

## DEAN'S MESSAGE



Dear Alumnus,

Warm greetings from IIT Bombay.

*"The best way to predict your future is to create it."*

Abraham Lincoln

And I have no doubt that our graduating students will create a wonderful and challenging future for themselves. August 2022 brought with it the annual 60th convocation ceremony which was held on August 20, 2022. Mr. Kumar Mangalam Birla, Chairman, Aditya Birla Group, was the chief guest and delivered the convocation address. During the main convocation session, a total of 2551 degrees were awarded to 2324 students.

I am also pleased to announce that we achieved a major milestone as an Institute when we awarded a total of 449 Ph.D. degrees this year (the first time that any Indian academic institute has produced more than 400 Ph.D. graduates in a year). I wish all the graduates the very best and a wonderful and successful future.

Speaking about convocation ceremonies, I would also like to provide some heart-warming news for all of you. Since the pandemic played havoc with our lives, the students from the 2020 and 2021 batches did not get to enjoy one of the best days of their college lives – their convocation ceremony in person. To make good, IIT Bombay hosted a special reunion convocation on August 6, 2022, exclusively for them. It was rewarding to see the excitement and pride on their faces as they returned to their alma mater to have a photo-op of them receiving their degrees in person, while also celebrating the event with their friends and peers.

I will now like to share some other key events that took place last month.

- In a path-breaking event, IIT Bombay signed multiple MoUs with the JSW Group. These include the setting up of the JSW Technical Hub, a Chair Professorship, and several R&D projects among others. I am very grateful to the JSW Group for entrusting us with so many socially relevant and nation-building projects.
- The ground-breaking ceremony of IIT Bombay's Humanities and Social Sciences (HSS) Annex Building was held on August 24, 2022. This wonderful initiative is the brainchild of the Institute's alumnus, Mr. Abhay Pandey (B.Tech., Computer Science, 1993) as a principal donor, and is supported by Technocraft Industries India Ltd. headed by IITB's alumni, Dr. Sharad Saraf (B.Tech, EE, '69; currently Chairperson IITB's Board of Governors) and Mr. Sudarshan Saraf (B.Tech., Mech. Engg. and Manuf. Engg, 1970). Apart from strengthening the B.S. Economics Programme at IIT Bombay, the HSS Annex Building will also reinforce the academic programs and research in the Humanities and other Social and Behavioural sciences, which will enable our students to get a holistic education. We are very grateful to Abhay, Sharad, and Sudarshan for this generous venture.
- IIT Bombay signed an MoU on August 19, 2022, with its alumnus, Dr. Viswanath Ramachandran (B.Tech, CSE, 1991), to establish the "Dr. K. V. Ramachandran Chair for Statistics and Mathematics" in honour of Vishwanath's father. The MoU is the first-of-its-kind Chair Professorship that will be set up at the Institute in the field of Mathematics and Statistics. Our grateful thanks to Vishwanath for this path-breaking venture which will be the first step towards further enhancing the Institute's lead in the domain of Statistics and Mathematics areas in the country.
- After a break of two years, the Institute hosted the 'Prof. N. R. Kamath Distinguished Institute Lecture' in person on campus and the occasion was graced by students as well as faculty. Our guest lecturer this year was Prof. Shankar P. Bhattacharyya, Professor of Electrical Engineering, and the Robert M. Kennedy Professor at Texas A&M University, who delivered a theoretically appealing and interactive

lecture on the progress made in the design of Proportional Integral Derivative (PID) Controller. I want to thank Prof. Shankar for his very intriguing lecture.

- The ‘Kadayam S. Srinivasan’ and ‘Harivallabh Nagar Micro-Factories (IIT Bombay’s first-ever micro-factories) were inaugurated on August 12, 2022, with a formal event held on campus. The Institute welcomed back its two main alumni donors, Balaji Srinivasan (B.Tech, Chemical Engineering, 1993) and Sumeet Nagar (B. Tech, Mechanical Engineering, 1993), and their family members on this joyous occasion. The inauguration buzzed with excitement as several Institute alumni, faculty members and students graced the occasion and got a tour of the newly established facilities on campus. I encourage you to drop by your alma mater the next time you are in Mumbai and take a look at the facilities yourself.
- Director Chaudhuri hoisted the Indian National Flag on our nation’s 75 Independence Day. The Institute also celebrated our nation’s independence with a series of events held under the Azadi Ka Amrit Mahotsav initiative. These included a magnificent display that recreated the Dandi Memorial and the Akhand Deep (Lighting of lamp) in remembrance of martyrs of the Indian Freedom Struggle.
- I am very thankful to the Hon’ble Minister for Road Transport and Highways, Nitin Gadkari, who took time out of his busy schedule and joined the completion event of the capacity-building program in New Delhi, called ‘Highways for 21st Century India – Modern Technologies for Highways for North India,’ conducted by IIT Bombay in partnership with the Indian Academy of Highway Engineering and NHAI INDIA. Mr. Gadkari urged the attendees to adopt innovative technologies to enhance quality, improve sustainability, reduce cost and increase the speed of execution.
- I am delighted that IITB alumnus, Dr. Ranjit Rath (MSc. Applied Geology, 1994) has taken over as the Chairman and Managing Director of India’s second-largest state-run oil and gas producer, Oil India Limited (OIL), on August 2, 2022. Congratulations to Ranjit on this exceptional accomplishment.
- Please join me in congratulating Prof. Dinesh Kabra and his team who were recognised by the prestigious Nature Journal for their work on the next generation of optoelectronic materials for solar cells and display technologies. This is an outstanding achievement by Dinesh and his team.
- My hearty congratulations to our very own Poyini Bhatt, CEO of SINE, who was felicitated by the Department of Science and Technology (DST), Government of India, as a key enabler of the promotion of innovation and entrepreneurial activities. The DST honoured her for her contribution to fostering innovation, incubation, and entrepreneurship in the country.

Before I wrap up – I want you to know how much your spirited involvement has contributed to the Institute’s advancement. Your love and affection for the Institute and your continued generosity are priceless. Undoubtedly, you will provide the same support to your beloved Institute in the future.

Please come by and visit us soon.

Sincerely,

Prof. Ravindra D. Gudi, Ph.D., FNAE and FIICHe  
Dean – Alumni and Corporate Relations  
Institute AI & ML Chair Professor

**GIVING**



## **Mr. Sanjeev Nabar Establishes the Jaywant M. Nabar Diamond Scholarship at his Alma Mater**

*“It is every man’s obligation to put back into the world at least the equivalent of what he takes out of it.”*

Albert Einstein.

The above quote epitomises IIT Bombay alumnus, Mr. Sanjeev Nabar, founder and managing director of Ikebana Engineering Limited, and his philosophy of giving back.

