of the joining technique is the function of the various design parameters involved with the particular joint. For bonded joint, it depends upon the overlap length, adhesive thickness, adhesive material type (High modulus/ Low modulus) adherend thickness, surface preparation, and temperature and for bolted joints, it depends upon the geometric parameters (width to dia, edge to dia), bolt-torque, stacking sequence, bolt-hole clearance, bolt geometry and material (countersunk bolt or bolt with hexagonal head), etc. All aforementioned parameters that affect the bonded and bolted joint performance exclusively are considerable design parameters for the hybrid joint.



Joint after the final failure

## 2. Large Area Additive Manufacturing (LAAM)

With the growth of metallic Additive Manufacturing (AM), processes capable of producing large components (more than 1m in size) with high deposition rates have been of particular interest. On this front, arc-based deposition processes stand out among the metallic AM processes with their high deposition rates, high material and power efficiency, lower investment costs, simpler setup, and less demanding environmental requirements. The essential weld-deposition AM system consists of a wire-based weld unit and a multi-axis motion system. The research focus has been to develop such a system and addressing various related challenges. Various additional sub-systems including powder + laser system, deformation + deposition system, have also been built around this process. The following figures show some sample components built in our lab. As can be noted from the above figures, these components are much bigger in size than the usual AM-produced components. The challenges in realizing them are also quite unique. Current work focuses on the various studies on building such systems and addressing related challenges like shape complexity, residual stresses, etc.



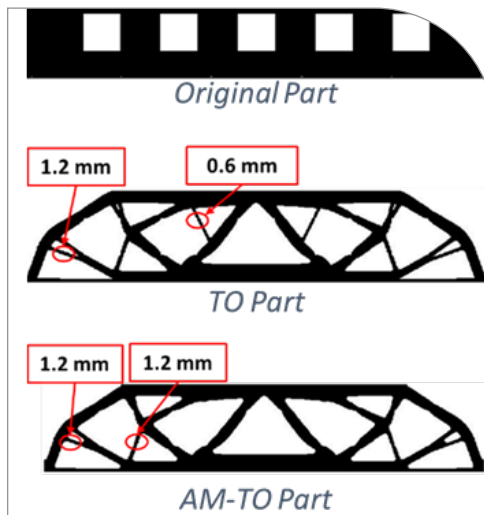
*Large Area Additive Manufacturing (LAAM)*

## 3. Design for Additive Manufacturing

Additive manufacturing (AM), known for its ability to manufacture complex shapes, is becoming an essential companion of topology optimization (TO) to optimize the structure. However, the topology-optimized structure may result in suboptimal performance or even have features, which are difficult to manufacture in a given AM process. This study attempts to refine the outcome from TO with AM-specific considerations, like minimum feature resolution and material continuity-related constraints by introducing a neighborhood density function. The four different cases have been studied to demonstrate

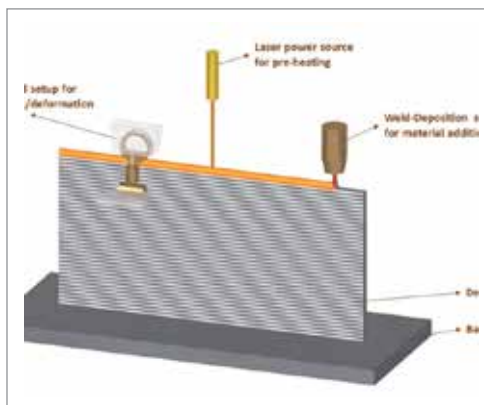
the effectiveness of the presented approach yielding better results when compared with conventional TO under the three-point bending test. The current study provides optimized geometry with the decreased number of voids and ensuring the minimum feature size without substantial loss in the structural behavior and becomes the basic framework to integrate manufacturability into structural TO for AM process.

*AMTO ie., Topology Optimization conscious of Additive Manufacturing constraints ensures better manufacturability with decreased number of voids and ensuring the minimum feature size*



#### 4. Integrated Metal Additive and Formative Manufacturing System

The overall objective of the research is to develop a methodology for the manufacture of complex metallic parts, combining the advantages of Additive and Formative methods. The primary aspect of the system is a wire-arc-based direct energy deposition system for fabricating the desired shape in a layer-by-layer manner. The second feature is the deformation system to introduce necessary shape changes to that partial/completed geometry. These are aided by a focused heat source system and/or electric current for process simplification, load reduction, and material property enhancement. This DED-based additive manufacturing and deformation system are capable of manufacturing complex geometries without the need for support structures. By employing the deformation loads, this system can be used for material property enhancement, lowering the residual stresses developed and distortion.



*Additive + Formative Manufacturing System for Four-Dimensional Printing of Complex Metallic Parts*

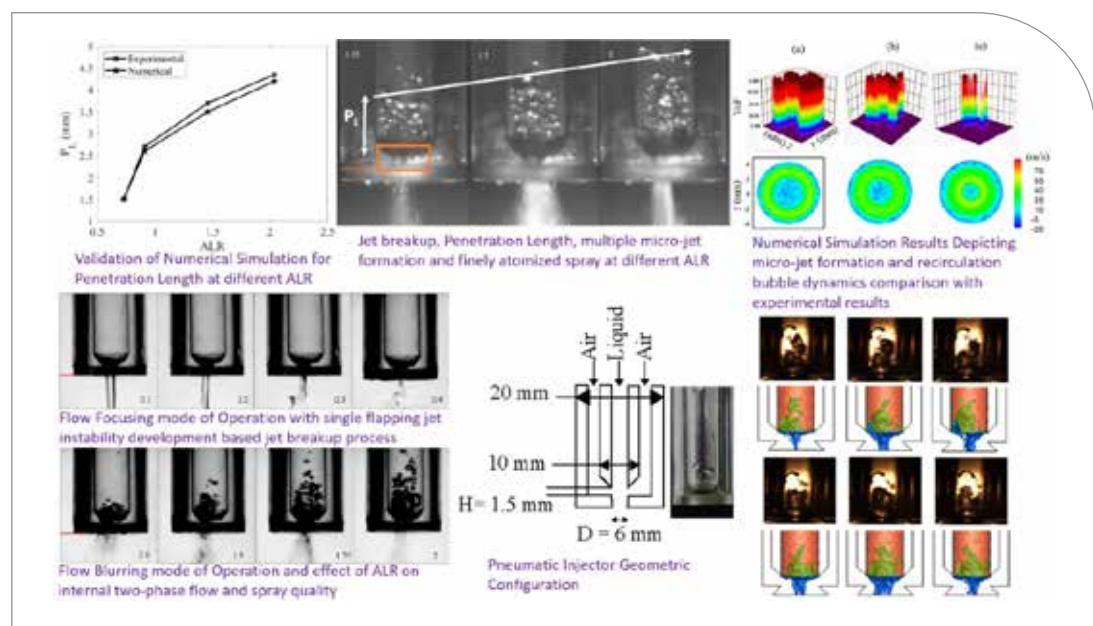
#### 5. Novel Flow Blurring injector working principle and explanation to spray characteristics observed.

Flow blurring atomizer configuration is very simple involving two concentric tubes and an orifice at dump plane placed at a distance of a quarter of the central tube diameter or less, resulting in the radial entry cross flow for outer atomizing air with respect to central liquid jet. Above certain atomizing air to liquid ratio (ALR), the air flow bifurcates leading to two-phase development in a central liquid tube similar to churn and annular flow characteristics, which length increases with further increase in ALR. The development of multiple micro-jets that face co-flow and counter-flow air currents leads to highly



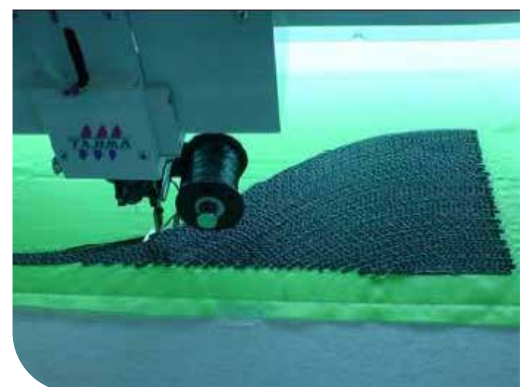
unstable jets which immediately break down to droplets at the exit plane giving a nearly uniform Sauter mean diameter (SMD) distribution of droplets. When the ALR is lower injector exhibits typical air-assisted co-flow arrangement behavior with flapping jet instability.

The formation of multiple micro-jets internally to the novel blow blurring atomizer explains the droplet dominant immediate near field spray characteristics and nearly uniform SMD distribution at any particular axial location. The multiple unstable micro-jets formations internal to the atomizer provide the explanation as to why these atomizers are least susceptible to adverse thermo-physical properties of alternative fuels (viz. high viscosity). It may be noted that fine spray even for 6 mm orifice size is observed in the near field of the injector. This twin fluid atomizer gives higher atomization efficiency compared to say air-blast atomizers.



## 6. Composite tailoring- Variable angle tow composite plates

The potential to tailor the directional stiffness of composites and maximize structural performance is well known. However, such potential is seldom exploited owing to a conservative approach to analysis, design, and manufacture. Variable Angle Tow (VAT) placement based on the embroidery fiber placement technique gives an added dimension to both stiffness and strength tailoring. Exemplar benefits are achieved, for example, by blending stiffness variations between structural components (e.g. stiffener to the skin) to reduce inter-laminar stresses by tailoring inplane fiber orientation and local thickness distribution to reduce the need for discrete stiffening, opening up the possibility of lightweight, stiffener-free skins.

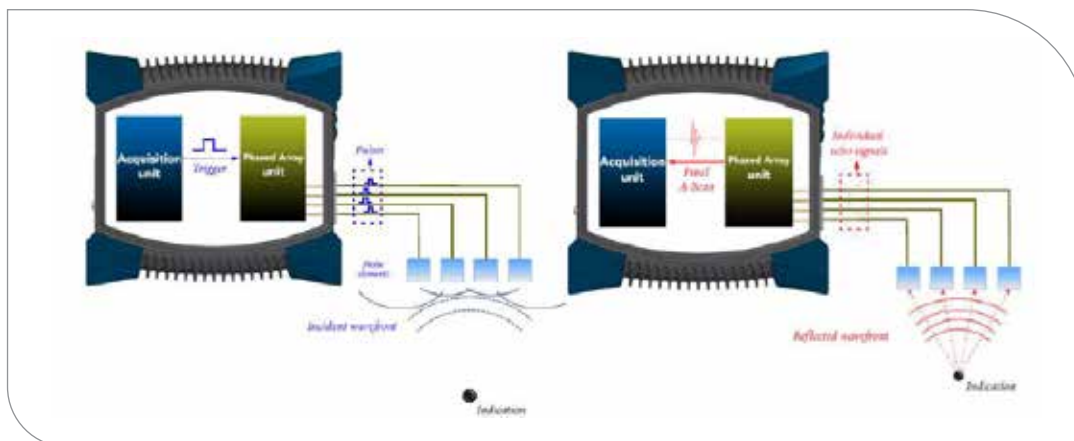


*Tailored fiber placement machine*



## 7. Ultrasonic array-based imaging of defects in thick composite structures

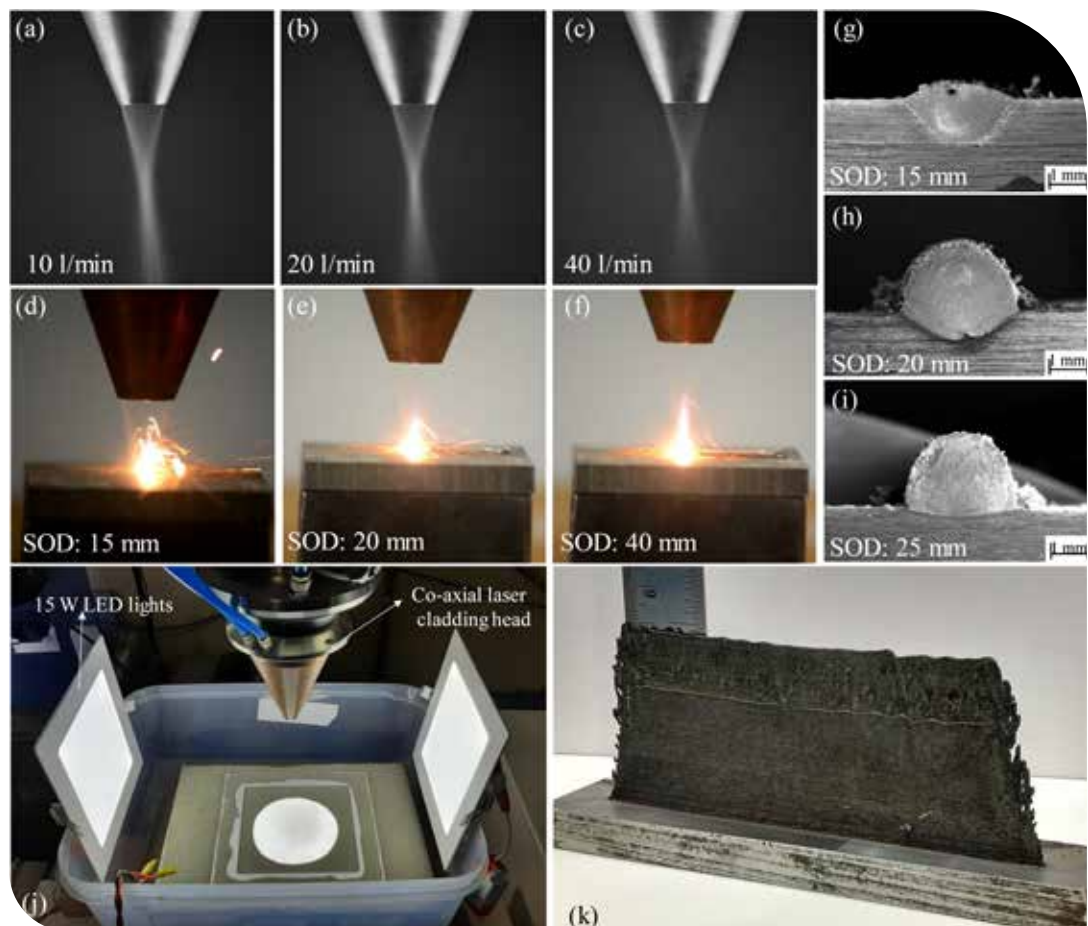
Recent years have seen a dramatic increase in the usage of thick composites in primary aircraft components like wings, fuselage, etc., fan blades in engine and wind turbine blades. Unlike in metals, the manufacturing of composite components largely depends upon hand-layup with vacuum bagging and autoclave curing. Various parameters like curing process time, temperature, and vacuum pressure will influence the manufacturing and introduces defects in the laminates like porosity or voids, in-plane and out-of-plane fiber waviness, missing plies, the presence of foreign objects, resin-rich areas, tow gaps, and tow overlaps in automated fiber placement, etc. As we cannot avoid these manufacturing defects (or get a product 100% defect-free), it is necessary to account for them while designing the composite structures for smooth and safe operation. Among the NDE techniques, ultrasonic-based techniques are widely used to quantify the defects present in thick composite sections because of their ease of operation and inspection capabilities. The schematic of the array controller and the array elements is shown in Figure below. The array elements can be used to steer and focus the ultrasonic waves electronically. Also, the array elements receive the A-scan signals which can be stored for image processing.



*Schematic of ultrasonic array-based system*

8. Laser-directed energy deposition (L-DED) is an additive manufacturing technique that allows localized deposition of material feed through a nozzle, coaxially to the laser beam feed from the center of the nozzle. Unlike the powder bed fusion process where the feedstock or the powder material is spread over the build surface, in the case of the DED process, the powder material is blown through the nozzle with interacts with a laser beam as well as the molten pool created on the substrate surface, resulting in melting, solidification, and fusion. During the deposition process, the laser beam interacts with the powder cloud where a portion of laser energy gets absorbed, reflected, and transmitted. The absorbed laser energy rises the temperature of the powder material while that transmits creates a molten pool on the substrate surface which majorly dictates the deposition quality and the metallurgical bonding. Insufficient melting or heat input through the transmitted laser beam results in balling phenomenon which is considered detrimental in the DED process. Therefore, it is very vital to understand the parameters that control the laser energy that is getting transmitted through the powder cloud. It essentially depends upon the powder cloud density and powder convergence

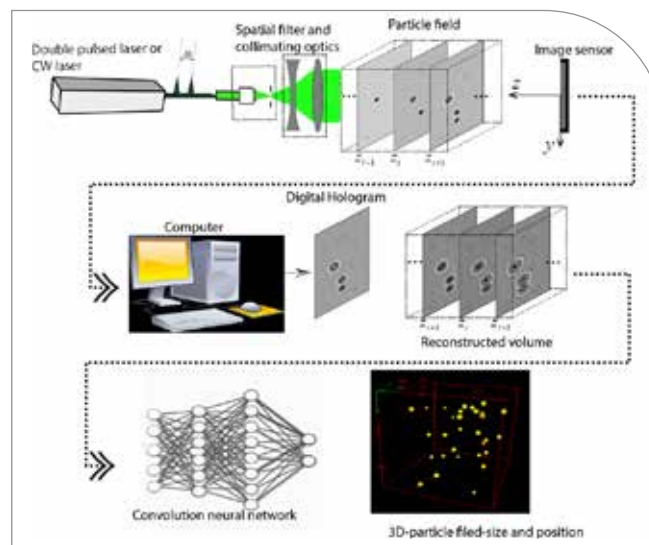
and divergence zone length which in turn depends upon the powder mass flow rate and carrier gas flow rate. High powder mass flow rates result in denser powder clouds with longer converging zone resulting in complete blocking of laser radiation. Similarly, lower carrier gas flow rates result in a lower kinetic energy powder stream which takes a longer convergence length, once again resulting in a block of a major portion of laser energy. On the other side, any low powder mass flow rate or higher gas flow rate results in an increase in dilution or excess remelting of previously deposited layers. In addition to these, laser spot diameter also plays a vital role in dictating the deposition quality as well as catchment efficiency of the powder. Typical the laser spot diameter should be either equal to or greater than the powder footprint diameter for better catchment efficiency. However, powder footprint diameter once again varies with carrier gas and powder mass flow rate. In addition to these, the laser power and scan speed also play a vital role in dictating the deposition rates and quality. Therefore, to understand all the above aspects, a thorough experimental analysis of laser-powder interaction is being carried out. Fig. 1 shows an outline of work being carried out in this direction.



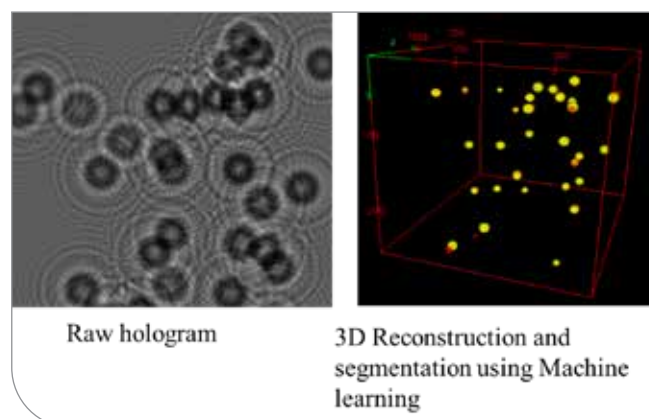
*Fig. 1 (a)-(c) Effect of carrier gas flow rate powder cloud density, (d)-(f) influence of SOD on laser-material interaction, (g)-(i) effect of SOD on bead geometry, (j) experimental setup to capture powder stream and (k) Multilayer Inconel 718 wall [212]*

## 9. Digital holography for particle dynamics and velocity measurements

Accurate determination of size and position of particles/droplets is important in several applications including aerosol transport, atomization of sprays, bacterial transport, droplet breakup in multiphase flows, etc., However, the conventional techniques such as shadowgraph and schlieren cannot reveal the location and size as they record integrated information along the optical path. Conversely, the digital holography can reveal the droplet position and size in a volume from the recorded interference pattern. The challenges with digital holography are computational time, segmentation of dense particle cloud, and accurate determination of particle position. With the advent of machine learning techniques, we successfully implemented a neural network-based approach to overcome the challenges involved in digital holography.