While he is now at the very top of his professional career, Mr. Nabar’s early years began very modestly. He hails from a middle-class family where his father, Mr. Jaywant Mangesh Nabar, worked as a security officer in the state transport corporation. Mr. Nabar’s father had a big family to support. But despite his myriad financial constraints he encouraged his son,

Sanjeev, to dream big, aim high, and appear for IIT’s entrance exam. Mr. Nabar justified the immense faith his father showed in him by receiving a high rank at the IIT’s Joint Entrance Exam (JEE). This allowed Mr. Nabar to receive a merit scholarship from the Institute and significantly ease the financial burden on the Nabar family.

Mr. Nabar went on to have a stellar career which included stints at Nelco (TATA Group) and Raychem in senior positions before he set up Ikebana Engineering Limited, a company that manufactures heat shrink cable accessories in Thailand. After 30 years, the Ikebana group is now one of the global leaders in this field and exports to more than 30 countries across five continents. Ikebana is also a multi-location group now and has over 200 employees working in its manufacturing base in Thailand.

But Mr. Nabar never forgot the two entities who had such a profound impact on his career: his father for always believing in him and supporting him, and his alma mater, IIT Bombay, from where he received a world-class education.

So, on his father’s 100th birth anniversary, July 22, 2022, Mr. Sanjeev Nabar paid homage to his father and his alma mater by instituting the Jaywant M. Nabar Diamond Scholarship which will cover the annual tuition and mess expenses of 16 students. The key mission of the scholarship is to provide many capable and deserving but financially constrained students a chance to receive one of the best education possible by studying at IIT Bombay. The scholarship is a way to provide these students with a level-playing field and to be able to pursue their education without financial worries.

Mr. Nabar says, “I firmly believe that my education at IITB was possible only with my father’s support and the scholarship I received from the Institute. My main goal with this donation is to help young students by providing them with a scholarship that will make their dream of receiving a world-class education at IITB come true.” He also hopes that these students will eventually pay it forward to other economically constrained students in the future and continue this cycle of giving back.

Mr. Nabar also hopes that alumni of the Institute come forward and contribute to IIT Bombay as well. Mr. Nabar urges other alumni saying, “I would request my fellow alumni to also donate generously to IITB so that the students receive scholarships and the facilities are upgraded. This is a way of giving back to the alma mater that has built us and made us what we are today.”

To call Mr. Nabar an inspiration to those around him is an understatement. His pure intentions, his abiding respect for his father and his alma mater, and his deep-rooted need to share his good fortune with those in need are profoundly uplifting. IIT Bombay is extremely grateful to Mr. Nabar for setting up the Jaywant M. Nabar Diamond Scholarship and will ensure that his endowment is bestowed on the worthiest of candidates at the Institute.

## **FACULTY INTERVIEW**



## **Professor Preeti Rao: Modesty Personified**

*Professor Preeti Rao is a member of the Department of Electrical Engineering, IIT Bombay. Her expertise lies in the field of computer audition, and she has been involved with research and technology development for speech and music applications including supporting a product through incubation at SINE.*

*We are delighted to speak with Prof. Rao for the Dean ACR Newsletter.*

**Prof. Rao - thank you for taking the time to speak with us. Can you begin by giving us a quick overview of your academic and professional career, so far?**

My association with IIT Bombay goes back a long way. I was an undergraduate student here between 1979 to 1984. Back then I had no clue as to what I wanted to study. I found myself at the IITB EE department having cleared JEE with a certain rank. The campus was beautiful but it was a competitive and lonely place, particularly for the few girl students who wandered in during those years!

After graduation, I got a job via campus placement in one of the Tata group's R&D centres in Mumbai and I spent about a year there. With somewhat limited future prospects, I went on to pursue my master's and Ph.D. at the University of Florida.

I always knew I would come back to work in India but, honestly, I never wanted to teach and did not see myself as someone who wanted to spend their life in academics. But in the early 90s, industry jobs were hard to come by, especially if you had a Ph.D. That made you overqualified. So, the only option was to get a job in a government lab. But even those options were very limited.

Since my husband was interested in an academic job, we both found ourselves teaching at IIT Kanpur. We were there for 5 years when IIT Bombay had a big recruitment drive and I applied for a research staff position. Unfortunately, IITB was phasing out these research centres, so two years later I found myself right back in the electrical engineering department doing what I was trying to escape – teach. But slowly, I started to appreciate the interesting avenues this opened up.

**Why didn't you want to teach?**

To be a teacher you had to be an expert in the topic you teach. I never believed I was an expert, preferring instead to read and listen but not talk so much. Whenever I went to class, I felt like a fraud. I never felt I had the kind of authority you needed to be a professor!

**I think you are being extraordinarily modest, Prof. Rao! But moving on - your research interests include speech and audio signal processing and music information retrieval, and more. What sparked your interest in these areas? Can you explain your research pursuits in layman's terms?**

These days, everyone is familiar with the use of computers for almost every aspect of life. People are very familiar with robots or computer vision, where computers can see and make sense. For example, while detecting and recognizing faces in crowds is considered a very human ability, we now have a lot of computer-based algorithms which see pictures and can make sense of them and act based on them.

**So, is this like artificial intelligence?**

Yes, it is artificial intelligence. My area is computer audition. It is about computers emulating how people listen and make sense of things from sounds. Human beings are used to talking to machines and having machines talk back but there are a lot of other sounds in this world, other non-language-based sounds around us. Humans can automatically analyse these signals and find patterns to decode and make sense of the world around us from these 'soundscapes' we are immersed in.

**You are an expert in Sound Processing. Can you elaborate on the work done by the Digital Audio Processing Lab at IIT Bombay?**

Well, we work with recorded sound which, of course, is digital and hence it's called the Digital Audio Processing Lab. Some audio engineers work with microphones, speakers, and sound reproduction. On the other hand, I work in information extraction for which we do not need a lot of hardware. We just do a lot of listening and computation.

I have spent time mulling over practical applications in the lab that could be taken to the industry to develop something tangible. One particularly interesting project came our way years ago and that was music processing. It's listening to music and making sense of it. When you listen to a piece of music you analyse it, find its main attributes, and then describe it. You gather information as to what type of music it is similar to, who is the singer, what is the genre of music, and so on.

I had students who were trained and interested in working with music. We built a system that gave feedback on the accuracy and quality of singing. It was a demonstrable system and featured in IITB's technical exhibitions. From there we were able to understand other requirements of the music industry. Like, the industry wanted the lyrics of a song to be displayed as the song played. While this is a simple enough task for a human being to do, a computer doing the same is helpful when the catalogue is vast and the languages are many. Another application that the music industry was interested in was to find the hook, or a short and catchy snippet, of a song to use as an audio thumbnail.

We incubated SensiBol Audio Technologies in SINE based on the patented IP and had a few deployments of the singing scoring technology on TV and mobile networks in India and other countries such as Vietnam. The radio and entertainment industry also used some of our other automated services. Unfortunately, we could not make further headway with the singing product because of the challenges posed by commercial music licensing. Recently, we started working in the lab on speech patterns similar to what we did for music. Much like how we gave feedback on music skills, we are doing the same for spoken language. For example, you can give children feedback on how fluently they read. This is useful for automating literacy assessment and has found interest among education agencies who otherwise use human facilitators to get children to read a passage aloud and then rate them on whether they're reading at their correct grade level. The computer provides feedback, much like a teacher would, on the accuracy of pronunciation as well as fluency and expression, all of which are indicative of the child's comprehension of the text. This work is supported by an Abdul Kalam Technology Innovation National Fellowship and the Tata Centre at IITB.

**That is incredibly interesting, Prof. Rao. Now, changing gears, can you also take us through the process of filing a patent in India and the potential hurdles that come with it?**

At IIT Bombay, there is a lot of emphasis on having an industry connection. The idea is to start with an idea at IITB and then take it to the real world. And the Institute's ecosystem works to support this. Suppose a student's research appears commercially viable, IITB's R&D office evaluates the work and decides whether it is suitable for patenting or not. And if it is, the Institute immediately advises them to apply for a patent. While the process is long, IITB ensures that the new idea, at least, gets into the pipeline. So, the project will be at the patent-pending stage while they are still working out the details. And if students have a prototype, they can demonstrate the product and get help with seed funding, and networking with investors and potential clients.

And now IITB has a school of entrepreneurship that runs courses and incubation initiation programmes every year which take students through that journey so that they know what's headed their way. Unfortunately, while the Institute trains students to be independent and become entrepreneurs, with campus placements students often get high-salaried jobs and toss all their entrepreneurial ambitions away. And, in India, there is a lot of family pressure that gets in the way, as well. Also, after students have been working for a while, even if they are very well off, they don't have the confidence to let it all go to start something from scratch. So that's a bit unfortunate but over the years we've still had some really big success stories from IITB.

**Finally, what advice would you give our women students at IIT Bombay who are just starting out?**

Times have changed and I am so happy that we now have some extremely capable and confident women at IITB. The women's faculty strength has grown. Back then I was so diffident and doubted my abilities. But this current generation – they are so clear-headed. They know exactly what they want and, of course, they have more opportunities, as well. My advice to them is to never get confined to traditional roles. The world needs a lot of passionate people to solve intricate problems. Just be at it and pick something that you like and persist with it.

And with some planning and organisation, you will strike a good balance – you can succeed professionally and also have a good personal life. There is really no need to compromise on anything.

*The Institute is always excited to get reacquainted with its former students and we are grateful to Mr. Subramaniam and his team for visiting the campus and taking the time to speak with us. We hope that Mr. Subramaniam will visit us again soon and stay for a more extended period.*

## **DONOR INSTITUTE CHAIR**



### **Prof. Atul Sharma appointed the Rahul Bajaj Chair Professor in Mechanical Engineering**

#### **About the Donor:**

The charitable trusts promoted by The Bajaj Group have helped create four Chair Professorships in various departments at IIT Bombay. The Rahul Bajaj Chair Professorship in Mechanical Engineering is one of the chairs and its core vision is to enhance industry collaboration, initiate new academic programs, and provide technical leadership in the areas of Mechanical Engineering.

#### **About the Appointee:**

Prof. Atul Sharma, FNAE, Department of Mechanical Engineering

Professor Atul Sharma is currently the Rahul Bajaj Chair Professor in Mechanical Engineering at IIT Bombay.

Prof. Sharma's stellar academic background includes receiving his B.E from the National Institute of Technology, Raipur, 1994, followed by his M.E. from the Indian Institute of Science, Bangalore, 1998, and his Ph.D. from the Indian Institute of Technology, Kanpur, 2004.

Prof. Sharma's research interests include Computational Fluid Dynamics and

Heat Transfer, and Computational Multi-Phase Dynamics (CMPD) involving (a) Computational Multi-Fluid Dynamics (CMFD) and (b) Computational Fluid-Structure Interactions (CFSI).

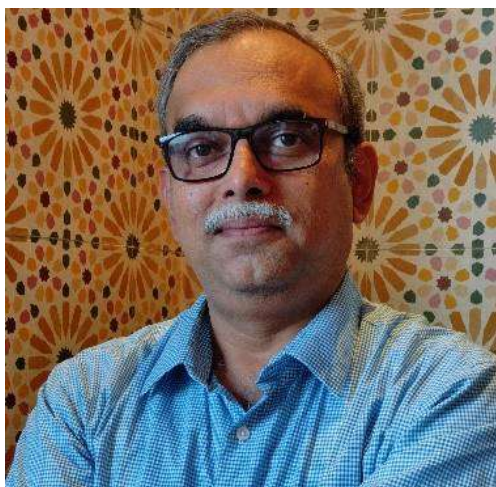
Dr. Sharma has also made several contributions to the development of a range of novel and efficient computational tools, their applications to time-consuming simulations, and analysis of the resulting big data for various problems in Computational Fluid Dynamics (CFD). For Computational Multi-Fluid Dynamics and Computational Fluid-Structure Interactions, he has demonstrated numerous innovative applications and provided a scientific understanding of various types of problems like fish-like swimming, energy harvesting from flow-induced vibrations, sustaining nucleate boiling at zero gravity, and self-cleaning surfaces. He also demonstrated simulations for industrial problems on circuit breakers, power transformers, and printed circuit heat exchangers. In his extremely well-received textbook, 'Introduction to Computational Fluid Dynamics,' he proposed a physical, insightful, and comprehensive approach to CFD, with an overall personal vision to make CFD software in India.

Over the years, Prof. Sharma has received multiple awards and accolades. He won IIT Bombay's "Research Dissemination Award 2020" in recognition of his "outstanding efforts to disseminate" research through his textbook 'Introduction to Computational Fluid Dynamics' and a review article on 'Level Set Method for Computational Multi-Fluid Dynamics,' 2020. He also won IIT Bombay's "Departmental Award for Excellence in Teaching 2019" in recognition of his significant teaching contributions to the institute.

Prof. Sharma's other accomplishments include being a Fellow of the Indian National Academy of Engineering (INAE). His wide-ranging research encompasses 96 articles published in 37 globally recognized and prestigious journals. He has contributed to 82 conference proceedings, 14 chapters in 5 edited books, and appeared on the cover of renowned journals such as JFM, POF, and Langmuir. He has also been a CFD consultant at Global R&D, Crompton Greaves Limited, Mumbai; served as Secretary, National Society of Fluid Mechanics and Fluid



Power; and is, presently, an associate editor at Sādhanā (Academy Proceedings in Engineering Sciences), a monthly, peer-reviewed, scientific journal published by Springer Science-Business Media on behalf of the Indian Academy of Sciences.