*Digital holography for particle size and velocity Measurements*



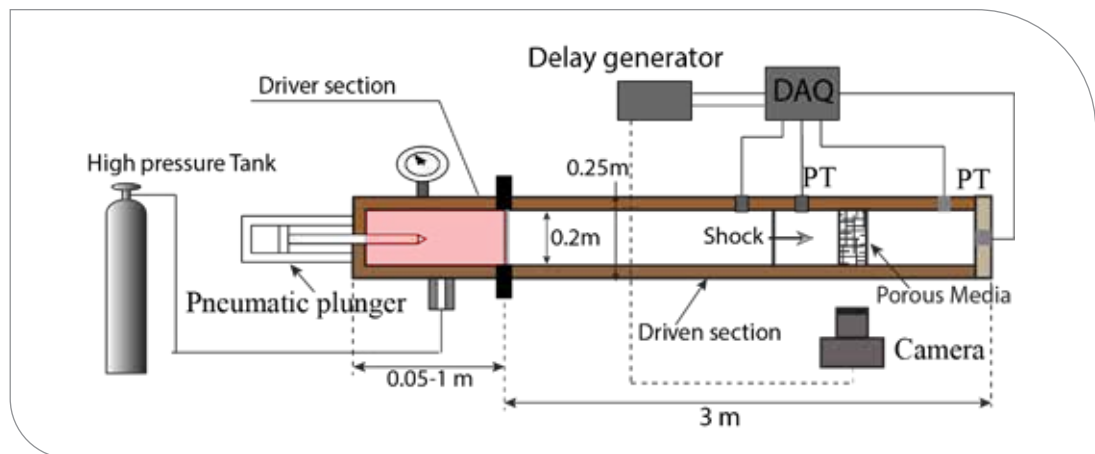
The schematic and principle of the Convolutional-Neural-Network (CNN) based holographic microscopic system is shown below. 2. Different auxiliary parts of the holography system are (i) coherent laser [dual cavity,  $\lambda=532\text{nm}$ ], (ii) spatial filter, and (iii) high-speed camera with a microscopic lens. In our research group, an experimental facility has been developed to record digital holograms of particles at high speed. In addition, in-house software has also been developed to obtain particle size and position in three-dimensional space.

## 10. Blast impact and mitigation

Mitigation of blast waves is of utmost importance in many industrial and military applications. These applications include blast wave propagation in underground military shelters and tunnels, largescale explosions due to industrial accidents, and precursor shocks during the start-up of a launch vehicle. Several blast mitigating techniques using either aqueous or solid obstacles have been developed in recent years. Implementation of rigid porous barriers, which partially block the shock path, is found to be a promising

method for the attenuation of shock/blast waves. These rigid porous obstacles absorb the blast energy through the introduction of shock-shock and shock-vortex interactions, and regions of entropy and intense turbulence in the flow field. Although this problem has been studied extensively, there is no systematic study that explains the complicated flow physics involved during shock wave interaction with porous media. An accurate estimation of the flow physics is needed for designing new protective devices against blast loading. Therefore, this project aims to fill this knowledge gap by understanding the intricate flow structures that are responsible for shock wave mitigation using state-of-the-art flow-diagnostic tools.

- Present capability: A shock tube facility is under construction to generate realistic blast wave conditions.
- GPU-based PIV and tomographic background-oriented schlieren are developed for estimation of the velocity and density fields.



*Shock tube facility for blast mitigation studies*

11. How do interactions with the deformable elastic walls of a soft fluidic confinement influence the near-wall swimming and collective behavior of microswimmers? Biological microswimmers interact with soft deformable walls during various natural processes, e.g. during upstream navigation of mammalian spermatozoa through the female reproductive tract, and during the initial adhesion of bacteria onto tissues which initiates biofilm formation. However, the role of the coupled hydrodynamic and elastic interactions between the microswimmer and the confining wall, or the elastohydrodynamic cues, in altering the near-wall swimming characteristics of the microswimmers remains poorly understood. Recent efforts in the development of artificial microswimmers have led to the synthesis of systems that mimic some of the motility and hydrodynamic signatures of their natural counterparts while circumventing the biological complexity. In this regard, self-propelling droplet microswimmers driven by micellar solubilization, or active droplets, provide a simple yet biomimetic model system for 'pusher-type' microswimmers like bacteria. However, even for such model microswimmers, the relationship between the near-wall elastohydrodynamic cues and the adaptation in swimming characteristics remains largely unexplored. To address this, we will investigate first the physical origin of the elastohydrodynamic cues, considering active droplets in soft microfluidic confinement as a model system. Second, we will study the

adaptive response of the droplet microswimmers to such elastohydrodynamic stimuli by characterizing the alterations in the near-wall swimming trajectory, speed, orientation, and in their collective behavior with varying elasticity [stiffness] of the confining walls. We propose to achieve these objectives by developing a state-of-the-art, double-channel fluorescence microscopy technique. This technique will enable simultaneous tracking of either the active droplet or the flow field generated by it, along with the local deformation profiles of the adjacent soft wall. Finally, we will develop a theoretical model to explain the changes in the swimming dynamics of the model microswimmers due to the elastohydrodynamic interactions, by combining elements of low-Reynolds-number hydrodynamic and linear elasticity theories. The proposed study will provide the missing insights into the role of elastohydrodynamics, besides the established Physico-chemical signals, in altering the near-wall swimming characteristics and collective behavior of microswimmers. These insights will help to explain the yet ambiguous role of substrate stiffness in the biophysical processes leading to the attachment of bacteria onto living tissues and the inert surfaces of medical devices. Finally, the acquired knowledge can lead to a new design protocol for controlling micro-robotic applications, like targeted load delivery using active droplets, based on tuning the substrate elasticity.

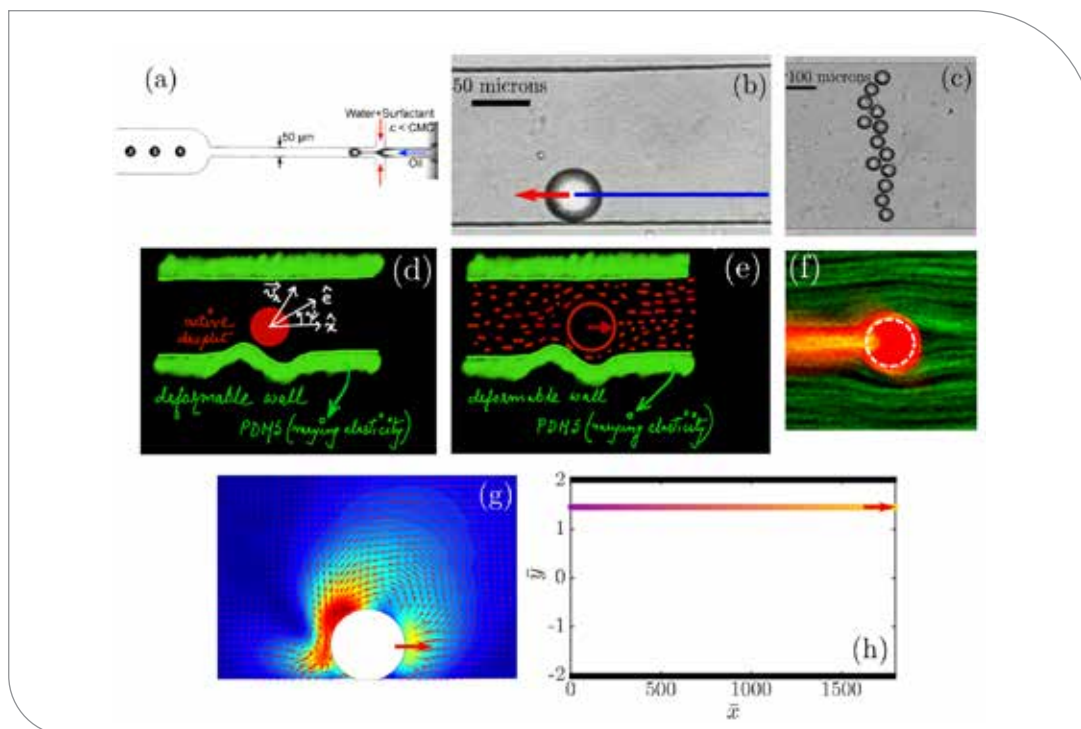


Figure: Proof-of-concept/preliminary results and schematics

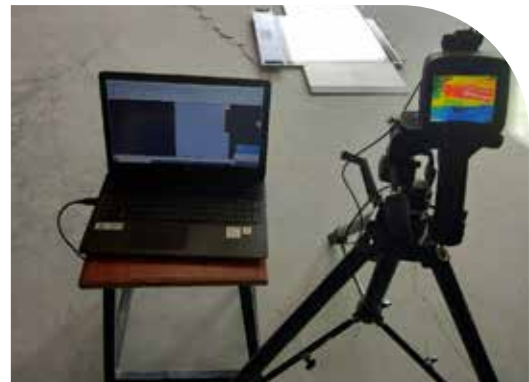
(a) Generation of monodisperse oil droplets [active droplets], in a surfactant solution, using pressure-driven flows in a microfluidic chip. (b) Sample of a bright-field microscopy image showing the trajectory [solid blue line] of a self-propelling active droplet along the rigid wall of a microchannel. The trajectory is evaluated using an image processing routine. (c) An example of a bright-field microscopy image showing the collective



behavior [‘pearl string’ formation] of droplet microswimmers in a rigid microchannel. [d] A schematic explaining the double-channel fluorescence microscopy technique for the simultaneous visualization of the active droplet dynamics [red emission] and the soft wall deformation profile [green emission] due to elastohydrodynamic interaction, or [e] the simultaneous visualization of the flow field generated by the droplet microswimmer [red] and the local wall curvatures [green]. [f] Sample of a reconstructed double-channel fluorescence microscopy image showing the self-propulsion of an active droplet in the bulk (red: droplet and filled micelle trail; green: ambient surfactant solution). The image was captured using a commercial double-channel microscopy system and is adapted directly from my previous publication [*Physical Review X*, 11 (1), 011043, 2021]. [g] An example of the flow field generated by a droplet microswimmer in the vicinity of a rigid wall, as evaluated using PIV (arrows: velocity vector; colormap: velocity magnitude). The flow field clearly shows the pusher-type swimming reminiscent of the swimming of *E. Coli*. [h] Theoretically evaluated trajectory of a droplet microswimmer. Theoretical prediction so far captures the tendency of pusher-type microswimmers to swim [left to right] along the wall of the microconfinement [bold black lines], as can be also seen in [b]. Colourmap: evolution of time; red arrow: direction of swimming.

## 12. Major Equipment

1. Tekscan TireScan system with a thermal camera is the integrated system that helps in capturing the tire contact area, also called as the tire print and normal pressure distribution when the tire is subjected to acceleration, deceleration, toe, and camber. A thermal camera helps in capturing the temperature distribution of tires. The system was procured in the year 2020.



*Tire Scan System*

2. **Autoclave system**

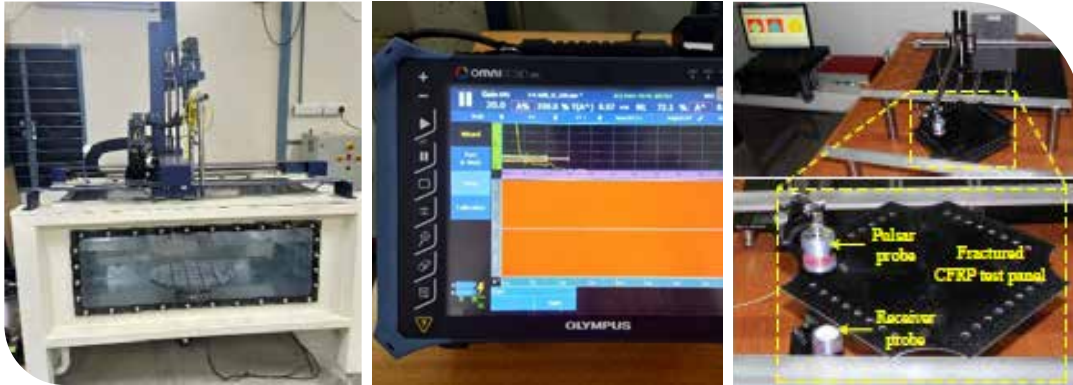
Autoclave systems are widely used for the manufacturing of high-quality composite structures for aerospace applications. Accurate pressure and temperature controls available in the system enable proper curing and manufacturing of composites with minimal defects.



*Autoclave System for Composite Manufacturing*

### 3. Ultrasonic NDE systems

Conventional immersion phased array and air-coupled ultrasonic systems are used to assess the quality of the fabricated composite structures. In addition, these systems are used to quantify the damages in composite structures due to impact/fatigue loading.



*Ultrasonic C-scan immersion, Phased array, and Air-coupled systems*

4. 40 kN linear friction stir welding aimed to join difficult to weld and dissimilar materials by a solid-state welding process.



5. Gigabyte ZEUS Mid-Tower Work station- for theoretical/numerical computations
6. Hot Air Oven Chamber- for soft lithography



## »»» Department of Physics

The physics department at IIT Hyderabad is committed to excellence in research and teaching by performing cutting-edge research and implementing new methodologies for teaching respectively. Department has excellent faculties in five (5) major research areas (condensed matter physics experiment, condensed matter theory, high energy physics, astrophysics, and optics). Apart from the core teaching of the department, four (4) of our faculties are involved in MTech (ISSS) and one (1) in MTech (EST). At present department has a total of 23 faculties and 221 students (PhD, MSc, and BTech (engineering physics)). FY 20–21 has been a fruitful year in terms of research and student achievements. Faculties of our department have published nearly 125 international journals and also delivered numerous talks at various conferences/workshops. Department established major facilities like XRD, VSM, MOKE, AFM, Femtosecond LASER, SQUID, etc. Our faculties are planning to build a departmental HPC facility with 576 Cores. One of our faculty was elected as a fellow of the Royal Society of Chemistry and Fellow in the Institute of Physics, London. In addition, two of our faculties are also involved in Belle and Belle II experiments. Our faculties also established various national and international collaborations and are involved actively in joint programs, such as GIAN, SPARC, and international bilateral research programs. Students of the department are placed at various national and international universities for pursuing their higher studies. In addition, many of our students have qualified for several national level exams such as GATE, CSIR-UGC/JRF, etc with top ranks. Our students obtained various international level fellowships such as Newton Bhabha fellowship, NIMS-ICGP fellowship, etc. Physics faculties are actively involved in obtaining sponsored projects from DST, DRDO, Sree Padmavathi Venkateswara foundation, IISC Bangalore, and many other funding agencies during FY 20–21, which is worth 550 Lakhs.

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### Publications [Conference]

1. Banerjee, K., & Asthana, S. [2020]. The Thermal Stability of Recoverable Energy Storage Density in Novel Eu-substituted Lead-Free  $\text{K}_0.5\text{Bi}_0.5\text{TiO}_3$  ferroelectric. 2020 Joint Conference of the IEEE International Frequency
2. Banerjee, Krishnarjun, & Asthana, S. [2020]. The effect of cation-size variance on the relaxor nature and insulating character of the lead-free Rb substituted  $\text{Na}_0.5\text{Bi}_0.5\text{TiO}_3$ . *AIP Conference Proceedings*, 2269(1), 030009. <https://doi.org/10.1063/5.0019516>
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4. Pal, M., Srinivas, A., & Asthana, S. [2020]. Exploration of lead-free magnetoelectric  $0.85[\text{Na}_0.41\text{K}_0.09\text{Bi}_0.5\text{TiO}_3] - 0.15[\text{CoFe}_2\text{O}_4]$  particulate composite for sensor application. *AIP Conference Proceedings*, 2269(1), 030006. <https://doi.org/10.1063/5.0019513>
5. Rao, T., Mishra, A., Sattibabu, B., Banerjee, K., Asthana, S., Murthy, V., & Chelvane, J. [2020]. Structural and magnetic properties of Ba and Sn co-substituted bismuth ferrite. *Materials Today: Proceedings*, 39. <https://doi.org/10.1016/j.matpr.2020.05.466>
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9. Biswas, C., Katturi, K. N., Duvva, N., Giribabu, L., Soma, V. R., & Raavi, S. S. K. [2020]. Plasmon Induced Ultrafast Excited-State Interfacial Electron Dynamics of Tetrathiafulvalene Sensitizers. The 22nd International Conference on Ultrafast Phenomena 2020 [2020], Paper M4A.32, M4A.32. <https://doi.org/10.1364/UP.2020.M4A.32>
10. Biswas, C., Devarajan, K., Panda, T. K., & Raavi, S. S. K. [2020]. Enhanced Broadband Emission in Novel Phenanthroimidazole Derivative Molecules via Excited State Intramolecular Proton Transfer. Part F186-NOMA 2020. Scopus.
11. Katturi, N. K., Jonnadula, V. S. K., Biswas, C., Raavi, S. S. K., Giribabu, L., & Soma, V. R. [2020]. Ultrafast photophysical studies and femtosecond third-order nonlinear optical properties of Soret-band excited zinc phthalocyanine. 11365. Scopus. <https://doi.org/10.1117/12.2558067>
12. Desai, S., & Gupta, S. [2020]. Recent bounds on graviton mass using galaxy clusters. *Journal of Physics: Conference Series*, 1468(1), 012003. <https://doi.org/10.1088/1742-6596/1468/1/012003>

## Funded Research Projects

1. Dr Jyoti Ranjan Mohanty, Tuning of magnetic skyrmionics spin structure in ferrimagnetic nanostructure for data storage applications, DST, Dec 15, 2020, 120.00L.
2. Prof Saket Asthana, Control on the relaxor behavior through cation engineering to lead-free disordered ferroelectrics to attain the optimum recoverable energy storage density, SERB, Dec 28, 2020, 48.44L.
3. Dr Bhuvanesh Ramakrishna, Bright Radiation Sources from Intense Laser Matter Interaction, SERB, Dec 28, 2020, 22.11L.
4. Dr Priyotosh Bandyopadhyay, Understanding Higher Gauge Symmetries at the LHC, SERB, Dec 29, 2020, 6.60L.
5. Dr Suryanarayana Jammalamadaka, Electric field control of exchange bias in FM/AFM hybrid multilayers for energy-efficient spintronic applications, SERB, Dec 30, 2020, 45.14L.
6. Dr Raavi Sai Santosh Kumar, Charge transfer dynamics in non-fullerene small molecule organic solar cell, SERB, Dec 31, 2020, 61.21L.
7. Dr Anupam Gupta, Collective behavior in a turbulent environment, IISs, Bangalore, Mar 27, 2021, 15.00L.

## Workshops Conducted

1. Joy Ganguly of IIT Hyderabad on "Neutrino mixing by modifying the Yukawa coupling structure of constrained sequential dominance".
2. Anirban Karan of IIT Hyderabad on "Production of Leptoquarks and Zeros of Amplitude at Electron-Photon Collider".