## **Prof. Soumyo Mukherji appointed the Madhuri Sinha Chair Professorship in Biomedical Engineering**

### **About the Donor:**

Dr. Krishna Sinha, M.D., a cardiologist, and a prominent private medical practitioner, based in Denver, Colorado, established the Madhuri Sinha Chair Professorship in Biomedical Engineering. This chair professorship was established to promote research in the niche area of biomedical engineering. It is a unique chair professorship that is awarded for a period of five years so that the recipient is given a reasonable period to germinate and establish a globally competitive research programme.

### **About the Appointee:**

Dr. Soumyo Mukherji, Professor, Department of Biosciences and Bioengineering

Dr. Soumyo Mukherji received his B.Tech. in Instrumentation Engineering from IIT-Kharagpur. This was followed by his M.S. from Colorado State University (Fort Collins, USA), and his Ph. D. from the University of North Carolina (Chapel Hill, USA).

Dr. Mukherji's research interests are in the field of Biosensors and Bioinstrumentation including physical, chemical, and biological sensing systems (macro and micro) for medical/biological applications in the fields of health, environment, and national security. He is also involved in the field of Cardiac Electrophysiology.

Prof. Mukherji is a Fellow of the Indian National Academy of Engineers (INAE).

## **NEWS FROM IIT BOMBAY**



### **IIT Bombay Celebrates 60th Convocation Ceremony**

The Indian Institute of Technology (IIT) Bombay held its 60th convocation ceremony in person on campus on August 20, 2022. Mr. Kumar Mangalam Birla, Chairman, Aditya Birla Group, was the chief guest and delivered the convocation address.

The convocation ceremony was presided over by the Chairperson, Board of Governors (BoG) of IIT Bombay, Dr. Sharad Saraf (the first IIT Bombay alumnus to become the Chairperson of the BoG at the Institute), in the presence of Prof. Subhasis Chaudhuri, Director, IIT Bombay.

During the main convocation session, a total of 2551 degrees were awarded to 2324 students. In a first, IIT Bombay became the first academic institute in India to confer 449 Ph.D. degrees this year, which is a landmark milestone for STEM education in India. The Institute also selected 35 research scholars for the 'Naik and Rastogi Award for Excellence in Ph.D. Thesis' for the years 2020-22.

Also, four students were presented with Gold Medals for their exemplary performances. Mohammad Ali Rehan, B.Tech., Department of Computer Science and Engineering, won the ‘President of India Medal’. The ‘Institute Gold Medal (2020–21)’ went to Koustav Jana, a dual degree student from the Department of Electrical Engineering while the ‘Institute Gold Medal (2021–22)’ was awarded to Aryaman Maithani, B.S., Department of Mathematics. Finally, the ‘Dr. Shankar Dayal Sharma Gold Medal’ was conferred on Shreya Pathak, B.Tech., Department of Computer Science and Engineering. Additionally, many more students were presented with gold medals sponsored by several donors.



The convocation ceremony was attended by Prof. Margaret Gardner, President and Vice-Chancellor, Monash University, Australia; members of the Board of Governors; and several other distinguished guests from India and abroad, besides the graduating students and their parents.

The function was broadcast live on <https://www.youtube.com/c/IITBombayOfficialChannel>

<https://youtu.be/j2KQyLkBh34>



### **IIT Bombay hosts reunion convocation for students from the 2020-2021 batches**

For the first time ever, IIT Bombay hosted a reunion convocation on August 6, 2022, for students who graduated in 2020 and 2021. The Institute held a special in-person convocation ceremony for students who missed experiencing the thrill of being among their peers and classmates and physically receiving their degrees due to the pandemic.

Prof. Subhasis Chaudhuri, Director, IIT Bombay, began the ceremony by warmly welcoming back the students to campus. This was followed in quick succession with the playing of the Institute’s song ‘Jnanam Paramam Dhyeyam’, the graduation song for the 2020 and 2021 batches, and a video showcasing the Institute – from its enhanced infrastructure and research facilities to the lush greenery and the many popular hangout spots on campus.

The Director then conferred the degrees to the students, among whom were Dr. Sharmila Sinha and Indrani De Parker, two of the Institute’s senior graduates, who received their Ph. D degrees from the IDC School of Design at IIT Bombay. This was followed by a heart-warming message by Prof. Ravindra D. Gudi, Dean, Alumni and Corporate Relations, who expressed his gratitude to the students for gracing the reunion convocation and wished them a bright future. The students then proceeded to attend the various reunions hosted by their respective academic departments.

One of IIT Bombay’s key objectives is to ensure that its students get a high-quality education, make them feel at home on campus, and provide them with experiences they will remember and cherish for a lifetime. Hosting the reunion convocation for the 2020 and 2021 batches was the Institute’s way of honouring these young, ambitious, and enthusiastic minds and bidding them a proper in-person farewell.





## Ground-Breaking Ceremony of IIT Bombay's Humanities and Social Sciences (HSS) Annex Building

IIT Bombay performed the ground-breaking ceremony of its new Humanities and Social Sciences (HSS) Annex Building on August 24, 2022. The project is the brainchild of IITB alumnus, Mr. Abhay Pandey (B.Tech., Computer Science, 1993), Co-founder and General Partner at A91 Partners (a late-stage venture capital firm) as a principal donor, and is also supported by the contributions of Dr. Sharad Saraf

(B.Tech, EE, '69), Chairperson, Board of Governors and a Distinguished Alumnus and his brother, Distinguished Alumnus, Mr. Sudarshan Saraf (B.Tech., Mech. Engg. and Manuf. Engg, 1970), owners of Technocraft Industries India Ltd.

Prof. Subhasis Chaudhuri, Director, IIT Bombay, extended a warm welcome to the guests. This was followed by a video presentation featuring Dr. Sharad Saraf, who shared his perspective on the importance of the HSS Annex Building project. Mr. Pandey addressed the audience and spoke about the crucial role that IIT Bombay has played in his professional and personal growth, and how his contribution to the HSS Annex Building was his way of repaying his alma mater.

Mr. Sudarshan Saraf shared his thoughts on how the HSS Annex Building will play a key role in IIT Bombay's academic advancement. The ceremony concluded with a vote of thanks by Prof. Ravindra D. Gudi, Dean, Alumni and Corporate Relations.

The HSS Annex Building, as envisioned by Mr. Abhay Pandey, will strengthen the B.S. Economics Programme at IIT Bombay. In addition, the facility will reinforce the academic and research programs in the Humanities, and Social and Behavioural Sciences. Upon its completion, the HSS Annex Building will also be the future home of the Technocraft Centre for Applied Artificial Intelligence (TCA2I), supported by Technocraft Industries.



## IIT Bombay Signs MoU to establish the "Dr. K. V. Ramachandran Chair" for Statistics and Mathematics

IIT Bombay signed a Memorandum of Understanding (MoU) on August 19, 2022, with its alumnus, Dr. Viswanath Ramachandran (B.Tech, CSE, 1991), to establish the "Dr. K. V. Ramachandran Chair for Statistics and Mathematics" in honour of the donor's father. The MoU is the first-of-its-kind Chair Professorship that will be set up at the Institute in the field of Applied Statistics.

This Chair Professorship will support education and research in Statistics and Mathematics and will encourage faculty to make ground-breaking contributions to the discipline through fundamental and applied research. The Chair will also encourage Master's and Ph.D. students in Statistics and Mathematics to undertake research, participate in competitions, provide internship opportunities, as well as collaborate with industry and government organisations for R&D.



## IIT Bombay Launches the 'Kadayam S. Srinivasan' and 'Harivallabh Nagar Micro-Factories

IIT Bombay inaugurated its first-ever micro-factories on August 12, 2022, with a formal event held on campus. It was an exciting occasion as several Institute alumni, faculty

members and students graced the occasion and took in the newly established facilities on campus.

The event began with the ribbon-cutting ceremony and the unveiling of the plaque for the micro-factories. The attendees then enjoyed a special tour of the premises. Some of the dignitaries present at the occasion then addressed the guests. These included Prof. Subhasis Chaudhuri, Director, IIT Bombay; founders of the micro-factories and Institute alumni- Mr. Balaji Srinivasan (B.Tech, Chemical Engineering, 1993) and Mr. Sumeet Nagar (B. Tech, Mechanical Engineering, 1993); Prof. Varun Bhalerao, Associate Professor, Department of Physics, and Prof. Darshan Shah, Assistant Professor, Department of Mechanical Engineering (who are part of the core team overlooking the micro-factory project), and Prof. Ravindra D. Gudi, Dean, Alumni and Corporate Relations.

The micro-factories – the first step in IIT Bombay’s larger Makerspace initiative- will expose students to the latest design and manufacturing practices and advanced facilities which are on par with those found in real-world industrial setups. In addition to using the micro-factories for their core academic work, students will also be able to use them for a wide range of extracurricular innovation-related activities.



### **IIT Bombay Hosts the ‘Prof. N.R. Kamath Distinguished Institute Lecture’ Presented by Prof. Shankar P. Bhattacharyya**

IIT Bombay hosted the ‘Prof. N. R. Kamath Distinguished Institute Lecture’ in person on campus after a gap of two years. The lecture took place on August 16, 2022, at the Institute’s Victor Menezes Convention Centre (VMCC) and was graced by students as well as faculty in large numbers. The lecture, presented by Prof. Shankar P.

Bhattacharyya, Professor of Electrical Engineering, and the Robert M. Kennedy Professor at Texas A&M University, was highly informative and interactive and focused on the recent progress in the design of Proportional Integral Derivative (PID) Controller.

Design methods available for PID Controllers – used in the control industry across robotics, aerospace, driverless cars, and unmanned autonomous vehicles – until recently, were ad hoc. Prof. Bhattacharyya and his colleagues have developed an analytical approach for the design process subject to multiple performance specifications. The lecture covered how this design has been made possible by first determining the PID stabilizing set for the nominal plant. The presentation also described a recently developed novel approach to Multiple-Input Multi-Output (MIMO) control problems using SISO theory.



### **IITB Alumnus, Dr. Ranjit Rath, Takes Over as Chairman and Managing Director of Oil India Limited**

IIT Bombay alumnus, Dr. Ranjit Rath (MSc. Applied Geology, 1994), was appointed as the Chairman and Managing Director (CMD) of India’s second-largest state-run oil and gas producer, Oil India Limited (OIL). Dr. Rath officially took over the position on August 2, 2022.

Dr. Rath has over 25 years of experience in the field of Geosciences and before taking over as CMD of OIL, Dr. Rath held several significant positions in the industry. He was the CMD of Mineral Exploration & Consultancy Ltd., the CEO of Khanij Bidesh India Limited, the Managing Director of Bharat Gold Mines Ltd., and the

Director General of the Geological Survey of India.

Dr. Rath was honoured with the ‘National Geosciences Award’ given by the President of India, in 2016, for his service to the field of geosciences.



## IIT Bombay Signs MoU with JSW Steel to Set Up the JSW Technology Hub

IIT Bombay signed a Memorandum of Understanding (MoU) with the JSW Group on August 18, 2022, to establish a first-of-its-kind, state-of-the-art, technology hub for research in steel manufacturing in India. The JSW Technology hub will be set up within IIT Bombay's Centre of Excellence in Steel Technology (CoEST), established through support from the Ministry of Steel, the Government of India, and other industry partners.

The objective of this hub is to achieve rapid expansion of quality steel production while maintaining carbon emissions within the target levels. The partnership with IIT Bombay will also facilitate the JSW Group to undertake and intensify R&D efforts in the steel sector to develop competent capabilities in the area of steel technology for the Indian conglomerate. IIT Bombay and the JSW Group will leverage the JSW Technology Hub to conduct interdisciplinary research projects as well as a wide range of R&D and technical activities on various aspects of steel manufacturing and its use. The two parties will undertake research and training projects through this partnership to develop patented industrial applications and solutions. In addition, the Institute will establish the Sajjan Jindal Steel Chair Professorship for enabling enhanced focus on research and education on new and emerging technologies in steel manufacturing.



## Prof. Dinesh Kabra's Research on Solar Cells Published by the Prestigious Nature Journal

Prof. Dinesh Kabra and his team were recognised by the prestigious Nature Journal for their work on the next generation of optoelectronic materials for solar cells and display technologies. In the article, Prof. Kabra says, "My team uses high-performing unconventional optoelectronic materials — such as halide perovskites or organic semiconductors — to create solar cells that more efficiently generate energy than do existing ones, or lighting or display

technologies that consume less energy." Prof. Kabra and his team work at his fabrication laboratory at the National Centre for Photovoltaic Research and Education, which is part of the IIT Bombay.



## SINE and Powerthon 2022

Sixteen Technology Solutions Providers (TSPs) working on cutting-edge technologies in the power sector were selected under Powerthon 2022 to execute a pilot with 12 DISCOMs for the next 4 months. Seventeen agreements were signed in Delhi and the occasion was graced by the presence of Shri. Vivek Kumar, Chairman and Managing Director, and Shri. R. Lakshmanan, Chief Executive Officer, of REC Power Distribution Company Limited.