3. Satyabrata Mahapatra of IIT Hyderabad on "Verifiable Type-II Seesaw & Dark Matter in a Gauged B-L Model".
4. Priyotosh Bandyopadhyay of IIT Hyderabad on "Perspective of extended Higgs sectors in beyond Standard Model scenarios".
5. Anomalies 2020, 11-13/09/2020: 120 people participated including 56 talks by the national and international speakers
6. TEQIP online workshop on "Magnetic materials for MEMS-based devices" organized at IIT Hyderabad between Oct 29 – Nov 01, 2020. [CEP]
2. Prof V Kanchana, Professor, received a Fellow of the Institute of Physics [UK].
3. Ms Shilpa Jangid received JRF to SRF within a year by inspires as she published three papers within a year
4. Ms Shilpa Jangid received the IITH Research excellence award for the year 2020
5. Saunak Dutta completed his Ph.D within 3 years and 7 months as a HEP theory student
6. Saunak Dutta Joined as a postdoctoral fellow at the University of Delhi
7. Dr Arabinda Halder, Assistant Professor, was Invited to write a "perspective" article by the Journal of Applied Physics, AIP Publishing [More details about a perspective: <https://aip.scitation.org/topic/collections/perspectives?SeriesKey=jap>]

### Awards and Recognitions

1. Prof V Kanchana, Professor, received a Fellow of the Royal Society of Chemistry [FRSC] [UK].

### Highlight – 1 (Dr J. Suryanarayana)

#### Graphene oxide-based synaptic memristor device for neuromorphic computing

Brain-inspired neuromorphic computing which consists of neurons and synapses, with an ability to perform complex information processing has unfolded a new paradigm of computing to overcome the von Neumann bottleneck. Electronic synaptic memristor devices which can compete with the biological synapses are indeed significant for neuromorphic computing. In this work, we demonstrate our efforts to develop and realize the graphene oxide (GO) based memristor device as a synaptic device, which mimics as a biological synapse. Indeed, this device exhibits the essential synaptic learning behavior including analog memory characteristics, potentiation, and depression. Furthermore, the spike-timing-dependent-plasticity learning rule is mimicked by engineering the pre-and post-synaptic spikes. In addition, non-volatile properties such as endurance, retentivity, multilevel switching of the device are explored. These results suggest that Ag/GO/FTO memristor device would indeed be a potential candidate for future neuromorphic computing applications.

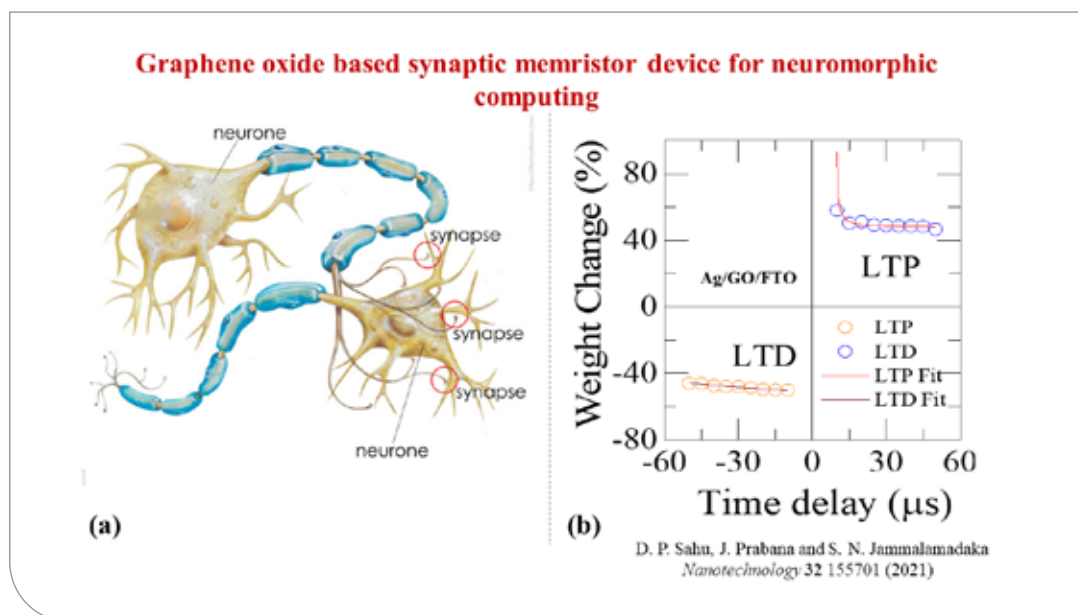
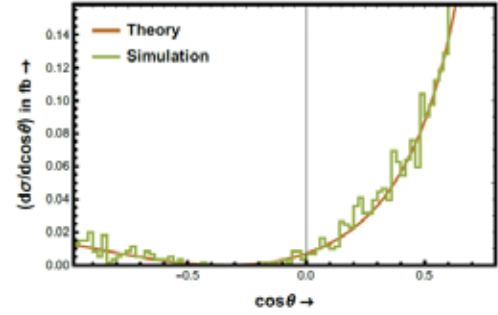


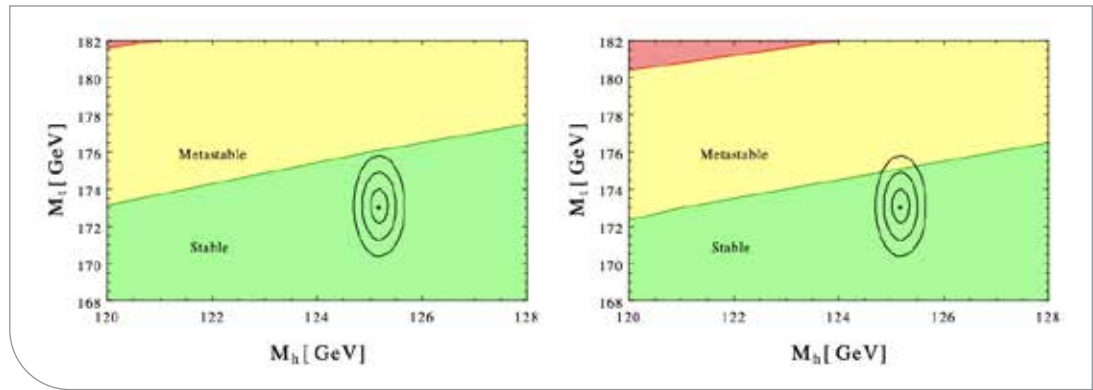
Fig. 1: (a) Connection between two neurons through synapse (b) Spike timing dependent plasticity (STDP) behavior of GO based synaptic memristor device

## Highlight – 2 (Dr Priyottosh Bandopadhyay)

In 2020, I explored the lepton-photon collider where we distinguish the different Leptoquark representations via the means of zeros of amplitude. Different Leptoquarks will have zeros in different points of the angle with the beam of the incoming particle. The proposed collider thus can distinguish among different such scenarios [Eur.Phys.J.C 80 (2020) 6, 573].



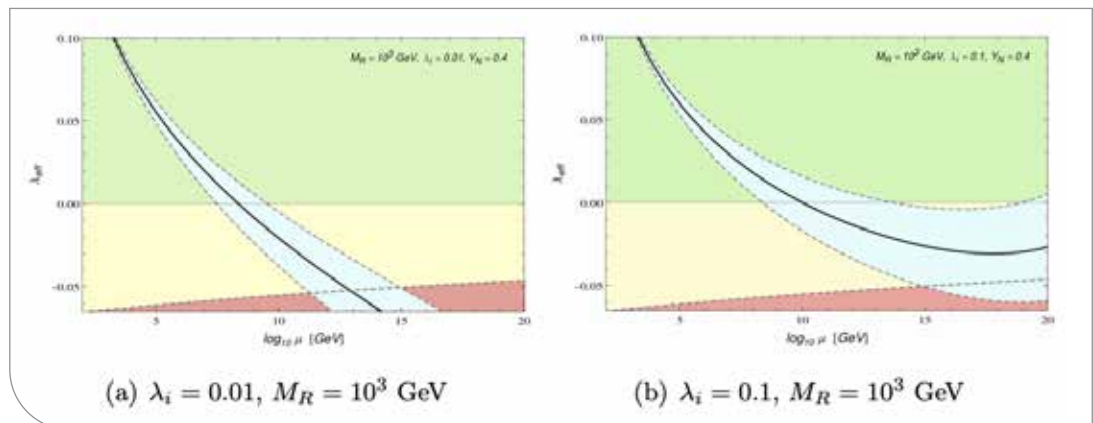
In a couple of projects, we studied the vacuum stability and perturbativity of the electroweak vacuum of various beyond Standard Model scenarios and probed the viable scenarios.



IDM

ITM

In Eur.Phys.J.C 80 (2020) 8, 715 we distinguished the Inert doublet model (IDM) and Inert Triplet model (ITM) via this and studied their phenomenology at the LHC. Similar studies with right-handed neutrinos give bounds to their corresponding mass and couplings.



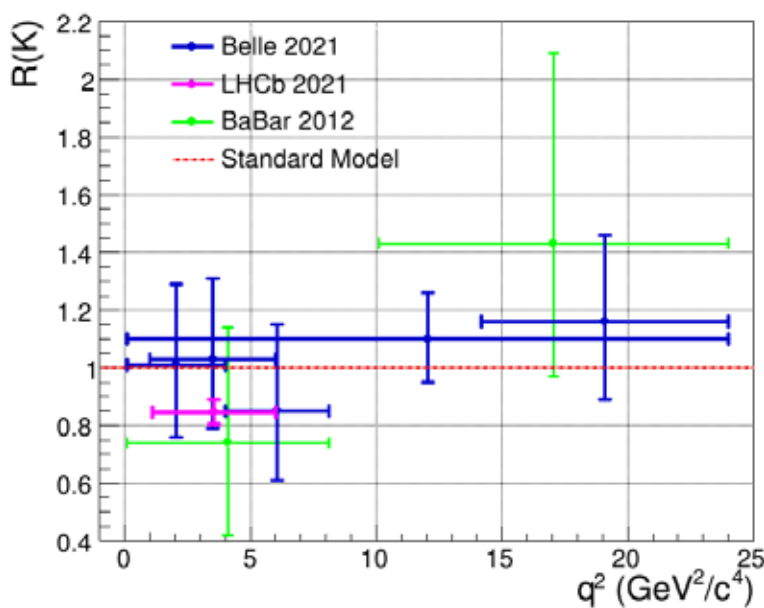
In a freeze-in multi-component dark matter scenario we addressed the issues of late decay and bounds from the neutrino detector [JCAP 08 (2020) 019].



### Highlight – 3 [Dr S Sandilya]

Our experimental high energy physics group at IIT Hyderabad is actively searching for any hints for New Physics (NP) beyond the Standard Model (SM) of particle physics with Belle and Belle II experiments. The flavor changing neutral current mediated B-decays such as  $B \rightarrow K ll$  (where  $l = \mu, e$ ) proceed via loop diagrams at the lowest order and are sensitive probes for the searches of the NP, as the particles predicted in the NP can enter the loop and alter the branching fractions or the kinematics of the decay. An important observable to test the presence of NP would be the ratio of the branching fractions of  $B \rightarrow K \mu \mu$  and  $B \rightarrow K e e$ , aka lepton flavor universality ratio:  $R(K)$ . The ratio,  $R(K)$ , is predicted to be unity in the SM and any deviation from that would indicate the NP.

Recently, LHCb experiment at CERN measured the ratio  $R(K)$  and reported its deviation from unity by about 3 standard deviations [arXiv:2103.11769]. We led the analysis at the Belle experiment to measure the ratio  $R(K)$  [JHEP03(2021)105]. This measurement is performed in the several bins of  $q^2$ , which is the square of dilepton invariant mass. We found the  $R(K)$  to be compatible with unity in all the  $q^2$  bins, as well as with the LHCb result in the given statistically dominated uncertainties. Our  $R(K)$  measurement in different  $q^2$  bins is shown below:

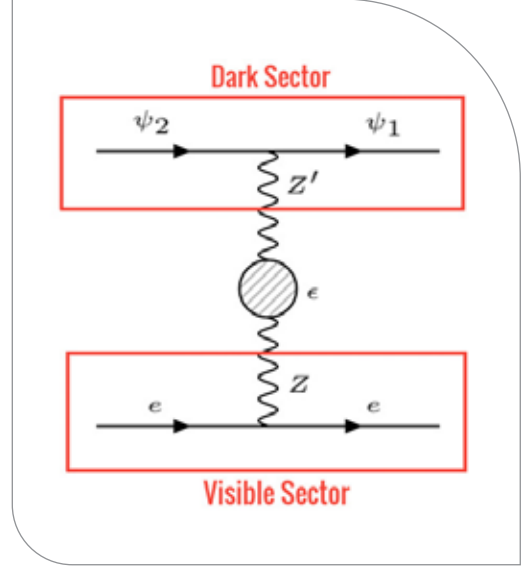


[Figure: Measurement of  $R(K)$  in bins of  $q^2$  from Belle experiment (blue points), LHCb experiment (magenta points), and Babar experiment (green points).]

#### Highlight-4 (Dr Narendra Sahu)

##### Is dark matter detected at XENON1T experiment ?

In June 2020, the XENON1T experiment, which is probing the direct detection of dark matter (DM), reported an excess of electron events over the background. In light of this our group (Dr. Narendra Sahu, Mr. Satyabrata Mahapatra and Mr. Manoranjan Dutta) in collaboration with Dr. Debasish Borah from Department of Physics, IIT Guwahati published a series of papers [Phys. Lett B 811 [2020] 135933, Nucl. Phys.B 968 [2021] 115407, Phys. Rev.D103 [2021], 095018 ] to unravel the microscopic properties of DM which are yet to be discovered. Our analysis is based on inelastic nature of self-interacting DM (SIDM). While the XENON1T excess can arise due to inelastic nature of DM (where the heavier component of DM can undergo a down scattering with electrons at the detector atoms as shown in Fig. 1), the corresponding mediator of such scattering, if sufficiently light compared to DM, can also give rise to the required self-interaction cross-section:  $\sigma/m \sim$  essential to solve the small structure problems associated with cold dark matter (CDM).



In elastic scattering of self-interacting DM:  $\psi_2 \rightarrow \psi_1 e$  at XENON1T experiment

We consider a gauged abelian symmetry in the dark sector with the gauge boson  $Z'$  which mixes with the SM gauge boson  $Z$  and provides a portal to dark matter to interact with the detector electron. The mixing parameter is  $\epsilon$  as shown in Fig.1. The requirement of large self-interaction forces us to consider a tiny  $Z'$ - $Z$  mixing ( $\epsilon$ ) essential for giving rise the XENON1T electron excess while satisfying all other existing experimental bounds. This is summarized in Fig. 2 in the plane of dark sector coupling:  $g'$  and dark sector gauge boson mass for dark matter mass 1 GeV and a small mass splitting ( $\Delta$ ) between the two components  $\psi_2$  and  $\psi_1$ .

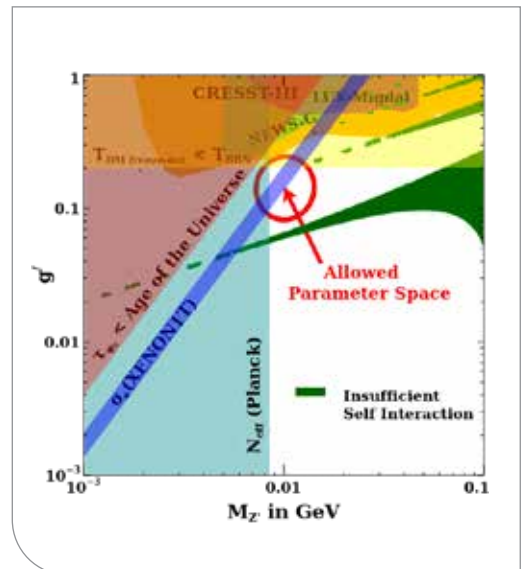


Fig.2: Summary plot for inelastic self-interacting DM showing the final parameter space from relevant constraints. The white region represents the allowed parameter space available after imposing all the constraints. The blue patch represents the parameter space allowed by XENON1T for 1 GeV inelastic DM with mass splitting 2 KeV between the two components and  $Z'$ - $Z$  mixing is  $\epsilon = 4 \times 10^{-8}$ .



# Virtual Departments



# Department of Artificial Intelligence

Established in 2019, the Department of Artificial Intelligence (AI) at IIT-Hyderabad is the first such in India offering BTech, MTech and PhD programs in AI with an objective to mould students with a holistic understanding of the theory and practice of AI, as well as to create an ecosystem for pedagogy and research in AI, encompassing foundational, applied and interdisciplinary perspectives. Its mission is to enable students to become leaders in the AI industry and academia nationally and internationally; as well as to meet the pressing demands of the country in various sub-areas and applications of AI. The department currently consists of ~28 faculty working in various areas of AI including machine learning, computer vision, speech understanding, natural language processing, social media analysis, robotics, signal processing, high-dimensional data analysis, distributed AI, compilers for AI, and embedded AI. It also includes faculty at the intersection of AI and other disciplines such as AI and IoT, AI and blockchains, AI and wireless networks, as well as AI and design. Faculty associated with the AI department have been involved in projects conducting research and development of AI solutions for healthcare, smart transport, security and surveillance, agriculture, disaster management, fraud analytics, e-commerce, astronomy and aerospace applications. In addition to several collaborations with government, academic and industry organizations, the AI department hosts India's first NVIDIA AI Technology Centre (NVAITC), as well as works closely with the Telangana AI Mission on its initiatives. For more information, please visit <https://ai.iith.ac.in/>

## Thrust Areas

- Core AI and ML Algorithms
- Reinforcement Learning and Control
- Computer Vision/ Image Processing
- Speech and Language Processing, Web Mining
- AI, Robotics and Autonomous Vehicles
- AI for IoT, Networks and Communications
- AI for Healthcare
- Efficient AI in Software and Hardware, Biomimetic AI
- AI Applications

## Faculty



**C Krishna Mohan**

**Computer Science & Engineering**

*Research Areas:* Video Content Analysis; Machine Learning



**Vineeth N Balasubramanian**

**Head & Computer Science & Engineering**

*Research Areas:* Machine Learning; Deep Learning; Computer Vision



**Srijith P K**

**Computer Science & Engineering**

*Research Areas:* Machine Learning; Bayesian Learning; Deep Learning; Bayesian Nonparametrics; Social Media and Text Analysis



**Maunendra Sankar Desarkar**

**Computer Science & Engineering**

*Research Areas:* Natural Language Processing; Recommendation Systems; Information Retrieval; Social Network Analysis; Machine Learning



**K Sri Rama Murty**

**Electrical Engineering**

*Research Areas:* Signal Processing; Speech Analysis, Recognition & Synthesis; Machine Learning



**Sumo hana Channappayya**

**Electrical Engineering**

*Research Areas:* Image and Video Quality Assessment; Biomedical Image Processing; Machine Learning



**Aditya Siripuram**

**Electrical Engineering**

*Research Areas:* Graph Signal Processing; Mathematical Aspects of Sampling; Adversarial Machine Learning



**Jayaram Balasubramaniam**

**Mathematics**

*Research Areas:* Approximate Reasoning; Connectives in Multi-Valued LogicManufacturing



**C S Sastry**

**Mathematics**

*Research Areas:* Wavelets; Inverse Problems and Sparse Representation Theory



**Amit Acharyya**

**Electrical Engineering**

*Research Areas:* VLSI Systems Resource-Constrained Applications; Low Power Design Techniques; Machine Learning Hardware Design; Signal Processing Algorithm and VLSI Architectures; Digital Arithmetic; Hardware Security;





**P Rajalakshmi**

**Electrical Engineering**

*Research Areas:* Internet of Intelligent Things; Artificial Intelligence; Computer Aided Diagnosis; Intelligent and Autonomous Transportation