SINE is the implementing partner of Powerthon-2022, an initiative held under the Revamped Distribution Sector Scheme (RDSS) organised by the Ministry of Power, Govt of India, to enable advanced technologies in power distribution.





### **SINE and Ms. Poyni Bhatt, CEO, SINE, Felicitated at DST Utsav**

The Society for Innovation & Entrepreneurship (SINE) at IIT Bombay was recognised by the Department of Science and Technology (DST), Government of India, as a key enabler of the promotion of innovation and entrepreneurial activities. The ceremony was conducted during the DST Startup Utsav, a part of the Azadi Ka Amrit Mahotsav. Ms. Poyni Bhatt, CEO of SINE, was felicitated by the DST for her prolific and outstanding contributions to fostering innovation, incubation, and entrepreneurship in the country.

## **INSTITUTE HIGHLIGHTS**



### **IIT Bombay hosts Deputy Secretary of US Department of Treasury, Mr. Wally Adeyemo**

The Deputy Secretary of the US Department of Treasury, Mr. Wally Adeyamo, accompanied by senior members of the US Consulate General Mumbai, visited SINE and interacted with entrepreneurs and student innovators. As Deputy Secretary, Mr. Adeyemo serves as the US Treasury Department's number two official and chief operating officer. During the meet-and-greet, Prof. Subhasis Chaudhuri, Director, IIT Bombay, and Prof. Santosh Gharpure, SINE Professor-in-Charge, highlighted the contribution of IIT Bombay's innovations to the startup

ecosystem in the country.



### **IIT Bombay Celebrates Independence Day**

IIT Bombay celebrated Independence Day in the Main Building on August 15, 2022. The celebration began with the hoisting of the national flag by the Institute's Director, Prof. Subhasis Chaudhuri, at 9.30 a.m. Later, he addressed the gathering. The entire programme was broadcast live on IIT Bombay's YouTube Channel. Students also participated in a cultural programme on the occasion.





## **IIT Bombay Celebrates Azadi Kaa Amrit Mahotsav**

IIT Bombay held a series of events celebrating India's Azadi Ka Amrit Mahotsav (75 years of India's Independence). The Institute, in a stunning display, recreated the Dandi Memorial on campus. Twenty-four murals of Gandhiji and Satyagrahis were placed on the lawn facing the Main Building of the Institute. These 24 narrative murals depicted the various events and stories from the historic 1930 Salt March.

Many faculty members of IIT Bombay extended their valuable engineering, technology, and design contributions to building

this memorial which was a tribute to the 1930 Dandi March led by Mahatma Gandhi and 80 of his fellow Satyagrahis.

Also, as part of Azadi Ka Amrit Mahotsav, IIT Bombay arranged an Akhand Deep (Lighting of the Lamp) in remembrance of martyrs of the Indian Freedom Struggle in the Main Building during August 13-15, 2022. Prof. Subhasis Chaudhuri, Director, IIT Bombay, and Mr. Ganesh Bhorkade, Registrar, IIT Bombay, lit the Akhand Deep in the presence of other Institute employees. The Institute also arranged to showcase films on the National War Memorial and "Partition Horrors Remembrance Day" (August 14) at the same venue for three days.



## **IIT Bombay celebrates Van Mahotsav**

Van Mahotsav, the annual tree plantation drive, was held on campus (behind the Udayagiri building) on July 30, 2022. Prof. Subhasis Chaudhuri, Director, along with Prof. S. Sudarshan, Deputy Director (AIA), and Prof. K.V.K. Rao, Deputy Director (FEA), planted saplings of Ashok on the occasion. An additional 400 saplings were planted by the faculty, staff, and students of IIT Bombay, along with the students and teachers of Kendriya Vidyalaya and Campus School.

Prof. Chaudhuri spoke about the significance of the environment in our lives and encouraged the students to help build a greener campus by planting more trees.

Prof. Tom Mathew, Dean (Infrastructure Planning and Support), Prof. Anurag Garg, Associate Dean (IPS), and Prof. Vedagiri Perumal, Associate Dean (IPS), were also present on the occasion and encouraged the participants to develop a sense of responsibility for the saplings.

Later, students of Campus School and Kendriya Vidyalaya presented cultural performances highlighting the importance of trees which were much appreciated and enjoyed by those present. The event was organized by the Horticulture Section of the Estate Office, IIT Bombay, which takes due care of the saplings planted at Van Mahotsav throughout the year.



## **Team Shunya Launches Newsletter**

Team SHUNYA successfully launched the first edition of their newsletter, SUSTAIN. Esteemed chief guests, Mr. Durgesh Maru and Mr. Jaideep Hardikar shared their experiences of Net Zero Targets and the fight against climate change, and how to achieve sustainability on the occasion.



## IIT Bombay completes Highway for 21st Century India – Honourable Minister, Nitin Gadkari joins festivities

IIT Bombay completed its capacity-building program called ‘Highways for 21st Century India – Modern Technologies for Highways for North India’ in partnership with the Indian Academy of Highway Engineering and NHAI INDIA. The Honourable Minister for Road Transport and Highways, Nitin Gadkari, and Shri Giridhar Armane (Secretary RT&H) took time out of their busy schedule and interacted with the participants and encouraged them to adopt innovative technologies to

enhance quality, improve sustainability, reduce cost and increase the speed of execution.

## UPCOMING EVENTS



### IITB Bangalore Alumni Roadshow

IIT Bombay, in collaboration with the IIT Bombay Alumni Association Bengaluru Chapter, would be hosting an interactive meet-and-greet session for all its alumni members based in Bengaluru with Prof. Subhasis Chaudhari, Director, IIT Bombay, and learn about the Institute’s latest strategic initiatives. This dinner meeting will also allow attendees to catch up with their fellow IIT Bombay alumni and reminisce about their times together on

campus.

**Day & Date:** Saturday, September 10, 2022

**Time:** 7:00 P.M. onwards

**Venue:** Radisson Blue, Outer Ring Road, Bengaluru



### IIT Bombay Trust Lab

IIT Bombay will launch its first-ever Digital Trust Lab, named the ‘IIT Bombay Trust Lab’ on September 15, 2022. This Lab has been set up through the generous donation of IITB alumnus, Dr. Shridhar Shukla, who has generously contributed Rs. 29 Cr. towards this initiative.

As digital experiences rapidly become an integral part of our lives, security, privacy, population-scale access

and usability, citizen empowerment, etc., become fundamental enablers for a safe and prosperous society and nation. Towards that goal, IIT Bombay is setting up the IITB Trust Lab as a timely and far-reaching initiative so that the Institute takes the lead in the vast area of digital trust and supports nation-building.

**Day & Date:** Thursday, September 15, 2022

**Time:** 11:00 A.M. onwards

**Venue:** Victor Menezes Convention Centre, IIT Bombay campus



## **IIT Bombay Gen Zero Women Initiative**

IIT Bombay represents some of the best science and technology talent in India. The Institute has always promoted gender equality and women empowerment, even as our next generation of women students will join a legacy of women alumnae and global icons such as Padma Shri awardees Dr. Rohini M. Godbole, Dr. Sharada Srinivasan, and more.

To honour these exceptional women alumnae and their many stellar accomplishments, IIT Bombay, along with our alumnus, Mr. D.C. Agrawal, will be hosting an event called the 'IIT Bombay Gen Zero Women Initiative' with the launch of a coffee-table book and a podcast highlighting their stories.

**Day & Date:** September 23, 2022

**Time:** 3:00 pm onwards

**Venue:** Victor Menezes Convention Centre, IIT Bombay campus



## **IIT Bombay Research Park to Host Conclave on Sustainability**

IIT Bombay Research Park Foundation will host a Conclave on Sustainability on November 30, 2022.

Dr. M. Ravichandran, Secretary, Government of India, will be the guest of honour at the occasion. The sessions at the conclave will cover critical topics such as Air and Water Quality, Sustainable & Resilient Infrastructure, AI for Sustainability,

Climate Mitigation, Green Technology & Carbon Sequestration, Climate Policy and Circular Economy, and Food-Energy-Water nexus.

**Day & Date:** November 30, 2022

**Time:** TBA

**Venue:** IIT Bombay campus

## **STUDENT SUCCESS STORY**

IIT Bombay General Elections 2022: Crowning the Winners of the General Secretary, Hostel Affairs (GSHA), and General Secretary, Cultural Affairs (GSCA) Positions

*IIT Bombay General Elections 2022 were held on campus in March 2022. Kartik Bachhav won a very competitive election for the position of General Secretary, Hostel Affairs (GSHA), and Divya Mrinal won the election for General Secretary, Cultural Affairs (GSCA).*

*Here, both of them take us through the thrill of winning this election, what their new positions mean to them and how they plan to fulfil the mission they laid out in their respective manifestos.*

*Read on for more on Kartik and Divya's journeys.*

**Kartik Bachhav - General Secretary, Hostel Affairs, 2022-23 (GSHA)**





**Hi, Karthik...congratulations on a well-deserved victory. What made you contest for the position of General Secretary, Hostel Affairs (GSHA) during the 2022-23 General Elections?**

Thank you for your wishes. I am grateful to all the students of IIT Bombay for believing in me. Previously, I served as Institute Secretary, Hostel Affairs, in my 3rd year. I was also part of the maintenance and mess councils during my freshman and sophomore years. The knowledgeable and enriching experiences I got from these tenures gave me the impetus to run for the post of GSHA.

**The GSHA is a very specific post...what about taking care of hostels interested you?**

Working for the department of Hostel Affairs has intrigued me since my freshman year and continues to excite me. Hostels are where students spend most of their lives at the institute. I had a specific vision for the GSHA position and came up with many initiatives for the betterment of the student community. The GSHA position is a highly responsible and impact-making post. All this aligned with my previous experiences on campus and motivated me to contest for the position of General Secretary, Hostel Affairs.

**Any election campaign brings with it a lot of excitement, stress, and nervousness. Combine that with the pandemic, I'm sure there was extra pressure this time around. How did you handle it? Can you take us through the campaigning process?**

Absolutely. The whole journey was filled with ups and downs and was very stressful. My coursework and the electioneering campaign occurred simultaneously. I had to file nomination papers, do a lot of groundwork, prepare my manifesto, and campaign for the elections, along with studying for my degree. But it was also very exciting. Campaigning for the GSHA position gave me an insight into the diverse mindset and expectations of various students from different departments. In terms of handling stress, the lion's share of the credit goes to my dear friends. They were with me during every phase of the elections and shared my worries and concerns. Also, talking to my family and my seniors helped me relax.

**What are your key roles as the General Secretary of Hostel Affairs?**

As GSHA, I'm a member of various committees on campus that deal with issues related to our hostels and make decisions for the welfare of the hostels. GSHA is a member of the Security Advisory Committee, Hospital and Health Advisory Committee, Gender Cell, etc. and these committees make important decisions across all Institute-based guidelines.

The GSHA also chairs the Hostel General Secretaries Committee, Maintenance Committee, and Mess Committee. Apart from these, the position of the GSHA is very dynamic and ongoing and I have to handle situations that change daily.

**How do you plan to fulfil all of the goals about the welfare of hostels at IITB as outlined by you in your election manifesto?**



We have already started working on the manifesto. The formation of the Hostel Affairs Council will be completed in a couple of weeks and I will then distribute the work among the council members. We have already started the transportation project which will be extremely beneficial to our students. We are setting up new juice centres across campus. We are also working on some digitisation projects. The plan is to distribute the work efficiently among the council members and follow up with them regularly. I'm certain that the Hostel Affairs Council will run smoothly and we will deliver the results as expected by the students.

### **Divya Mrinal – General Secretary, Cultural Affairs, 2022-23 (GSCA)**



**Hi, Divya, our heartiest congratulations to you on winning the position of General Secretary, Cultural Affairs. How does it feel?**

Thank you for your wishes! It feels great! This is the first time that I've contested an election and the journey was marvellous! I am grateful for the opportunity to represent the students in our institute and provide them with a platform to develop, nurture and hone their skills in various cultural activities during their stay at IIT Bombay.

**What made you contest for the GSCA position? Are you artistically and/or culturally inclined yourself?**

Anni Albers said that "Art is something that makes you breathe with a different kind of happiness." I believe in this wholeheartedly. I am an enthusiastic artist and have participated in a variety of cultural activities during my school days. I learnt the classical dance form *Bharatanatyam*. I have won first prize in singing competitions, debating competitions, and on-the-spot elocution competitions. I have passed the Elementary and Intermediate Drawing Grade examinations with an 'A' grade. I write articles, quotes, and poems. I also enjoy making greeting cards, origami art, mandala, Madhubani, and Warli art.

I have also taken an active part in Culturals, IIT Bombay, right from my first year. All of these memorable artistic experiences led me to run for the GSCA position during the Student Elections.

**What are some of the key responsibilities of the GSCA?**

Some of the key responsibilities of the GSCA are:

- Ensuring planning and conducting of cultural events and GCs by the Institute Cultural Council
- Working on collaborative cultural events and encouraging active participation of IIT Bombay students in inter-college cultural events and competitions

**Do you have any interesting and unique cultural activities planned for IIT Bombay? Can you elaborate on them?**

One of my plans is to introduce the culinary arts on campus this year and provide food enthusiasts the chance to experiment and explore making new dishes. I also want to encourage students to produce original video mini-series on various cultural genres and activities on campus.