**Soumya Jana**

**Electrical Engineering**

*Research Areas:* Biomedical Image and Signal Analysis; Air Quality Analysis; Network Information Theory; Computer Vision; Artificial Intelligence; Radar and Sonar Imaging and Signal Processing



**Sathya Peri**

**Computer Science & Engineering**

*Research Areas:* Parallel & Distributed Systems



**G V V Sharma**

**Electrical Engineering**

*Research Areas:* Wireless Communications; Physical Layer Modulation; Synchronization Techniques; Channel Coding Techniques



**Lakshmi Prasad Natarajan**

**Electrical Engineering**

*Research Areas:* Modulation and Coding for Communications



**Shantanu Desai**

**Physics**

*Research Areas:* Galaxy Clusters and Cosmology; Pulsars; Astrostatistics and Data Mining; Gravitational Wave Searches



**R Prasanth Kumar**

**Mechanical & Aerospace Engineering**

*Research Areas:* Multibody Dynamics; Robotics; Control Systems



**Abhinav Kumar**

**Electrical Engineering**

*Research Areas:* Resource Allocation for 5G; Visible Light Based Communications; Security and Privacy in Wireless Networks; Cellular Operation in the Unlicensed Spectrum



**Saidhiraj Amuru**

**Electrical Engineering**

*Research Areas:* Applications of AI and Machine learning in Wireless Communications



**Chandrika Prakash Vyasarayani**

**Mechanical & Aerospace Engineering**

*Research Areas:* Nonlinear Dynamics and Control



**Nixon Patel**

**Electrical Engineering**

*Research Areas:* Wireless Communications; Applications of AI and Machine learning



**Suryakumar S**

**Mechanical & Aerospace Engineering**

*Research Areas:* Metal Additive Manufacturing; 3D Printing; CAD / CAM



**M V Panduranga Rao**

**Computer Science & Engineering**

*Research Areas:* Applications of Formal Methods



**Kishalay Mitra**

**Chemical Engineering**

*Research Areas:* Machine Learning; Artificial Intelligence; Wind Farm Design; Supply Chain & Circular Economy; Climate Change; Systems Biology; Uncertainty Modeling; Optimal Control; System Identification;



**Mohan Raghavan**

**Biomedical Engineering**

*Research Areas:* Computational Neuroscience



**Manish Singh**

**Computer Science & Engineering**

*Research Areas:* Databases; Data Mining; Text Mining; Social Network Analysis; Information Retrieval



## Faculty



**Satish Regonda**

**Head & Civil Engineering**

*Research Areas:* Urban and Rural Flood Modeling; Climate Sciences; Data Sciences; Statistical Modeling Techniques; Ensemble Forecasting; Tools and Products Development; Gis; R; Shiny



**Aalok Khandekar**

**Liberal Arts**

*Research Areas:* Environment; Disaster; Climate Change; Science Technology and Society Studies [STS]; Urban Studies; Cultural Anthropology



**Abhinav Kumar**

**Electrical Engineering**

*Research Areas:* Resource Allocation for 5G; Visible Light Based Communications; Security and Privacy in Wireless Networks; Cellular Operation in the Unlicensed Spectrum



**Asif Qureshi**

**Civil Engineering**

*Research Areas:* Environmental Science, Biogeochemistry, and Public Health



**Bhuvanesh Ramakrishna**

**Physics**

*Research Areas:* Laser plasma Interaction



**Chandra Shekhar Sharma**

**Chemical Engineering**

*Research Areas:* Polymer and Carbon Nanomaterials; Carbon-MEMS; Electrospun Nanofibers; Nature inspired Functional Surfaces; Drug Delivery; Waste Management; Batteries and Supercapacitors



**D Chandrasekharam**

**Civil Engineering**

*Research Areas:* Groundwater Pollution; Geothermal Energy



**Debraj Bhattacharyya**

**Civil Engineering**

*Research Areas:* Water & Wastewater Treatment; Solid Waste Management; Renewable Energy [Biofuel]



**Digvijay S Pawar**

**Civil Engineering**

*Research Areas:* Driver and Pedestrian Behavioral Modeling; Traffic Safety and Accident Analysis; Traffic Operation and Simulation; Intelligent Transportation Systems; Statistical Modelling and Classification Technique;



**Harish N Dixit**

**Mechanical & Aerospace Engineering**

*Research Areas:* Interfacial Flows – Moving Contact Lines; Drop; Bubbles and Thin Films; Hydrodynamic Stability Theory



**K B V N Phanindra**

**Civil Engineering**

*Research Areas:* Groundwater Modeling; Soil-Water-Plant Interactions; Remote Sensing & Gis; Eco-Hydrological Processes



**Kaushik Nayak**

**Electrical Engineering**

*Research Areas:* Electronic Devices Physics; Mesoscopic Electronics



**Kishalay Mitra**

**Chemical Engineering**

*Research Areas:* Machine Learning; Artificial Intelligence; Wind Farm Design; Supply Chain & Circular Economy; Climate Change; Systems Biology; Uncertainty Modeling; Optimal Control; System Identification;



**Melepurath Deepa**

**Chemistry**

*Research Areas:* Applied Electrochemistry



**Pritha Chatterjee**

**Civil Engineering**

*Research Areas:* Waste Treatment; Resource Recovery from Waste; Bioenergy; Bioelectro Chemical Systems; Anaerobic Digestion



**Raja Banerjee**

**Mechanical & Aerospace Engineering**

*Research Areas:* Computational Fluid Mechanics with Emphasis on Multi Phase Flow; High Fidelity Solver Development on Accelerators Like Gpu; Experimental and Numerical Study of Interfacial Flows Like Primary Jet Breakup; Sloshing of Liquid In Partially Filled Tanks; Spray and Atomization of Liquid Fuel and Turbulent Non-Premixed Combustion; Nucleate Boiling Using Two-Phase Lattice Boltzmann Method



**Raavi Sai Santosh Kumar**

**Physics**

*Research Areas:* Optics and Spectroscopy of Energy Conversion Materials



**Sathya Peri**

**Computer Science & Engineering**

*Research Areas:* Parallel & Distributed Systems





**Sayak Banerjee**

**Mechanical & Aerospace Engineering**

*Research Areas:* Experimental and Numerical Combustion Kinetics; Kinetic Model Reduction; Bio-fuel Combustion and Emission; Combustion Diagnostics



**Shantanu Desai**

**Physics**

*Research Areas:* Galaxy Clusters and Cosmology; Pulsars; Astrostatistics and Data Mining; Gravitational Wave Searches



**Shashidhar**

**Civil Engineering**

*Research Areas:* Bio-remediation; Contaminant Hydrology; Hydraulic Transients; Hydro Climate; Hazardous Waste Management; Wastewater Treatment; Remote Sensing and GIS Applications



**Shiva Ji**

**Design**

*Research Areas:* Design for Sustainability; Sustainability Assessment Methods; LCA; Environmental Planning and Design; Virtual Reality Applications in Architecture



**Ch Subrahmanyam**

**Chemistry**

*Research Areas:* Catalysis; Nanomaterials and Energy Systems



**Sumohana Channappayya**

**Electrical Engineering**

*Research Areas:* Image and Video Quality Assessment; Biomedical Image Processing; Machine Learning



**Vineeth N Balasubramanian**

**Computer Science & Engineering**

*Research Areas:* Machine Learning; Deep Learning; Computer Vision



**M P Ganesh**

**Liberal Arts**

*Research Areas:* Cross-Cultural Virtual Teams; Workplace Bullying; Cross-Cultural Collaborations



**Niranjan Shrinivas Ghaisas**

**Mechanical & Aerospace Engineering**

*Research Areas:* Wind Energy; Turbulent Flow Simulations; Computational Mechanics



**Ketan Detroja**

**Electrical Engineering**

*Research Areas:* Control Theory; State Estimation; Fault Diagnosis



## Faculty



**Ranjith Ramadurai**

**Materials Science & Metallurgical Engineering**

*Research Areas:* Multifunctional Thin Films; Piezoresponse Force Microscopy; Hybrid Piezoelectrics; Piezoelectric Sensors and Actuators



**Bhuvanesh Ramakrishna**

**Head & Physics  
Associate Professor**

*Research Areas:* Laser plasma Interaction



**Siva Rama Krishna V**

**Electrical Engineering**

*Research Areas:* Biosensors; Electrochemistry; MEMS; 3D-IC



**Syed Nizamuddin Khaderi**

**Mechanical & Aerospace Engineering**

*Research Areas:* Solid Mechanics; Impact Mechanics; Fluid-Structure Interaction; Lattice Materials; Metal Foams



**Badarinath Karri**

**Mechanical & Aerospace Engineering**

*Research Areas:* Experimental Fluid Mechanics; High-Speed Imaging; Cavitation; Bubble Dynamics



**Tanmoy Paul**

**Mathematics**

*Research Areas:* Functional Analysis



**Abhinav Kumar**

**Electrical Engineering**

*Research Areas:* Resource Allocation for 5G; Visible Light Based Communications; Security and Privacy in Wireless Networks; Cellular Operation in the Unlicensed Spectrum



**Ramakrishna Upadrasta**

**Computer Science & Engineering**

*Research Areas:* Compilers; Program Analysis; Optimization; Polyhedral Compilation; Programming Languages and Domain Specific Languages



**Digvijay S Pawar**

**Civil Engineering**

*Research Areas:* Driver and Pedestrian Behavioral Modeling; Traffic Safety and Accident Analysis; Traffic Operation and Simulation; Intelligent Transportation Systems; Statistical Modelling and Classification Technique;



**Praveen Meduri**

**Chemical Engineering**

*Research Areas:* Photo electrochemical Water Splitting; Photocatalysis; Lithium Sulfur Batteries



**Venkata Rao Kotagiri**

**Chemistry**

*Research Areas:* Functional Organic Materials; Supramolecular Chemistry; Organic Semiconductors



**KP Prabheesh**

**Liberal Arts**

*Research Areas:* Macroeconomics International Finance and Applied Econometrics



**Chandrasekhar Murapaka**

**Materials Science & Metallurgical Engineering**

*Research Areas:* Nanomagnetic Materials; Spintronic Based Memory and Logic Devices



**B Munwar Basha**

**Civil Engineering**

*Research Areas:* Unsaturated Soil Mechanics; Reliability Based Design; Geotechnical & Geoenvironmental Engineering; Computational Geomechanics; Municipal Solid Waste Landfills; Soil Dynamics and Earthquake Resistant Design; Retaining Structures; Reliability Analysis of Pavement Geotechnics; Rock Mechanics



**N R Aravind**

**Computer Science & Engineering**

*Research Areas:* Algorithms; Parameterized Complexity; Graph Theory; Combinatorics



**Aravind Kumar Rengan**

**Biomedical Engineering**

*Research Areas:* Nanomedicine; Bio-Nanotechnology; Photothermal Therapy; Nanotoxicology; Cancer Theranostics



**Manish Singh**

**Computer Science & Engineering**

*Research Areas:* Databases; Data Mining; Text Mining; Social Network Analysis; Information Retrieval

## »» Department of Entrepreneurship and Management

Department of Entrepreneurship and Management is one of the youngest departments in the IIT Hyderabad which was established in July 2020 with an aim to nurture entrepreneurship motivation and skillset among students within and outside IITH. The department offers a minor in entrepreneurship to the UG students of IITH. The department has also started the Dual Degree in MTech in Techno-Entrepreneurship in which final year BTech students have an option to pursue this post-graduate degree by spending an extra year undergoing the required course credits. The department has hosted an online workshop in the past year on Deep-tech Entrepreneurship in collaboration with i-Tic, IITH. It has plans to host many such workshops and certificate courses for aspiring entrepreneurs and working professionals in the coming years. Currently, the department has three PhD students working in the areas of organizational learning, HRM, and moment marketing. Two new faculty in the areas of strategy and innovation and Operations research have been recruited recently and the department is looking forward to expanding both in terms of the number of faculty as well as programs to be offered.

### Faculty



**M P Ganesh**

PhD – IIT Bombay

**Associate Professor**

*Research Areas: Cross-Cultural Virtual Teams; Workplace Bullying; Cross-Cultural Collaborations*





# Happenings

# Happenings

## NSS Activities

During the academic year 2020-21, NSS IIT Hyderabad (NSS IITH) was proactively involved in many community development activities in an online mode. A total of 200+ volunteers participated in various activities organized by NSS IITH. Under the able leadership and guidance of the faculty in charge and associate in-charge, NSS IITH pledged to devote the best efforts for the betterment of society. NSS IITH has around 200+ registered students. NSS IITH has been successfully doing its part in society since dawn. Here's a descriptive list of all the activities it has undertaken during the academic year 2020 21.

## Online events

- » World Photography Day
- » Independence Day
- » Ganesh Chaturthi
- » Drug Abuse - Awareness & Prevention
- » Teacher's Day
- » Staying safe online & offline
- » Audiobooks
- » Gandhi Jayanthi
- » Bridge the Gap
- » Vigilant India, Prosperous India
- » Milad-Un-Nabi
- » National Education Day
- » Constitution Day
- » Audiobooks Edition 2
- » Guru Nanak Jayanti
- » Survey on prevalent societal stereotypes and prejudices
- » National Youth Day
- » Best from Waste
- » Evolve
- » Road Safety
- » Sri Guru Tegh Bahadur
- » E-Vidyadaan
- » Tidy Room, Tidy Life
- » Life, a million facets
- » Weed Removal Drive
- » Gratitude Beyond Words
- » Elimination of Single-Use plastic
- » Act Wise, Save Life



Education is not preparation for life; education is life itself. – John Dewey



### World Photography Day

On the occasion of World Photography Day and World Humanitarian Day, we conducted a photography event with the theme 'Hope and Humanity'. Students were asked to click a picture on the given theme.

**Best Entries** [No.of Entries: 28]



### Independence Day

On the occasion of the 74th Independence Day, we conducted Essay writing, Slogan writing, and Drawing/Poster making.

**Topics:** '74th Independence Day' and 'Take on banning China products'.

**Best Entries** [No.of Entries: 72]



## Ganesh Chaturthi

On the occasion of **Ganesh Chaturthi**, we conducted Essay writing, Video making, and Drawing/Poster making.

**Essay Writing:** We asked volunteers to submit an essay on the topics 'How they celebrate' and 'Importance of Eco-friendly idols'.

**Video Making:** We asked volunteers to submit a video of them making an idol from eco-friendly materials.

**Drawing/Poster Making:** We asked volunteers to submit a poster or drawing with the theme 'Ganesh Chaturthi'.

**Best Entries:** (No. of Entries: 75)



## Teacher's Day

On the occasion of **Teacher's Day**, we conducted Essay writing, Video making, Drawing/Poster, and open note of thanks.

**Essay Writing:** We asked volunteers to submit an essay on the topics 'About Teacher's Day' and 'About their favourite teacher'.

**Video Making:** We asked volunteers to submit a video of them talking about their favourite teacher.

**Drawing/Poster Making:** We asked volunteers to submit a poster or drawing with the theme 'Teacher's Day'.

**Open Note:** Volunteers have to thank their teachers.



### Best Entries [No.of Entries: 81]



### Staying Safe Online & Offline

This event is conducted to bring awareness on Cybercrime & Security with the theme: Staying safe online & offline. We conducted Poster making, Dialogue writing, and Case study.

**Poster Making:** We asked volunteers to submit a poster with the theme 'Watch out for cyber crooks!'

**Dialogue Writing:** We asked volunteers to submit a dialogue writing with 8-14 exchanges drawing a conclusion on the themes 'A colleague who wants to make money through cyber looting' and 'Educating the family about the threat of cyber attacks.'

**Case Study:** We asked volunteers to submit a case study on 'Experience of a victim of cyberbullying they know'.

### Best Entries [No.of Entries: 22]





## Gandhi Jayanthi

On the occasion of **Gandhi Jayanthi**, we conducted Essay writing, Video making, Poster/ Drawing making, Slogan writing, and Open note thanks.

**Essay Writing:** We asked volunteers to write an essay on the topic 'How peace can change the world'.

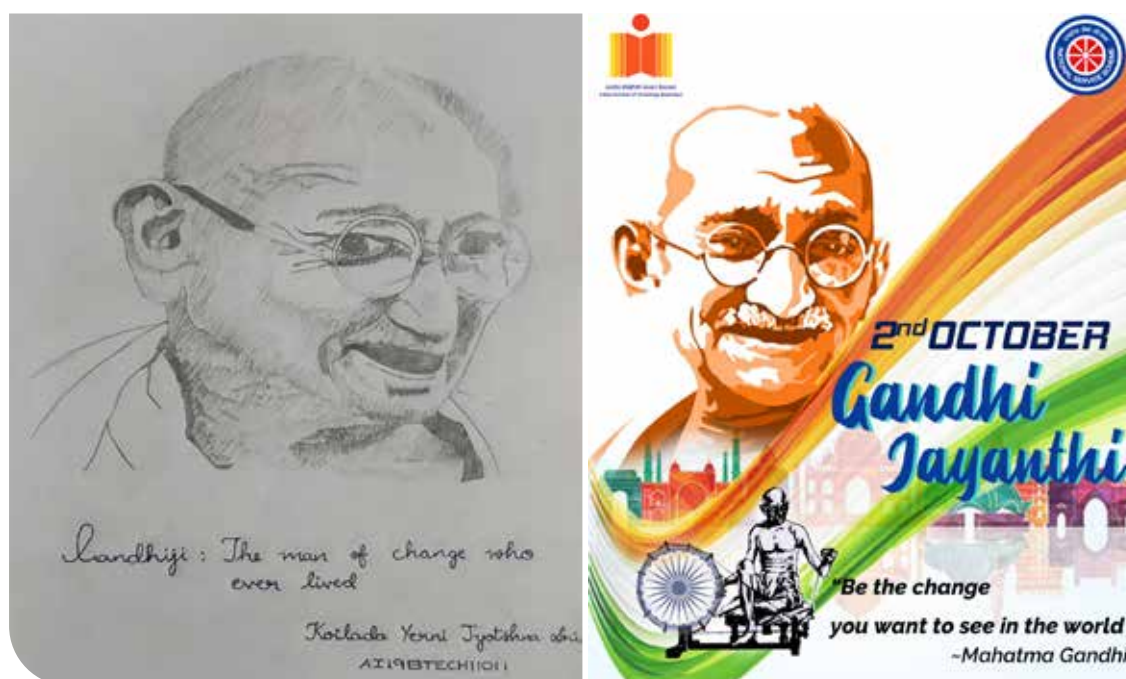
**Video Making:** We asked the volunteers to make a video of 'Planting a plant of their choice'.

**Poster Making/Drawing:** We asked volunteers to submit a poster/ drawing on the topic 'Gandhiji: The man of change whoever lived'.

**Slogan Writing:** We asked volunteers to submit a slogan on the topic 'The virtue of Non-violence'.

**Open Note:** We asked volunteers to submit an open thanks letter (digital or handwritten) on the theme 'Qualities of Bapuji which made them a better citizen'.

**Best Entries** (No.of Entries: 63)



## Bridge the Gap

This event is all about giving back and reciprocating the love shown toward us by our loved ones.

**Blog:** Students were asked to describe a fond and nostalgic memory of a time they spent with their near and dear ones (grandparents or parents) and attach a picture for the same.

**Vlog:** Students were asked to make a vlog of them spending some quality time with their near and dear ones (grandparents or parents).

**No.of Entries: 8**

### Audiobooks Editions 2020-21

We asked the volunteers to record themselves while reading a story or a lesson out loud. We have collected those files and postcode them on our youtube channel. We have conducted them twice.

**Audiobooks - 1** was conducted in September and focused on short fables and moral stories from selected famous books that can develop the students in all aspects.

**Audiobooks - 2** was conducted in December since part 1 was successful and we have received 88 submissions from the volunteers. This focused on recital of moral stories as well as audio presentations of Vidyadaan PPTs for 6th and 7th classes. The best videos were uploaded on our youtube channel upon editing.

**Best entries** (No.of Entries: 57)

► <https://youtu.be/S0hCm2r4bdU> ► <https://youtu.be/Fib0TXX9rMQ>

### E-Vidyadaan series 2020-21: Our voice, for a cause:

We have given PPTs that are already available on the e-Vidyadaan portal in the NSS website, for the volunteers to present and record. While recording the audio, the volunteers were asked to record the screen as well. And explain the slides from 6th to 10th classes [chapters from math, science & social studies]. The best PPTs were uploaded on our youtube channel upon editing.

**Best entries** (No.of Entries: 154)

► <https://youtu.be/7nTwtw17YmY> ► <https://youtu.be/UrVkc5CpzRE>

### Evolve

This initiative aimed to throw light upon a few prevailing issues and deliver the best practical ideas/approaches to spread awareness and make people act accordingly. One topic was assigned to each of the selected volunteers. And the selected volunteers have made a recording of their presentation. The topics were arranged to allow the volunteers to think, respond, and evolve positively on health and hygiene, mental health, women harassment, educational systems, career aspirations, sports & fitness, etc. This was conducted in February and received 54 responses.

**Best entries** (No.of Entries: 54)



### Vigilant India, Prosperous India

On the occasion of Vigilance Awareness Week [2020], we conducted pledges, poster making, comic making, and infographic designing.

**Pledge:** We asked the volunteers to record a video of them doing the 'Integrity Pledge for Citizens'.

**Poster Making:** We asked volunteers to submit a poster with the theme 'Vigilant India, Prosperous India'.

**Comic making:** We asked volunteers to submit a digital comic with 3-6 frames on the topic 'Vigilance leads to prosperity'.



**Infographic designing:** We asked volunteers to submit an infographic with 90-120 words per page on the topic 'Ill impacts of corruption and necessary steps to be taken for a corruption-free India'.

**Best entries** (No.of Entries: 24)

### Milad Un Nabi

On the Occasion of **Milad Un Nabi** we conducted an essay writing event. **Essay Writing:** We asked the students to write an essay on the relevance of the festival, traditions associated with it, and any fond memories they have attached to the same.

**Best Entries** (Number Of Entries: 6)

### National Education Day

On the Occasion of **National Education Day**, we conducted the following events.

**Topics Of Essay:** Your perspective of the Indian education system, Child labor and their right to pursue Education, Stereotypes in the Educational system.

**Topics Of Audio Recording:** About real-life heroes who fought to reform the Educational system, How does Education play a role in one's life?

**Topics Of Presentation:** Your idea of new Education laws with special regard to government schools and their improvisation with technology and at a low cost.

**Topics Of Poster Making:** National Education Day, Child labour and their right to pursue Education.

### Best Entries [Number Of Entries: 53]

- **Essay:** Stereotypes in the Education System - AAHAN JAIN
- **Posters**



### Constitution Day

On the Occasion of **Constitution Day**, we conducted many events and they are as follows: Essay Writing, Audio Recording Of Preamble, Presentation, Poster making.

**Topics Of Essay:** The constitutional values and the fundamental principles of the constitution.

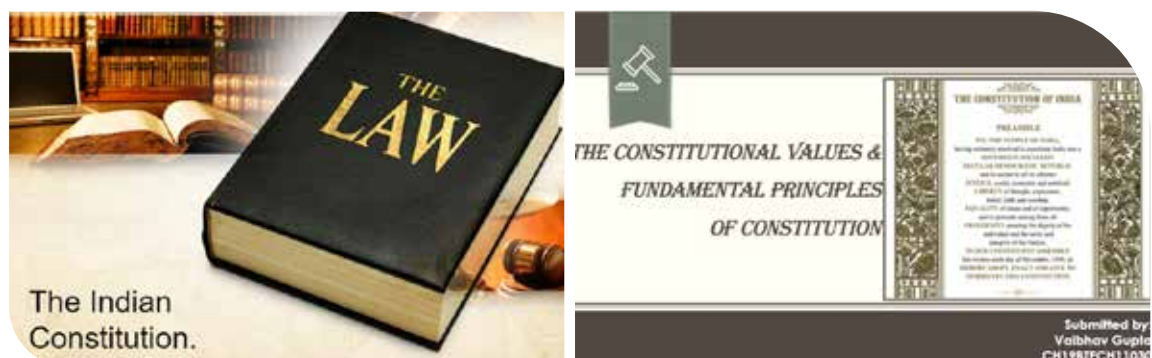
**Topics Of Audio Recording:** Read the Preamble.

**Topics Of Presentation:** The constitutional values and fundamental principles of the constitution.

**Topics Of Poster Making:** The constitutional values and the fundamental principles of the constitution, Constitution Day.

### Best Entries [Number Of Entries: 119]

#### Presentations





#### Audio Recordings

- ▶ Sharanya Gupta Shathavelli
- ▶ Tarun Ram Menta

#### Poster Making



### Guru Nanak Jayanti

On the Occasion of **Guru Nanak Jayanti**, we conducted an **Essay Writing** event.

**Topics Of Essay:** Write an essay on the relevance of the festival, traditions associated with it, and any fond memories you have attached to the same.

**Best Entries** (Number Of Entries: 14)



**G**urupurab or Guru Nanak Jayanti praises the birth commemoration of Guru Nanak Dev, the first among ten Sikh gurus. He is also the founder of the Sikh religion. The celebration is of unique importance to the Sikh people group and is one of the most excitedly anticipated events of the year. The year 2020 imprints the 551st birth commemoration of Guru Nanak Dev. Gurudwaras over the world are decked up with lights to praise the celebration, as individuals trade welcome and accumulate to ask together and show their worship to Guru Nanak Dev. Guru Nanak Jayanti is celebrated on, 30th November, 2020. Guru Nanak Dev was born on 1469 in Nankana Sahib. He was the author of Sikhism, which is the reason his introduction to the world was viewed as downright a celestial wonder. His introduction to the world commemoration concurs with Kartik Purnima according to the Hindu schedule. Guru Nanak Jayanti is a memorable day and return to the lessons of the Guru. One of the essential standards was the faith in one God, otherwise called 'Ek Onkar' and accommodation to the desire of God, or 'Waheguru'. The nitty gritty lessons can be found in the blessed book of Sikhism, Guru Granth Sahib.

Guru Nanak Jayanti is a memorable day and return to the lessons of the Guru. One of the essential standards was the faith in one God, otherwise called 'Ek Onkar' and accommodation to the desire of God, or 'Waheguru'. The nitty gritty lessons can be found in the blessed book of Sikhism, Guru Granth Sahib. On Guru Nanak Jayanti day, it is standard to have the community lunch or 'Langar' served in Gurudwaras. The food that is cooked is totally veggie lover and uniquely set up in the common kitchen by volunteers - a sign of the Sikh way of thinking of serving others sacrificially. The satisfying food that is served in Langar normally incorporates Roti, Rice, Dal, vegetables alongside Chaach or Lassi. The sweet and consoling Kada Prasada made with coarse wheat, sugar and ghee is additionally a necessary piece of the Langar passage.



As far as I can recall from my memories the holy occasion of Guru Nanak Jayanti incorporates the three-day Akhand Path, during which the Guru Granth Sahib, the sacred book of the Sikhs is perused out from the earliest starting point as far as possible without a break. Upon the arrival of the headliner, the Granth Sahib is ornamented with blossoms, and carried on a buoy in a legitimate parade all through a town or village. The parade is going by five equipped watchmen, delegates of the 'Panj Pyaras,' who convey the Nishan Sahibs or the Sikh banner encapsulating their confidence. Strict songs from the Granth Sahib are sung all through the parade, denoting an uncommon element of the occasion. The parade at long last prompts a Gurudwara, where the assembled aficionados get together for a network lunch, which is called Langar.

**Bhukya Nandini (CH18BTECH11006)**

## “How we do it”

Omkar Labhshetwar  
CE17BTECH11027

# Guru Nanak Jayanti

Guru Nanak Dev was a great reformer and one of the prominent leaders of the 'Bhakti' movement that spread across the country during 15<sup>th</sup>-16<sup>th</sup> century. This year we will be celebrating his 551<sup>st</sup> birth anniversary. This event is also known commonly as *Guru Nanak Gurpurab*. Guru Nanak Dev was born at the time when the conflicts between Hindus and Muslims were at peak regarding the faith in their religions. Nanak was distressed at this conflict so he preached oneness of God for both Hindus and Muslims. His teachings were "God is One, whether he be 'Allah or Rama'". By fusing the fundamentals and established preachings of Hinduism and Islam, Guru Nanak Dev ji found a new religion, which came to be known as Sikhism. All his teachings are collected in the "Guru Granth Sahib", the sacred book of Sikhs. Because of all his work we commemorate him on his birth anniversary and that's why it is the most important festival of Sikhs.

Even through the works he wrote he spreads the message of selfless service to humanity, prosperity and social justice for all people irrespective of any difference.

He taught people the lessons of communal harmony and goodwill to others. The traditions associated with this festival are reverent for these people. Generally, they start the preparations two or three days prior. The Gurudwara is cleaned and decorated by every individual and not just by the people working there. No one feels ashamed of doing common work there. Then a 48-hour non-stop recitation of the 'Guru Granth Sahib' called 'Akhand Path' is held. A day before Guru Nanak Dev ji's birth anniversary a procession led by five people also known as the Panj Pyare, who hold the Sikh flag, Nishan Sahib. The holy Guru Granth Sahib is placed in a palanquin ("Palkhi" in common terms) during the procession. Everyone sings hymns and verses of the Guru Granth Sahib and plays traditional instruments and displays their martial arts skills, for which they are worldly renowned. This procession passes through nearby streets decorated with flags and flowers. I got to spend this festival with my friends. Being a resident of Nanded which is considered as the second most holy place by Sikhs after Amritsar as the last Guru of the ten Gurus, Guru Gobind Singhji resided here, lots of people come from different parts of the country to visit the Gurudwara residing here. I saw different stalls selling holy turban, the daggers, swords, and 'kara', which was instituted by tenth Sikh Guru Gobind Singh ji at the Baisakhi Amrit Sanchar in 1699. I purchased one for myself and visited the enormous gathering there. I enjoyed the procession and the feast there with my friends and we also saw the martial arts visualization by some of the Sikh brothers, which was very fascinating. So overall I got to know much about this festival by spending a day with my friends.

## Drug Abuse- Awareness & Prevention

On the Occasion of Drug Abuse - Awareness & Prevention we conducted the following events:

**Topics Of Essay:** How do drug abuse and illicit trafficking affect Indian society? What preventive measures are to be taken? What would you do if your friend/ neighbour is addicted to excessive usage of drugs? How will you educate them to bring a change? Vision for a Drug-free India – challenges and possibilities.

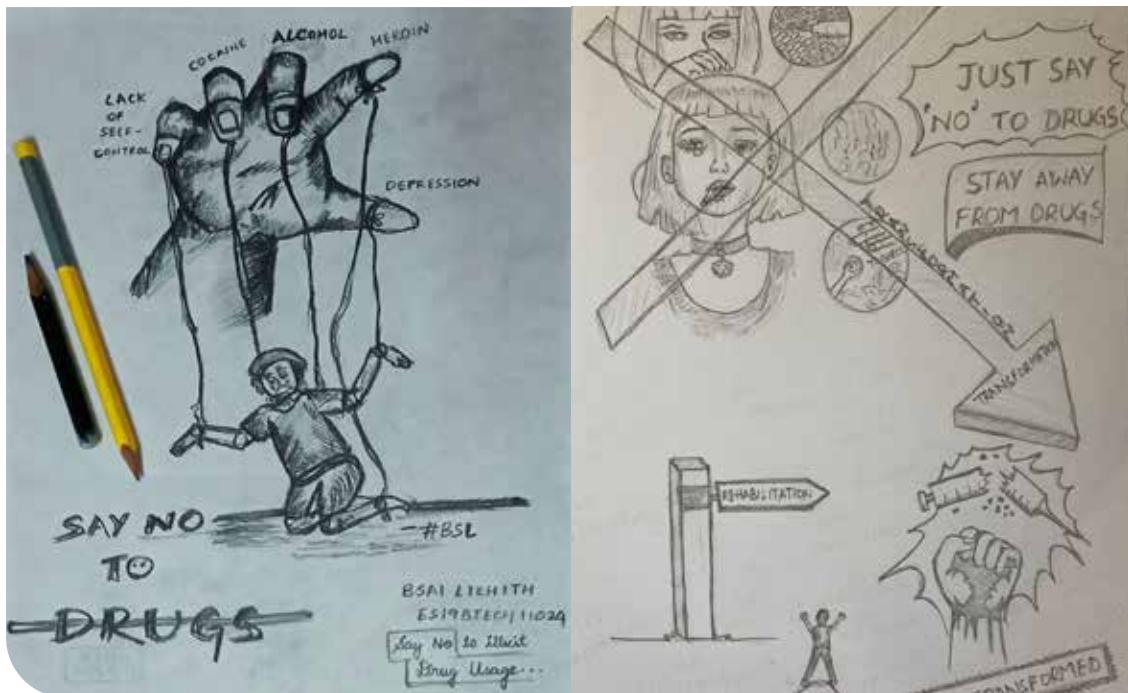
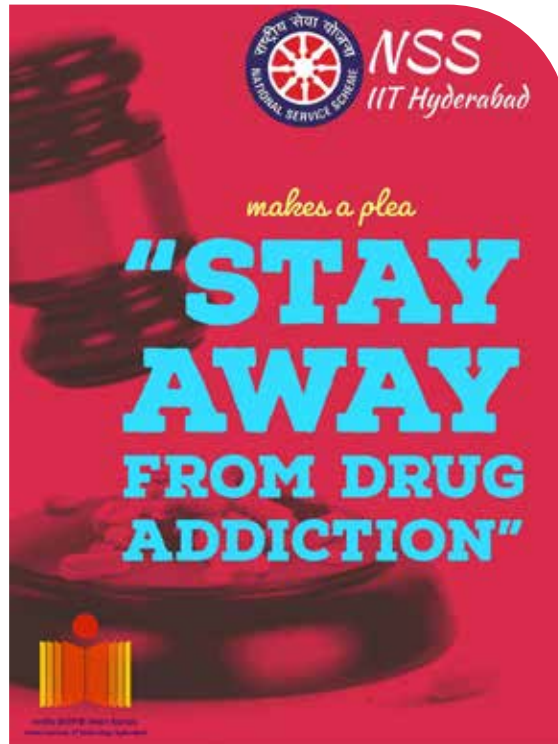
**Topics Of Poster Making:** Drug addiction: Risks and its impact on health, Say no to illicit drug usage

**Topics Of Slogan Writing:** Drug addiction: Risks and its impact on health, Say no to illicit drug usage.

**Best Entries** (Number Of Entries: 62)

**Essays Writing:** ES19BTECH11007-  
ESSAY-1 - SRAVANTHI REDDY M.pdf

**Slogans Writing:** 20200903\_183338 - MADDILA RAHUL.jpg



### Survey on Prevalent Societal Stereotypes and Prejudices

We, the NSS team conducted a survey to gauge the extent of the stereotype and misinformation present in society.

### National Youth Day

On the Occasion of **National Youth Day**, we conducted many events and they are as follows :  
**Video making, Infographic, Letter writing, Poem, Case study.**

**Topics Of Video Making:** The problems that youth are facing, Changes you want to see in present society.

**Topics Of Infographics:** Moment that led to marking youth day as important.

**Topics Of Letter Writing:** Write a letter to the president stating what changes you want for India to be a better place for youth.

**Topics Of Poem:** Youth

**Topics Of Case Study:** If you know a person who has been unemployed, make a case study about what he could have done for getting employment and what you learned from him.

**Best Entries** (Entries: 67)

#### Video Making



## Letter Writing

*Respected Sir,*

Factors like a young and quickly growing work age population increasing education and engineering ability levels that enhance growth of the producing sector and a growing social class that provides sustained growth of the buyer market, are unit factors that have propelled Asian nation towards the standing of the world's sixth-largest economy. Despite this, Asian nation ranks one hundred thirty out of 189 countries within the latest human development. Trends 2018 report, India's per centum is three.5 percent. Asian nation is second most inhabited country within the world. Nearly a fifth of the world's population live here currently. Asian nation is additionally projected to be the world's most thickly settled country. over fifty % of the country's population is below the age of twenty five, and over sixty five % area unit aged below thirty five.

The contradiction so, stares United States within the face. Given its young population and aggressive economy Asian nation is at some extent in history wherever it's a large prospect of garnering world respect. However, we tend to area unit all mute witnesses to the agitated transport of currency across the country throughout the past months. I would wish to see Asian nation proportion its academic infrastructure, that specialize in 2 key aspects – consistency in quality education, and on developing ability sets relevant to the fashionable work.

India has few quality establishments to soak up the quantity of scholars passing out of college. there's an enormous visit the tutorial expertise of scholars WHO area unit unable to urge admissions to the few prime establishments. Public faculties and faculties got to be given higher teaching employees, infrastructure and choices to students on subjects they want to review. kids got to be schooled to be told over what's within the textbooks, and nobody ought to be discriminated against, supported their caste or faith. Equal priority must be to cultural activities in conjunction with studies.

Opportunities got to be hiked, to try to to away with state and financial condition. to boost the standard of life in villages so they will get on par with urban areas, basic amenities like water, individual bathrooms, rural roads, animal shelters, ability development centres etc ought to be created obtainable.

Integrity, honesty, refined culture and kindness form up our national character. Asian nation is thought for unity in diversity, however in recent times this has been disturbed. we must always reinvent our valuable values in addition as our unity. we'd like to infuse qualities of kindness and generosity among individuals, enhance their money standing and conjointly originate rules for individuals beneath the poverty level to fulfill their daily wants. we'd like to make a society that's freed from crime. Let's select showing wisdom and not

solely build the amendment, however be the amendment. The amendment I would like to check forthwith is that the education system be additionally organized and have high moral standards. Academic establishments became money-minting organisations. Right from admission to books, uniforms to TC, we'd like to manage corrupt agencies. The foremost priority for Asian nation is to develop AN economical human resource pool, and for this, a serious overhaul within the education system is imperative. Right from the first stages of college education, students are unit compelled to settle on bound streams and are unit exposed to solely the themes that are unit thought-about to assist them enter specific careers like engineering, drugs and finance. Hence, they miss out on learning alternative subjects which will expand their information.

Many schools in Asian nation don't prepare teens to be in person, professionally and socially adjusted persons. There's AN excessive stress on regurgitating archaic content that gives very little scope for college students to make, explore and take possession of their learning processes – capabilities that are unit predominate for a productive life in a very world landscape. The impact of media and thus social media is so vast that they need to be regulated. Infrastructure must improve. The human must respect belongings. Cleanliness ought to begin from every individual. School system ought to be concerning transfer of data instead of simply course of study, exams and marks.

Second, I believe there ought to be higher schemes for our individuals. For instance, in countries like Singapore, the govt. pays some quantity to the individuals to remain healthy. We need our government to safeguard natural resources. Animal abuse and neglect could be a growing downside across the state. I'd like our government to strengthen laws against animal cruelty.

When you check up on politics, the globe is currently additionally divided than united. If you check up on the economy, there are unit clear gaps between the made and therefore the poor. Once you check up on ideology, faiths and beliefs are unit being manipulated. There are unit invariably 2 extremes. I'd attempt onerous to push moderation inside the country.

If youth thinking changes the country automatically changes. Please consider these.

***Your's obediently,***

Your Beloved Citizen.

(By Dalli Leela Sai Lokesh Reddy)



Date: 09-01-2021

To

The President of India,  
Rashtrapati Bhavan,  
Delhi (PIN: 110004)

***Respected President,***

Subject: Changes for India to be a better place for youth

I am suggesting some changes that can be made in our country to make our country a better place for the youth of our nation. Our country is having a very high percentage of youth compared to many other nations and also today's youth will affect our country in many ways in the next upcoming years. So it is sensible to make appropriate changes so that the youth of our nation can live in a better nation.

Youth of our country should be educated well from the early stage of their lives itself so that they can learn and apply their knowledge in a better way. This can be made sure by giving some weightage for grading to attendance and helping teachers to adapt to new ways of teaching which are more productive and helpful for students while learning. Since educating the youth is a very important aspect, we have to give higher importance to this aspect compared to other aspects.

Education provided to them can be upgraded by using technology like installing projectors in government schools so that they can understand the concepts better. They should also be taught about presenting their work in their classrooms or assembly in order to improve their presentation skills and communication skills. Grading students based on how well they have understood and how can they apply their knowledge innovatively along with the descriptive exams.

Physical education is also important for the youth to be healthy and fit, so sufficient time should be allotted to this in their schools. Playing sports also helps them to relax by reducing their stress. We can increase the number of people who are interested in entrepreneurship by giving proper guidance to them and helping them by funding them with the help of banks. This will increase the employment opportunities for the youth.

Youth of our nation should be taught about the different career options they have from an age of 15 or 16 helps them to know about the possibilities better and choose a suitable path for them since this will affect their lives heavily. If a person does something with interest

and gets happiness by working in a particular field, then one should go in that path rather than a path which gives them sufficient money. We should make the youth aware about the bad effects caused by smoking, drinking etc.

Many young people in our country who are making their lives miserable by getting addicted to bad habits. This can be reduced by providing them proper awareness from a young age with the help of their parents. Controlling the population of our country is also important since it will gradually lead to shortage of food and land to live which eventually lead to deforestation. Educated and sensible youth entering politics also helps our nation in a very good way. This can be taken care of by making politics also a career option for them.

Young people of our nation should also be educated about gender equality and given proper education about living in a civilized and democratic nation. We are hearing a lot about the human exploitations these days which should be nullified and is only possible if people take safety measures and by educating the youth about this. Social education is also an important aspect to build a better nation for youth. This will help in building a better civilized and secure country.

Thank you very much and my warm regards to you.


***Yours sincerely,***

xxxxxxx

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[By Kalepalli N V S D M Ananyan]

## Poems

|   |   |
|---|---|
|  <p><b>POEM FOR YOUTH</b></p> <p>OH YOUTH!!</p> <p>Do what is right for society.<br/>Not what looks bright for you</p> <p>Why are you flying away to somewhere?<br/>When you can build everything here.</p> <p>OH YOUTH!!</p> <p>Stop looking at senseless screens.<br/>Start looking at the life around you.</p> <p>Why are you shying away to question?<br/>When you feel injustice around you.</p> <p>OH YOUTH!!</p> <p>You are great as yourself<br/>Don't let anyone change that.</p> <p>Why are you depressed about your failures?<br/>When you can happily learn from them.</p> <p><b>LIVE LIFE TO FULLEST<br/>YOU CAN ONLY DO IT ONCE</b></p> <p>By Srijith Reddy Pakala</p> | <p><b>Poem : Youth</b></p> <p><i>Not too young but not too old<br/>Lot have changed but a lot to change<br/>Not too naive but not too skilled<br/>Lot have been learnt but a lot left to learn<br/>Not too strong but not too weak<br/>Lot has passed but a lot is left<br/>Not mature but not callow<br/>Lot of goals but lack of means<br/>Not so free but not occupied<br/>Highs to reach and hands to help<br/>Know your rights and do your chores<br/>Ups and downs, smiles and frowns</i></p> <p>V. S. V. Manideep<br/>ee17btech11046</p> |
|---|---|

## Case Study

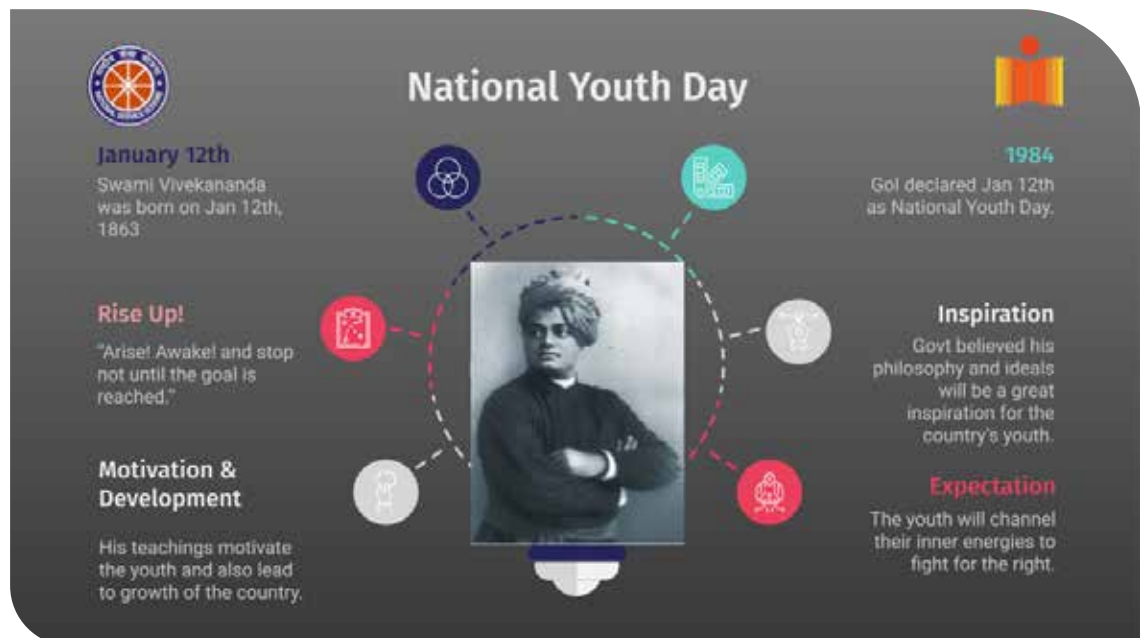
I have known a person for a very long time. He completed his degree 3 years ago and is unemployed. I saw him walking through a lot of interviews for the last 3 years and left with nothing but rejection. The very first thing that strikes me whenever I see his pain after every rejection is his reluctance in taking up things seriously during his studies time. He was a good student in his school days with good percentile and conduct. As soon as he entered the college, he started enjoying life a lot. Enjoying in his terms was bunking classes a lot, roaming around without any purpose, watching movies a lot and living in social media leaving the reality. His parents are very hardworking people and their financial status is just above poverty but not even middle class. As he started enjoying life, his studies started to be a burden to him. His quest for learning subject and new things in academics completely drained off. He stopped listening to classes and used to study a night before the exam with the means being just remembering concepts without actually understanding the subject the end for him was just a pass mark in all the subjects with no specific knowledge enough to work in any company. Other than leaving studies a part, he always used to have a deaf ear to his parents advices. He never tried to help his parents in any way possible. When he got relieved, he started entering the world of reality and started facing the competitive world around him. His vision now extended from his classroom walls to the world out. He started realizing the importance of everything he ignored previously but it was very late by then. I think he himself was responsible for his downfall and no one else was. He is not someone who was dumb in his studies as he once was a good student some

learnt that, our purpose of doing something should not be shadowed by some other activities in the name of enjoying life. I don't meant that, enjoyment should not be there at all, but it should has its own limits i.e. should not impact our work in any way. The way of defining our terms of enjoyment is also important in our life. It should be in a constructive way giving us the real pleasure but not some fake or unrealistic one for which we will regret later in our life. The second thing that I learnt from him is, always listen to our parents and elderly people. They are someone who crossed many obstacles in their lives and gained certain knowledge related to every phase of our life and above all they are our well-wishers. We can't be aware of the path we are going on and the ends to which it lead finally, but it is inbuilt for everyone to think that they are so sure about what they are doing. This illusion is present even more in youth. But it is the group of elders who actually know things better than us. So we should always try to listen to our parents and elders. We can also say that at times their advices too can fail but it is always advisable to listen to them to find out the pros & cons, odds in doing something. This helps us in taking a good path with good conduct in our life. I think it's better for him to take things seriously at least now and listen to his parents. He can take any professional courses he is interested in and work well to get some job.

**Chukka Sindhusa Kumari**

CH17BTECH11010

## Infographics



### Best from Waste

As we all know nothing in this world goes to waste, all we have to do is think of something so that we can reuse it. So the NSS team had organized an event in which we requested students to make a video of them preparing something productive from waste materials around them.

#### Best Entries (Entries: 11)



### Road Safety

On the Occasion of **Road Safety**, we organized an event to create awareness about how cautious we should be while we are driving, riding, or even walking. In the year 2018, our country reported nearly **1,51,000** deaths due to road accidents.

We conducted the following events: **Essay writing, Poster making, Case study, Infographic, Presentation**

**Topics Of Essay:** Measures need to be taken for minimizing drunk and drive cases, Ideas on improving road safety.

**Topics Of Poster Making:** Traffic rules and violation

**Topics Of Case Study:** If you or someone you know were involved in an accident, make a case study about how it happened and what precautions could you or they could have taken to prevent the accident or minimize the damage.

**Topics Of Infographics:** Stats of the road accidents that happened in your district or your city, these stats may include different aspects like “drunk and drive”, no safety precautions (no helmet or no seat belt), or due to fog.

**Topics Of Presentation:** Rules of the road, Traffic signages, Distracted driving

#### Best Entries (Entries: 91)

##### Essays

Minimizing Drunk and Drive Cases - Essay  
- CH18BTECH11031 - VAIBHAV KU...

Measures need to be taken to minimize  
drunk and drive cases - VISHNU NAGAR....

##### Presentations

CE18BTECH11036-PRESENTATION -  
Vedashree Chandewar.pptx

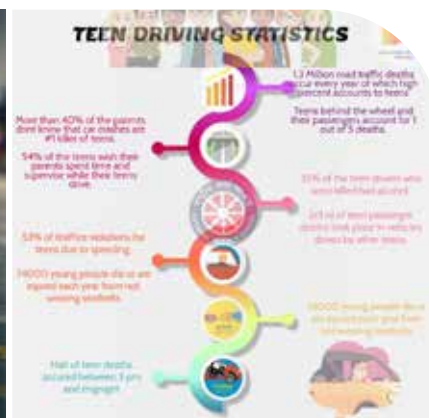
CS17BTECH11029-PPT - PUNEET  
MANGLA.pptx



## Posters



## Infographic



## Sri Guru Tegh Bahadur

Guru Tegh Bahadur, born in Amritsar, was the ninth of the ten Gurus who founded Sikhism. He was born on 1st April 1621. He's honored and remembered as the man who championed the rights for all religious freedom. He founded the city of Anandpur which later became a center of Sikhism.

The NSS team conducted an essay competition on the occasion of the 400th birth anniversary of Guru Teg Bahadur, about his life and legacies.

**Best Entries** [No. of entries: 85]

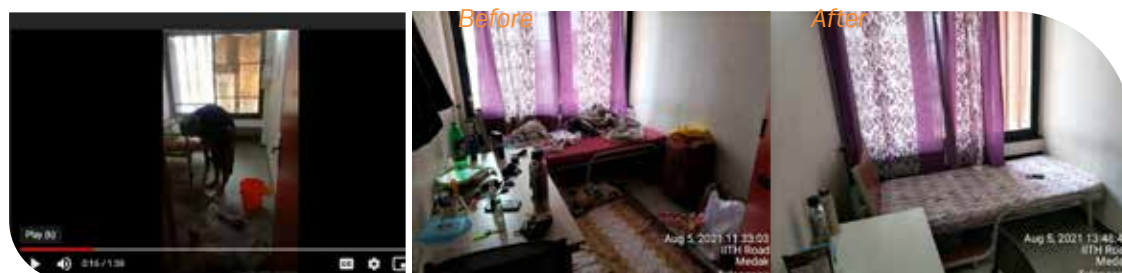
- ▶ [EP17BTECH11010\\_NSS\\_GuruTeghBahadur\\_Essay - Guru Sai Haveesh Singirikonda.pdf](#)
- ▶ [CS18BTECH11013\\_essay - Giduturi Vishal Siva Kumar.pdf](#)
- ▶ [CE19BTECH11001\\_ESSAY - Sarthak Konher.pdf](#)
- ▶ [CE20BTECH11046 nss-essay on Shri Guru Tegh Bahadur-Yarramasu Vishnu P](#)

## Tidy Room, Tidy Life

Organizing our stuff makes us stress-free and helps us to concentrate on what we want. Keeping our rooms clean from dust is so important for our health. This event was organized to make everyone realize how important it is to be hygienic and organized about our own stuff.

Volunteers needed to clean their rooms by themselves and make a video of it. Also, we asked them to click 2 pictures of the room before and after the cleaning.

**Best Entries** [No. of entries: 67]



Before



After



### Life, a Million Facets

This event was organized with the purpose of highlighting different aspects and phases of life. We asked volunteers to capture a perfect moment around them and express what they truly feel or what hits them hard while beholding it. Volunteers needed to click a scenario and describe it in a few words.

**Best Entries** (No. of entries: 47)

nss- life - DHANUSH PITTALA.bm20btech11004

NSS - LINGAMADINNE SAI SPURTHI REDDY.pdf

### Weed Removal Drive

As a part of our commitment to a cleaner, safer campus and in response to our director's announcement regarding the increasing parthenium weeds, we organized a Weed Removal Drive on 24 March 2021 on campus. It was the *1st offline event* in a year.

**Venue:** Hostel Circle

A total of **32 volunteers** were selected for this drive. Accessories like bags and gloves were provided by the NSS team and wearing a mask and maintaining a social distance was made sure. Hours were allotted to volunteers based on the number of bags.

### Gratitude Beyond Words

This event was aimed to let everyone show their gratitude to the real fighters (doctors, police, and army). The whole country was under lockdown, and we all were struggling to find a ray of hope amidst anxiety and uncertainties. Despite all the challenges and difficulties, our doctors, police, and the army have constantly been doing a lot for our country.

We conducted this event in which volunteers needed to write an open thanks letter to doctors, police, or the army.

**Best Entries** (No. of entries: 65)

Me20btech11009 - Avni Parakh.pdf

Cs19btech11010-Gratitude Beyond Words - Gantasala Naga Aneesh...

Gratitude Beyond Words - Samyak Joshi.docx

## Elimination of Single-Use Plastic

It is known to everyone that plastic is harmful to the environment because of its nonbiodegradability.

Plastic has the potential to cause significant harm to the environment in the form of air, water, and land pollution. The pollution because of plastic can not be neglected. So, the NSS team conducted an essay competition about how necessary it is to eliminate single-use of plastic.

**Topic:** Necessity to eliminate single-use of plastic.

**Best Entries** [No. of entries: 83]

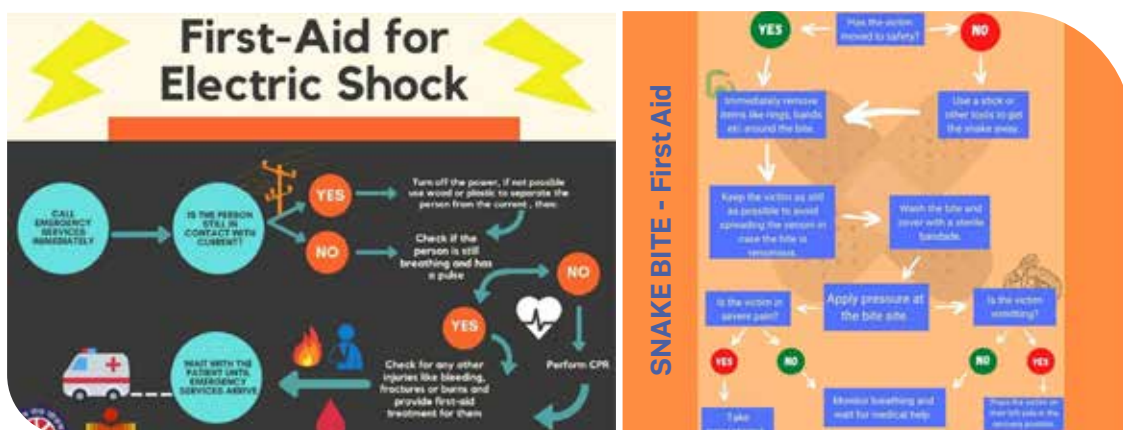
- ▶ NSS\_SingleUsePlastic\_es17btech11001 - ALEKHYA MADANU.pdf
- ▶ CE18BTECH11036-ESSAY-Single Use Plastic - VEDASHREE CHANDEWAR.pdf
- ▶ EE18BTECH11017\_ESSAY - GUGULOTHU YASHWANTH NAIK.pdf

## Act Wise, Save Life

Every year, many people who encounter an accident, severe injury, or suffer from an illness lose their lives by the time they reach a hospital. We are trying to help such victims by providing them with proper first aid and minimize the future seriousness of the injury or illness. We all need to have a good awareness of how to do first aid treatment.

We organized this event, in which the volunteers were asked to select a cause of injury or accident of their choice or they are willing to do first aid treatment. They needed to prepare a flowchart of the steps involved in the first aid treatment referring to proper knowledge from any doctor or trusted online sources.

**Best entries** [No. of entries: 120]



**The report made by:**

- ▶ Chandana J, Student Representative I- 2021-22
- ▶ G Lakshmi Lohitha, Student Representative II- 2021-22
- ▶ A Dharanee Kumar, Student Representative III - 2021-22
- ▶ Reviewed by: Sai Varshitta Ponnamm, General Secretary, NSS - 2021-22
- ▶ Reethu Vinta, General Secretary, NSS - 2020-21
- ▶ Anurag Reddy, Student Representative I - 2020-21

# EML Series

**Event Date:** August 20, 2020.

**EML Speaker:** PULLELA GOPICHAND [Chief National Coach of India National Badminton Team].

**Event Type:** e-talk.

**The Man behind Indian Badminton Pullela Gopichand**  
Chief National Coach of the Indian Badminton Team

Also known as, **The Champ-Maker**  
Coach of **Saina Nehwal & P.V. Sindhu**

2014, Padma Bhushan  
2009, Dronacharya Award  
2005, Padma Shri  
2001, Rajiv Gandhi Khel Ratna  
1999, Arjuna Award

**26<sup>th</sup>**  
August, 2020  
6pm - 7 pm

Details to join the event will be shared on your mail.

Director IIT Hyderabad

pullela gopichand Badminton Foundation

B

IIT HYDERABAD

BAPATU MANOHAR

Dean Students

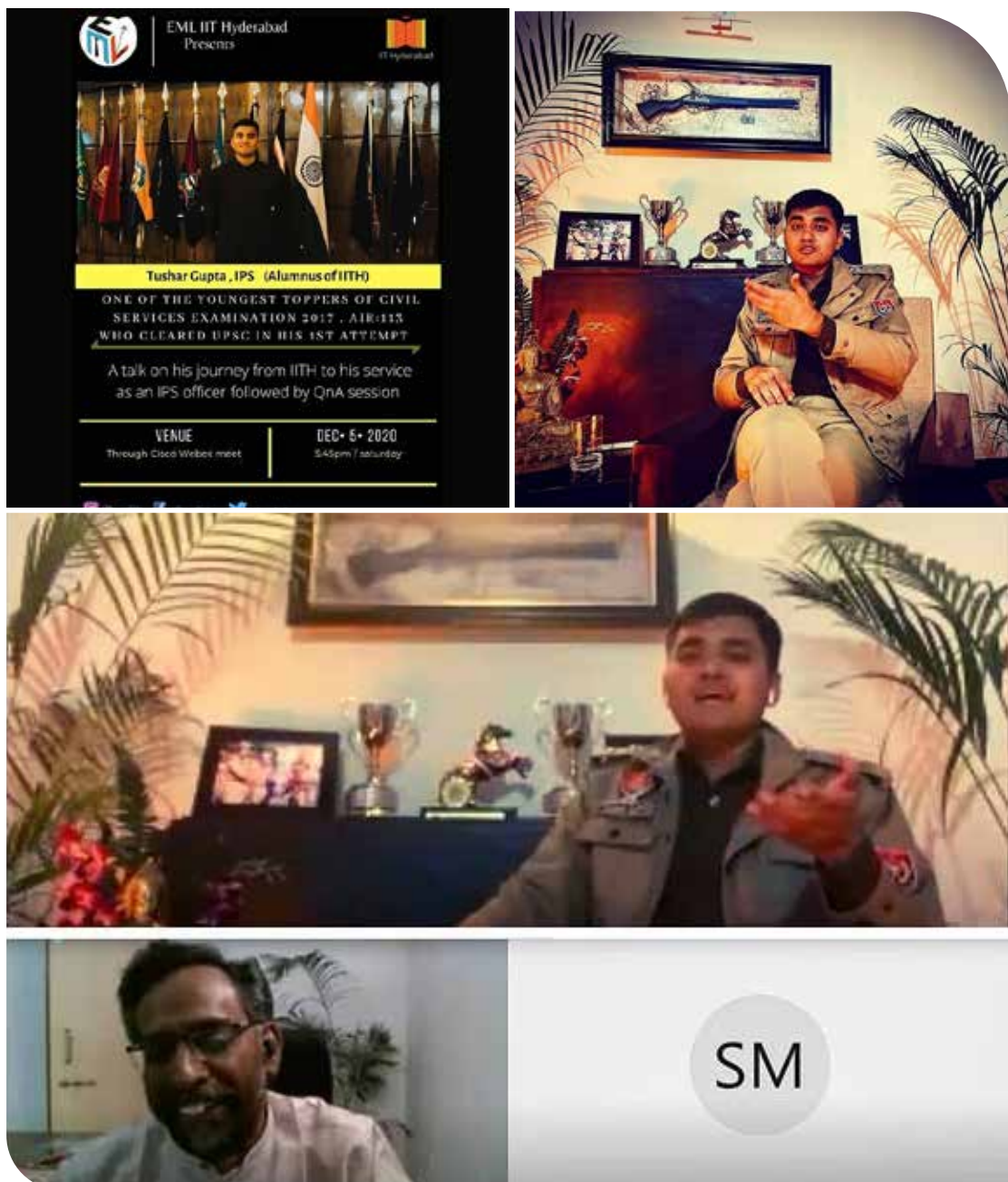


**Event Date:** December 5, 2020.

**EML Speaker:** MR. TUSHAR GUPTA (IPS)

**Event Type:** e-talk. ( A talk on his journey from IIT Hyderabad to his service as an IPS officer followed by a Q&A session

**EML Talk Link:** <https://youtu.be/hv9ltQUsA94>



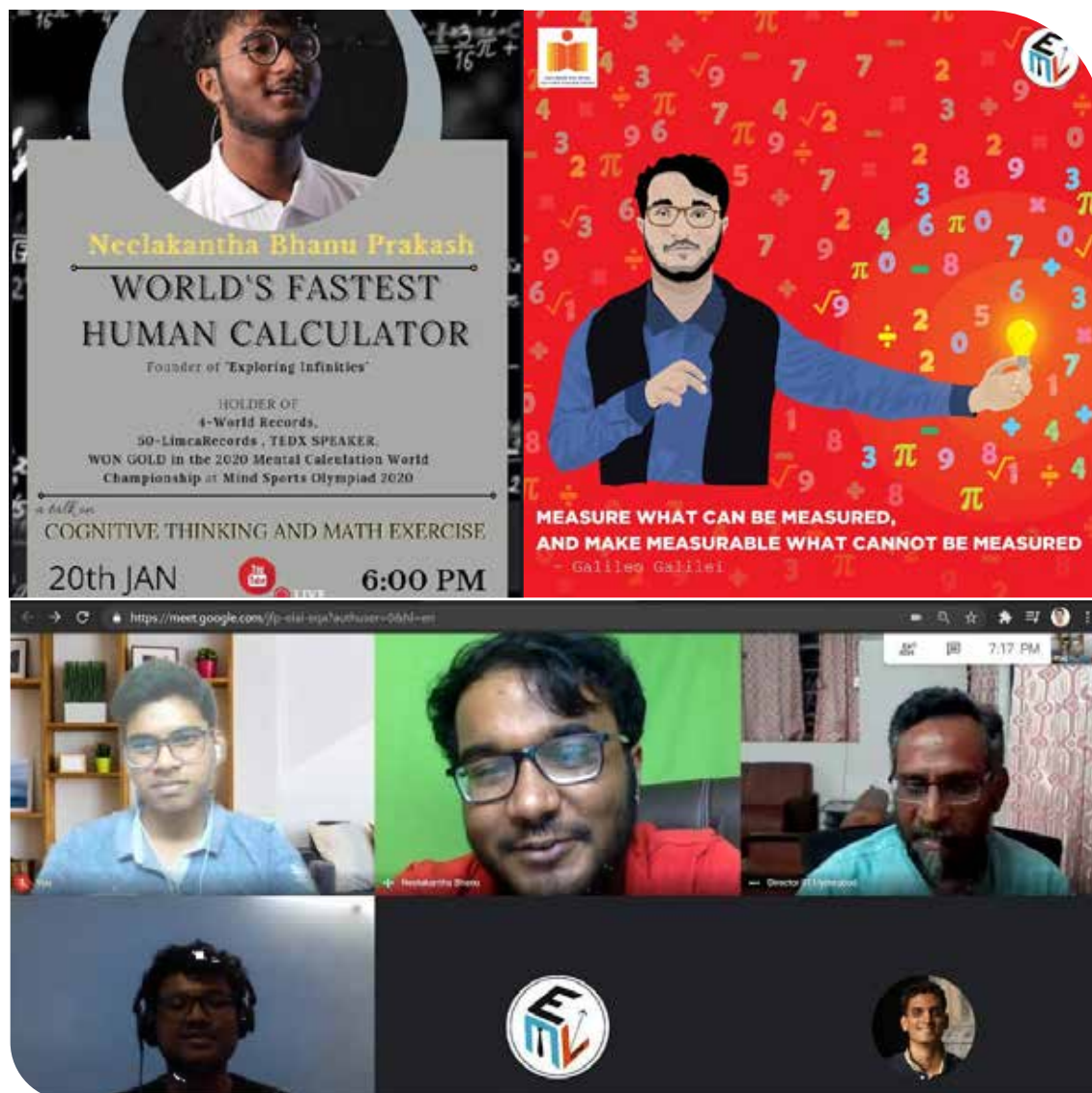


**Event Date:** January 20, 2021.

**EML Speaker:** MR. NEELAKANTHA BHANU PRAKASH - World's Fastest Human Calculator

**Event Type:** e-talk. [A talk on Cognitive thinking and math exercise followed by a Q&A session]

**EML Talk Link:** <https://youtu.be/FBTns-EeUMo>

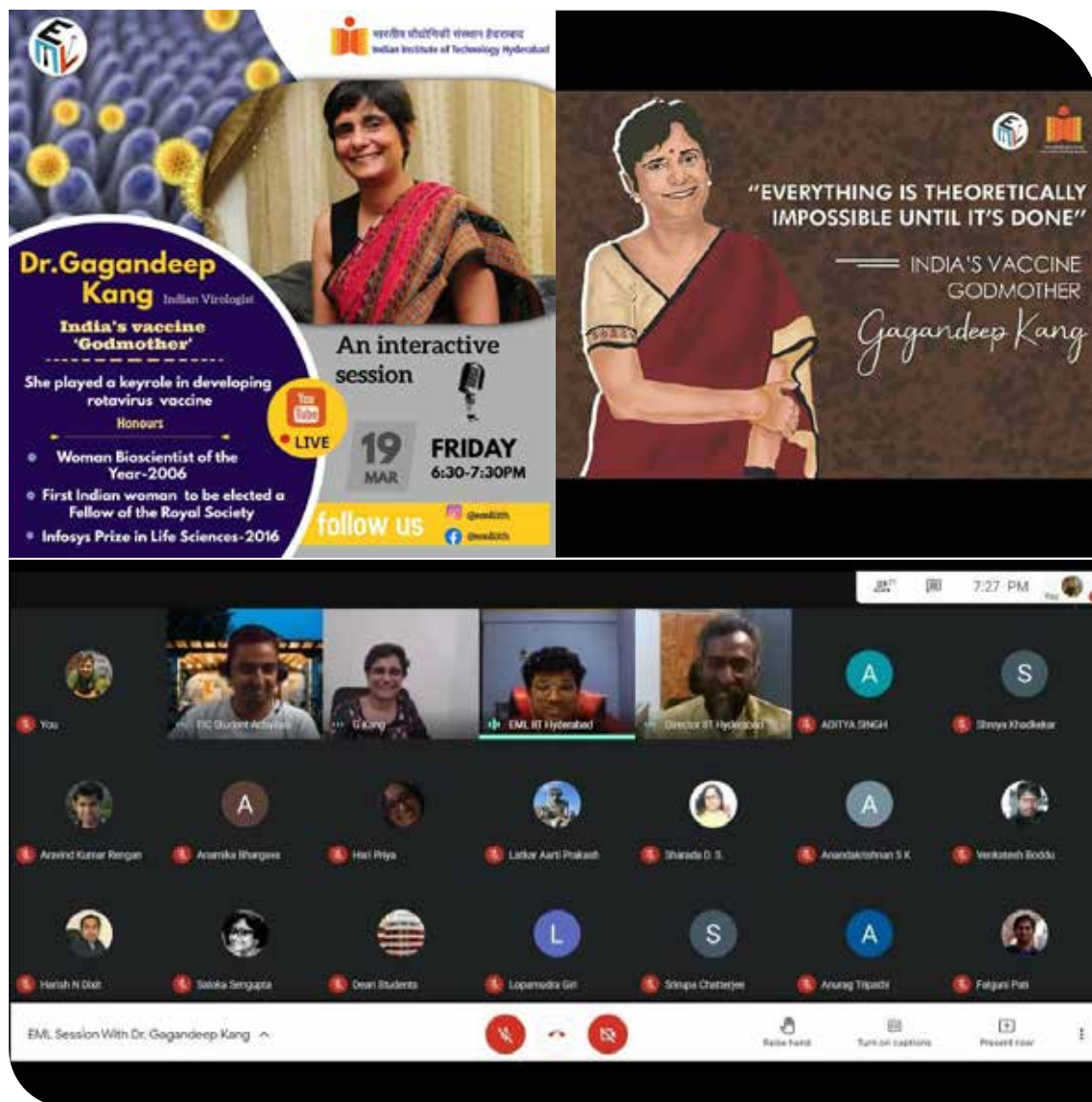


**Event Date:** March 19, 2021.

**EML Speaker:** DR. GAGANDEEP KANG - India's Vaccine Godmother

**Event Type:** An interactive session with Gangadeep ma'am

**EML Talk Link:** <https://youtu.be/YWVAgQP368>



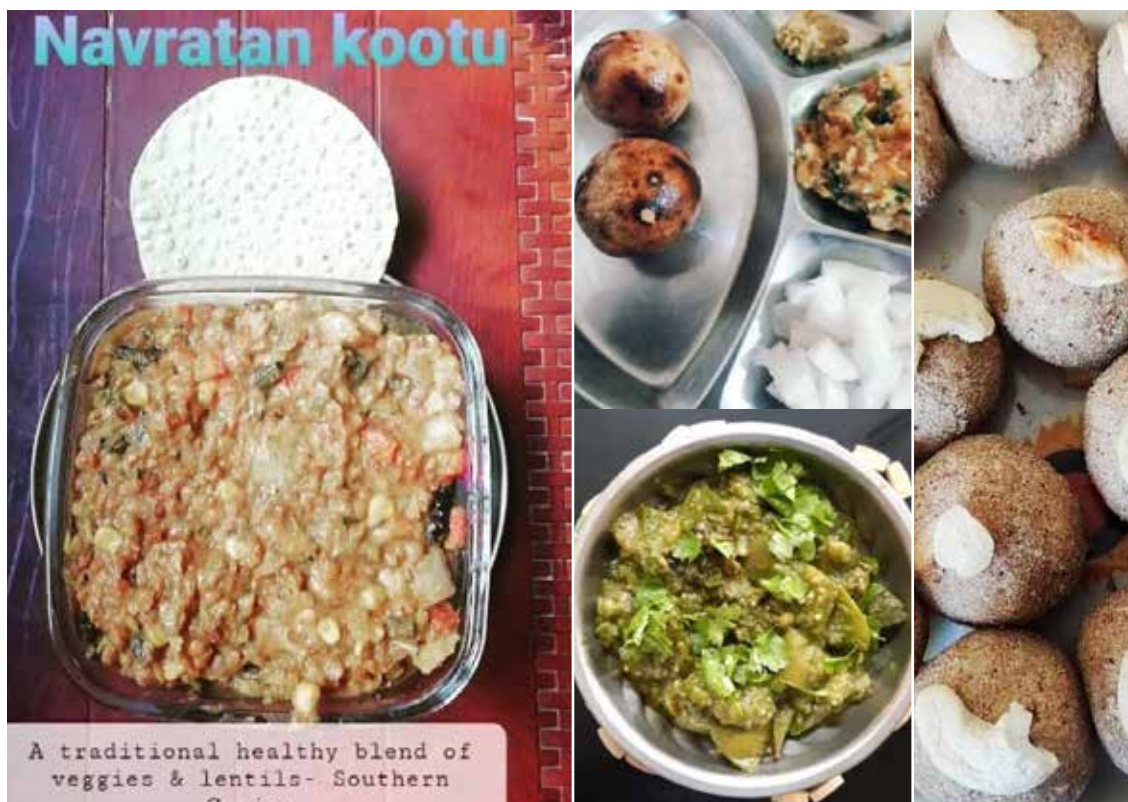
# EBSB Activities

## Culinary & Traditional Food Challenge



Traditional foods are nutrient-rich and have a long history of supporting health and wellness. Indeed, these foods have been consumed for thousands of years. Traditional foods played a major role in the traditions of different cultures and regions for thousands of years. Preparation methods of traditional foods are part of the folklore of a country or a region. To reduce your stress during these busy times, the EBSB club of IITH came up with a fun cooking challenge for the IITH community to participate in.

Below are some of the best entries received:





## Change Starts With You



The EBSB club organized an awareness campaign '**Change starts with you**' as our new year resolution for the year 2021. Students, staff, and the faculty members of the IITH community were asked to post a picture or video adhering to social distancing and safety measures during the pandemic like wearing a mask, using sanitizer, etc.

They were encouraged to post these on social media to spread awareness and propagate healthy practices among everyone.

The following are some of the entries that we have received.



# EBSB Day 2021

The EBSB Club of IITH organized EBSB Day on Jan 14, 2021, online. The members of the club took valuable feedback and reviewed the previously conducted events, such as celebrations and expressions, remembering our roots, creative crackers, the spirit of unity, traditional cooking challenge, change starts with you.

## Winners of Traditional Cooking Challenge



1st - LOPAMUDRA NAYAK  
(PH18RESCH11008)



2nd - SUSHREE IPSITA  
(PH19RESCH02005)



3rd - AJAYA KUMAR .S  
(Admin IITH)

## Winners of Celebrations And Expressions

1st - Abhishek Thakur

2nd - Anish (CH18BTECH11021)

3rd - Akshar



## Winner of creative crackers

GAUTHAM BELLAMKONDA  
(CS20BTECH11017)



## EBSB ORIENTATION - 2020

On 19 November 2020, EBSB club IITH organized an orientation program for the newly admitted freshers' batch of '24. The EBSB club members explained that EBSB is a program for promoting national integration through systematic exchange between paired institutes in the cultural, literary, and linguistic fields. With EBSB, we intend to learn the linguistic and cultural aspects of the home state of our paired institute, covering history, culture, language, cuisine, festivals, clothing, etc.

Some examples of the previously conducted events like Lohri Celebration, bonfire, Traditional Day, Sankranti Celebration, Holi Celebration, and other online events were explained along with the pictures of those events.



## Lohri Celebration

- ❑ Lohri is a Punjabi folk festival which marks the end of winter was celebrated on January 12th 2020.
- ❑ We organized bonfire and few cultural events
- ❑ TV coverage (DD national) also took place.



## Sankranti Celebration

- ❑ On this occasion which was celebrated on Jan 15th, a bunch of fun-filled events and friendly competitions were held
- ❑ Like Rangoli, Kite flying, Tug of War, Mehendi and Kho-kho was held.



## TRADITIONAL DAY



## NRITYANJALI

Classical Dance Competition



## Online Events by EBSB

- Quarantine cooking challenge
- Poetry competition
- Mandala art contest
- Celebrations and expressions
- Remembering our roots
- Creative crackers

## Celebrations And Expressions Contest



Most of the festivals celebrated across India vary with their own tinge of local aspirations, but the emotions and spirits remain the same. We, the EBSB team came up with a Contest on the occasion of Dussehra to spread this joy in a country that is extremely diverse and rich in culture. Participants shared their photos/videos of the celebration of Dussehra/Bathukamma/Navratri/Durga Pooja at their place. Following were the instructions for the contest:

Attached below are some of the best entries received:





## Remembering Our Roots Challenge



No matter how distant we are from our homeland, we do not veer away from the identity that it has passed on to us. And, clothing has been recognized to be more or less synonymous with it. Taking this into account, the EBSB **club came** up with another event - The traditional Outfit Challenge. Following were the instructions for the challenge:

Students, faculty, and staff members participated enthusiastically in both events in great numbers and made these events a huge success.

Here are some of the best entries that we have received:



# Elan, nvision & Alumni Day



Magic and illusions performed by Suhani Shah, Mentalist, Magician, and Illusionist



Talk Show with Shriya Pilgaonkar was organized



Comedy night was organized with one of the most celebrated comedians, Zakir Khan.



Independent rock band from Chandigarh, Naalayak performed at Elan Campus Events.



A solo singing competition was held in Elan Celebrations



A solo classical dance competition was held in Elan Celebrations.

# Green Office

## Dr Anurag & Dr Debraj

Door-to-door collection of source segregated waste enforced in March 2020. Dry and wet waste are collected from the source and transported to the Resource Recovery Park by a battery-operated eco-friendly vehicle.

Biogas Digester was commissioned on 01 February 2021. The food waste generated in the kitchen/dining hall area is converted to biogas and sent back to the kitchen. This reduced the fossil fuel demand.

Resource Recovery Park was established on 13 July 2021. Dry waste is segregated into plastic, paper, cardboard, glass, and metals. Revenue is generated through the sale of recyclables. The RRP also has a vermicompost facility for managing wet organic wastes from the residential areas. The compost is used for gardening purposes.

The institute has a Zero Liquid Discharge plant that treats the wastewater generated on the campus. The treated water is used for gardening, flushing toilets, and in cooling systems.



*Biogas digester*



*Battery operated vehicle for collecting waste*



*Compost facility at RRP*



*Dry recyclables segregation facility at RRP*





Zero Liquid  
Discharge Plant

### Mr D V Subramanyam

1. The Green office successfully conducted Monthly tree plantation drives on the 1<sup>st</sup> Saturday of every month to raise awareness and consciousness about the environment among the campus community by planting hundreds of Many flowering and fruit-bearing shrubs and trees.
2. Regular maintenance of all the plantation areas on the roadside shoulders, Swales, and its surroundings through removing and cleaning the overgrown & congested brush using petrol-operated Brushcutters, and application of fertilizers, pesticides, and Fungicides.
3. Many ornamental trees and shrubs were added to the academic block Plaza to enhance the beauty and make the environment pleasant. The green office took an initiative to reduce domestic water consumption by introducing water-saving adapters to the existing water supply system of the campus. This is a step towards the sustainability of natural resources as well as huge savings in water bills.
4. The Green office helped to convert the existing original urinals fitted with automatic water flushing systems into waterless urinals by introducing advanced Bio-Blocks to eliminate the water usage for flushing purposes. It helped to save energy in the transport or convey the water to these urinals and recycle the sewage.

# Inter IIT Tech Meet 9.0

## Overview

The theme this year is Pandemic, Paranoia, and Possibility via which we wish to contribute to the cognizant and escalating India, by bringing about impactful changes. A total of 22 IITs participated in the inter IIT-tech meet 2020-21 and IIT Hyderabad was able to secure 10th position in the overall standings.

Among all the different contests we were able to secure 3rd place in the TPF contest and were awarded joint silver medals along with 2 other teams. Also, we were able to tie for the highest score of 150 points in the SAC and EC sections. Furthermore, we were able to secure joint bronze medals(7th place) in 2 contests based on problems from ISRO and Bridgei2i respectively.

This was the first time when the Inter-IIT Tech Meet took place in an online mode, so it was new for every one of us. Most of the problem statements were software-related. Some problem statements which were supposed to be hardware were conducted in a simulated environment. (ex. DRDO's Challenge). As the meet was online, finding participants for some events was pretty challenging, but it was still somehow managed.

Apart from being in the exam week, every participant gave their best for the event they were taking part in and helped each other learn and gain knowledge during the preparation.

## Student experiences

The InterIIT Tech Meet 9.0 experience was quite exciting for me. Although it was conducted in a completely online mode, the competitive spirit between the teams to work on the problem statements and simultaneously improve themselves was the same as before. I worked on the problem statement entitled as 'DRDO DGRE's Vision-based Obstacle avoidance drone'. The work for the PS was done in simulation, with certain evaluation parameters and a presentation at the end. Overall, it was a good learning experience for me.

**- Soham Kulkarni**

INTER-UT TECH MEET 9.8

THE THEME

PANDEMIC, PARANOIA AND POSSIBILITIES

The theme this year is Pandemic, Paranoia and Possibility via which we wish to contribute to the cognizant and escalating India, by bringing about impactful changes

HOPE

Any major technological or social innovation that defines human evolution is the product of hope. It is the spark that ignites the fire of innovation. It is the spark that ignites the fire of innovation. It is the spark that ignites the fire of innovation.

TECHNOLOGY

The progress of our generation is defined by the technology we use. It is the spark that ignites the fire of innovation. It is the spark that ignites the fire of innovation. It is the spark that ignites the fire of innovation.

VISION

Our vision is to see a world where technology is used to solve the world's most pressing problems. It is the spark that ignites the fire of innovation. It is the spark that ignites the fire of innovation. It is the spark that ignites the fire of innovation.

THE PARTICIPANTS

MID PREP EVENTS CONTINGENT

ACTIVITY 10

RUTAG-NE'S AGROBOT DESIGN INNOVATION CHALLENGE

SRINIVAS KALON  
VISHNVI K  
BASA SODIK  
BHARTARU PURANETIA  
PAVAN BHANUJALI  
NUPRANETHI

MECHNICAL ENGINEER

TECHNICAL STAFF

LOW PREP EVENTS CONTINGENT

ACTIVITY 10

SAPTANG LAB'S NETWORK SECURITY HACKATHON

SHANUAT SANGAR  
RAJESH CHAVAN  
RANDEE LAKSHMAN  
ARASHI TACHARI  
K. HARVA SREE

THE PRODUCT FOLKS AND KACHING'S PRODUCT CASE STUDY COMPETITION

LEANDRA LAWRENCE  
ADITHYAN CHANDRAN  
NISHU REDDY  
HARSHVATH GUPTA

QUANTINTS'S ALGORITHMIC TRADING CHALLENGE

DARSHAN MEHER  
SRINIVAS GUNDA  
ADITHYAN KUNAR SINGH

MECHNICAL ENGINEER

TECHNICAL STAFF

HIGH PREP EVENTS CONTINGENT

ACTIVITY 10

BOSCH'S TRAFFIC SIGN RECOGNITION

RACHET KUNTI DAS  
NISHU REDDY  
NISHU R  
SANDHEEP KUMAR  
KARTIM KULUM GUNAM

ADITHYAN  
SREE ANAND MUGTHAN  
YASH TILAK  
SHRINIVAS KUNALIAW  
SANDHEEP KUNALIAW

BRIDGEIT'S AUTOMATIC HEADLINE AND SENTIMENT GENERATOR

RAJDEEP AGARWAL  
ADITHYAN SANGHVI  
SUNNY GUPTA  
PUNYU GUPTA  
LEANDRA LAWRENCE

SHANUAT SANGAR  
SANDHEEP KUMAR  
NANDY ANANT NUNUNATI  
NANDY ANANT NUNUNATI

DRISHTEE TECHLED INNOVATION FOR RURAL ENTREPRENEURS

KARTI GUPTA  
SUNNY GUPTA  
SUNNY GUPTA  
SUNNY GUPTA  
SUNNY GUPTA

MECHNICAL ENGINEER

TECHNICAL STAFF

MID PREP EVENTS CONTINGENT

ACTIVITY 10

DRDO'S VISION BASED OBSTACLE AVOIDANCE DRONE

SHANUAT SANGAR  
SANDHEEP KUMAR  
SANDHEEP KUMAR  
SANDHEEP KUMAR  
SANDHEEP KUMAR

ISRO'S WEB BASED VISUALIZATION TOOL FOR ASTROSAT OBSERVATION

NISHU REDDY  
SANDHEEP KUMAR  
SANDHEEP KUMAR  
SANDHEEP KUMAR  
SANDHEEP KUMAR

BOSCH'S ELECTRIC VEHICLE SIMULATION

SHANUAT SANGAR  
SANDHEEP KUMAR  
SANDHEEP KUMAR  
SANDHEEP KUMAR  
SANDHEEP KUMAR

MECHNICAL ENGINEER

TECHNICAL STAFF

326 | Inventing and Innovating in Technology for Humanity

# Japan Day @IIT Hyderabad 2020

*India has the talent of global standards, said Japanese Companies*

**Japanese companies interacted with IITH students on opportunities available and skill sets that are in demand.**

IIT Hyderabad hosted the 3rd edition of Japan Day 2020 on 2nd Oct 2020. This is an annual event co-organised by the Japan External Trade Organization (JETRO) and Japan International Cooperation Agency (JICA). Japan Day 2020, witnessed an overwhelming response from 20 Japanese companies interacting with 436 students from IIT Hyderabad.

***These companies represented diverse sectors of Japanese industry including, IT services, Deep tech, Core Engineering, Design, Manufacturing, Healthcare and Marketing.***

Reiterating the importance of Indian talents in the Digital Transformation and Creation of new global business models for Japanese Companies and wishing team IITH and India, the 150<sup>th</sup> Birth Anniversary of Mahatma Gandhi, Mr. Takashi Suzuki, Director General, JETRO Bengaluru said in his Opening Remarks: *"Knowing each other means the take-off to the win-win relationship between Japanese companies and Indian talents, as well as virtually the final approach to the successful placement to Japan for Indian talents. The online live interactions bring a lot of benefits for the participants from Japan and India. Japanese companies can get exposure to the very high potential and enthusiasm for Indian talents. And IITH students can deepen the understanding about Japanese companies themselves, job culture, life, career development, and cutting-edge technologies in high demand, and, most importantly, increase the chances of getting a job in Japan."* Mr. Takashi Suzuki also presented the survey done by the JETRO team on the Indian talents in Japan, highlighting the conducts in which ***'Recruitment and Retention of Highly Skilled Indian Talents is done by Japanese Companies'***.

The event also featured an experience sharing session by IITH Alumni, Dr. Divya Anand, who is currently an executive in the technology planning department at Nippon Paint Holdings Co Ltd. Speaking from her personal experiences in Japan, Dr. Divya, presented the winning mantras for building a successful career in Japan.

# JAPAN DAY

## 2020

SUPPORTED BY



JETRO



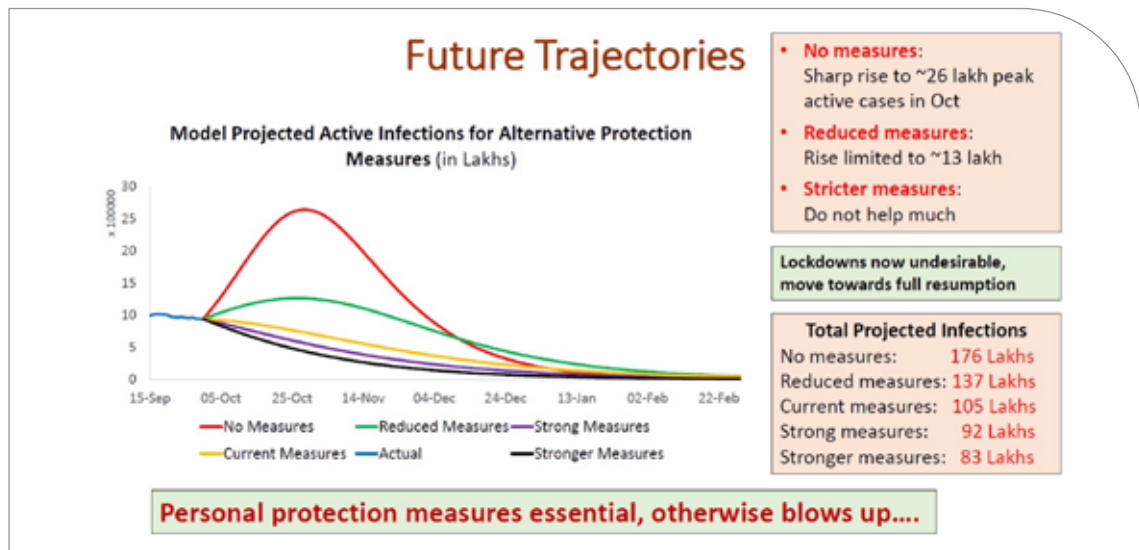
# Fight against COVID-19 (2020-2021)

## Research being carried out at IITH to fight COVID-19:

1. Prof. Vidyasagar, Distinguished Professor of IITH, and his team came up with Supermodel for the prediction of Covid-19 progress in India.
2. Dr. Jyotsnendu Giri (BME dept.) and his startup EaffoCare Innovation, incubated by IITH, developed commercial Antiviral coating solutions (Durokea range of products) which includes a hand sanitizer, mask sanitizer and surface disinfectant.
3. Prof. Shiv Govind Singh (EE dept.) has developing rapid, ultrasensitive biomolecule sensor for detecting coronavirus in individuals.
4. Nemocare and Heamac, two startups of Centre for Healthcare Entrepreneurship (CfHE) of IITH, mentored by Dr. Renu John (BME dept.) have developed Nemocare Raksha, a wireless wearable, for Covid-19 patient monitoring in isolation wards.
5. USafe, a start-up under CfHE has developed a N95 equivalent Mask US9™ under the supervision of Prof. Surya Kumar (MAE dept.) and Prof. Renu John.
6. Aerobiosys, a startup of CfHE at IITH, has developed a low-cost portable ventilator, Jeevan Lite under the mentorship of Prof. Renu John.
7. Dr. Sobhan Babu (CSE dept.) has developed apps that collect data about health conditions of the citizens and provide to local administration on a constant basis. On the request of Telangana state government, his group has developed an app that helps to monitor quarantining.
8. A PhD Scholar Mr. Priyabrata at Dept. of Design has developed a UV air sterilizer “Swatchh Air” supported by IITH via a BUILD (Bold Unique Ideas Leading to Development) project. Priyabrata has recently installed UV based Sterilizer “Sudhikaran” in the campus.
9. Dr. Mahati and Dr. Haripriya (LA dept.) explored working mothers’ experiences, regarding housework, childcare and professional work during the lockdown.
10. Dr. Prabheesh (LA dept.) has worked on the impact of Covid-19 on financial markets.



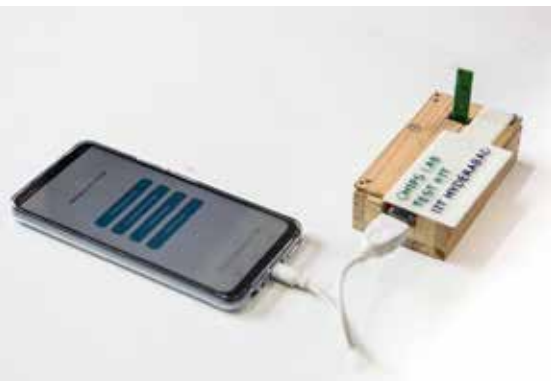
Some of the amazing research outcome during COVID-19 to fight COVID-19 are shown below:



*SUTRA Model (Progression of the COVID-19 Pandemic in India: Prognosis and Lockdown Impacts by Prof M Vidyasagar, Distinguished Professor, IITH & his team)*



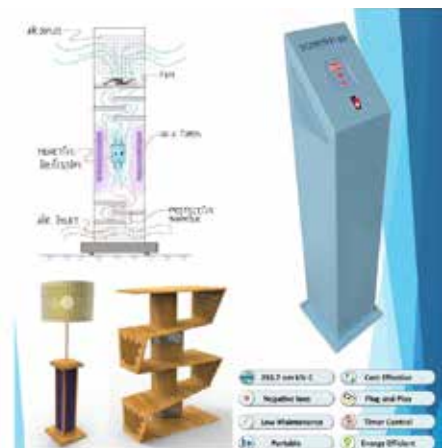
*Durokea – Range of Hygiene Products by Dr Jyotsnendu Giri, Department of Biomedical Engineering Start-up Kea Biotech*



*COVIHOME – Electronic Test Kit for COVID-19 Diagnosis by Prof Shiv Govind Singh, Department of Electrical Engineering*



*US9™ – N95 equivalent mask by USafe, CfHE @ IIT Hyderabad*



*Swatchh Air, a low-cost air stabilization system that reduces the overall viral load in the air*



*Low-cost, Portable Ventilator by Aerobiosys, CfHE@IIT Hyderabad*

#### Other Covid-19 related activities carried out by IITH for helping the local population:

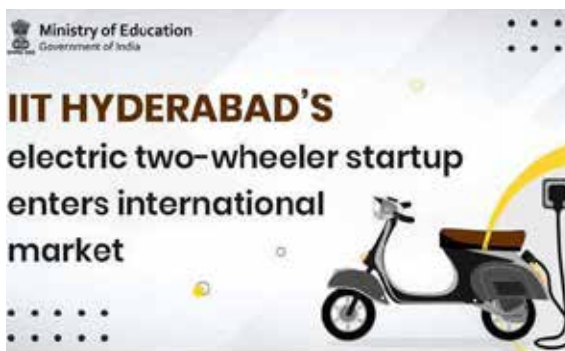
1. Dr. Mudrika Khandelwal (MSME dept.) has developed sanitizer and distributed to various essential services in the IITH campus.
2. Dr. Jyotsnendu Giri (BME dept.) has developed hand sanitizer and IITH could supply about 200 liters daily to the District Collectorate and government hospitals in Hyderabad.
3. Pure EV, a company incubated out of IITH, with one of our faculty (Dr. Nishanth Dongari, MAE dept.), has supplied about 3000 bottles of sanitizers (250 ml) to local bodies.
4. Pure EV have manufactured about 5500 3-ply masks and distributed to local needy people and have distributed around 10,000 face shields to Police, Administrative, Health Care, and Hospitals in Sangareddy district and GHMC.
5. Dr. Sobhan Babu (CSE dept) and his team developed and deployed an App for tracking the distribution of rice and money to more than 3,00,000 migrant workers.
6. Dr. Mohan and Dr. Kousik (BME dept.) and their team have provided Covid-19 prediction to the state administration.

# What's New in 2020-2021

## Research



IIT Hyderabad researchers developed first of its kind COVID 19 testing kit which can detect the Coronavirus within 20 minutes. The kit will be available at Rs 350 once commercialized.



IIT Hyderabad's incubated startup 'PURE EV' launched 'EPluto7G' - an eco-friendly two-wheeler in Nepal. 'PURE EV' works on the development of long-range & high-performance Lithium batteries.

## Academics



IIT Hyderabad has taken a bold step towards AtmaNirbharBharat through AtmaViswaas, by developing a strong BTech program in Biomedical Engineering. Thereby inculcating biomedical education in young minds from the grassroots, with the BTech program for the first time among all IITs.



IIT Hyderabad, Department of E & M in collaboration with Business Design Lab offers a unique Certificate program on 'Business Model Innovation'.

## Collaborations



IIT Hyderabad DST NM ICPS Technology Innovation Hub on Autonomous Navigation Data Acquisition Systems [UAVs, RoVs] to jointly offer 2 year M Tech in Smart Mobility, effective from Aug' 2020.



IIT Hyderabad & UK University has collaborated to study the impact of antibiotic disposal in Indian waterways that maybe posing a severe threat of spreading fatal infections.



IIT Hyderabad's incubated startup has won a fully sponsored research collaboration deal with Japan firm Technocorpus for manufacturing Internet of Things based smart home products.





IIT Hyderabad to collaborate with C-DAC India to establish a state-of-the-art 650 TFHPC facility under national computing mission. The purpose of this High-Performance Computing Centre is to solve grand challenges & problems of National Importance, to build 'AtmanirbharBharat'.



IIT Hyderabad inked an agreement with Deakin University, Australia, to offer Joint Doctoral Program



FabCi at IIT Hyderabad, in collaboration with NXP & MeitY, has launched Semiconductor Startup Incubation & Acceleration Program.

## Campus



Precast hostel block Ramanuja inaugurated at IIT Hyderabad by Shri BVR Mohan Reddy Chairman BoG IITH





*Hostel block Ramanuja inaugurated at IIT Hyderabad*



## Reaching Hours & Transportation

- » **Secundarabad - IIT Hyderabad Campus**  
~ **3 Hours approx** (buses, MMTS till lingampally, cabs - auto accessible).
- » **Rajiv Gandhi International Airport Hyderabad - IIT Hyderabad Campus**  
~ **1 Hour 30 Minutes approx** (buses till patancheru, cabs - auto accessible).
- » **Lingampally - IIT Hyderabad Campus**  
~ **1 Hour approx** (buses, cabs - auto accessible).
- » People coming by bus/cab/self-driven modes can easily access IIT Hyderabad as Campus is on Mumbai - Hyderabad highway (NH 65)  
~ **2.5 kms from Kandi Junction.**

1. IIT Hyderabad Main Entrance
2. Estate Office
3. Labs
4. a/b - Housing
5. Refreshment Canteen
6. Hostels/ATM/Bank
7. Dining Hall (LDH/UDH)
- » AUDITORIUM Ground Floor, Academic Block A

Layout & Design: Department of Design

Publication: Public & Corporate Relations Office



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भारतीय प्रौद्योगिकी संस्थान हैदराबाद  
Indian Institute of Technology Hyderabad

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