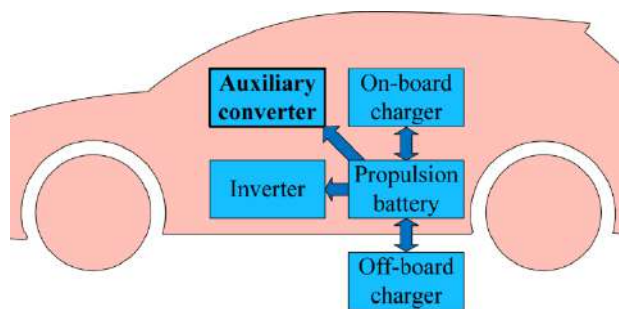
**Election campaigns are highly stressful and taxing, but I am sure you had some fun moments as well. Can you take us through some light moments from your election campaign?**

My election journey was a unique experience for me and my team. It was filled with learning, interacting, growing, exploring, and taking risks. It was the first time I saw all the hostels on campus inside and out. It was a great experience interacting with so many people and listening to their suggestions and ideas.

One of my most cherished memories is going out of campus with my campaign managers on the day of the election and spending the entire day with them.

*What a wonderful experience Karthik and Mrinal had during their elections to the Student Council. Both of them have a clear vision for their positions and the energy and enthusiasm to make sure they bring their vision to fruition. We wish them both the very best moving forward.*

## STUDENT RESEARCH ARTICLE



### Compact and efficient GaN-based power supply for E-mobility

**Name:** Arnab Sarkar  
**Department:** Electrical Engineering  
**Programme:** Ph.D.

#### Significance/Application

Power electronic converters play an essential role in the e-mobility industry. The ever increasing demand for better efficiency, reliability, and compactness of electric vehicle components requires innovation in power electronics. The wide bandgap (WBG) devices are a new disruptive technology that can drastically change the power electronics industry. Gallium Nitride (GaN) transistors, a WBG device, offer superior performance in various parameters than conventional Silicon (Si) based power devices. Properties such as very low input capacitance and low/negligible reverse recovery charge allow GaN devices to operate at higher switching frequency with lower power loss than Si devices. These features result in decreased cooling requirements and smaller passive components, contributing to lower system volume and costs, as shown in Fig. 1.

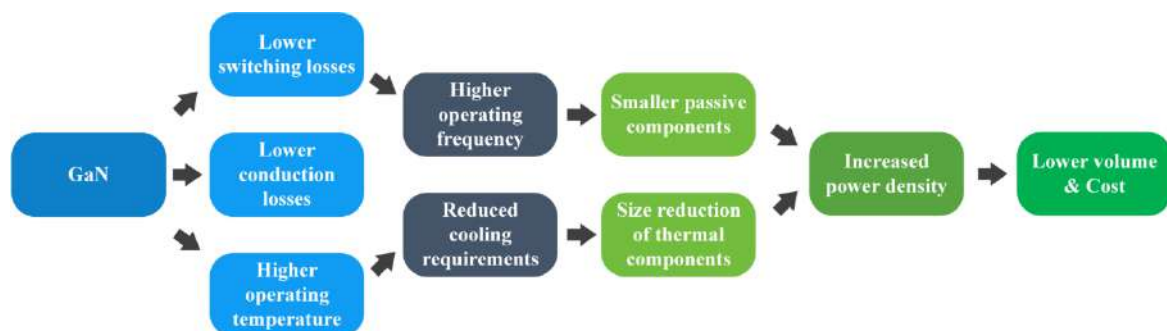
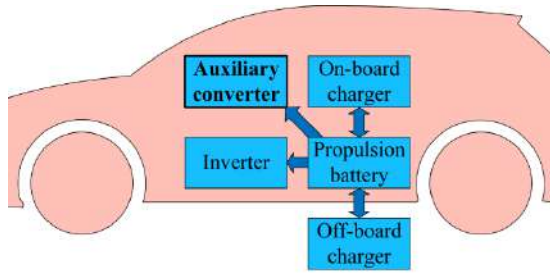


Fig. 1 Advantages of GaN technology in Power Electronics

The rapid advancement of wide bandgap power transistor technology has facilitated comprehensive R&D efforts in academia and industry to assess the impact of GaN devices for power electronic converters. Research is being carried out on converter topologies that can exploit the unique device characteristics of GaN transistors to get better performance in addition to volume and loss reduction. One such research project by our team, led by Prof. Sandeep Anand from the department of electrical engineering, utilized the distinctive reverse conduction characteristics of GaN transistors to improve the performance of power electronic converters. This improvement

reduces the cross-regulation while ensuring a small size and high efficiency of the auxiliary power supply for E-mobility applications.



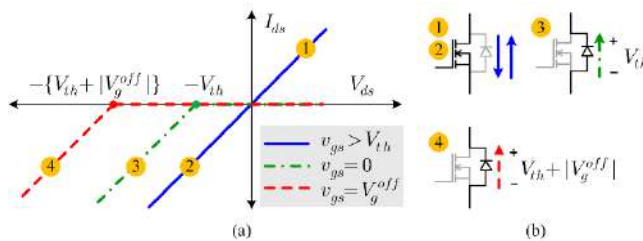
### The cross-regulation problem

Fig. 2 Power electronic converters in an electric vehicle

The four major power electronic converters in an electric vehicle are the off-board charger, on-board charger, inverter, and the auxiliary power supply, as shown in Fig. 2. Among these converters, the auxiliary power supply is used to provide power to the vehicle’s various subsystems,

such as communication, control, sensors, and protection circuits. Different levels of voltages are required to power these individual subsystems. Isolation between the output voltages and the input supply is another key necessity. The multiple output flyback converter (MOFC) topology is used widely as the auxiliary power supply in low-power applications because of its simplicity, fewer components, and overall cost-effectiveness.

Cross-regulation between different outputs is an important requirement in conventional MOFCs. It is defined as the deviation of an output voltage due to a load disturbance on another output. Note that it is different from load regulation, which is the deviation of an output voltage due to the load disturbance in the same output. The voltage deviation due to cross-regulation can be upwards of 5% in a worst-case condition, which is unacceptable since a regulated DC voltage is desirable in most applications. Conventional methods of improving cross-regulation achieve better performance at either the cost of system efficiency, power density, or both.



### Use of GaN characteristics to achieve better regulation

Fig. 3 (a) Gate dependent reverse conduction characteristic of an e-mode GaN HEMT. (b) Equivalent symbol representation

To solve the cross-regulation problem of MOFCs, the team came up with an innovative technique where the gate-dependent reverse conduction characteristics of enhancement-mode GaN transistors are utilized. In a nutshell, the GaN transistor can block a certain amount of voltage in the reverse direction when it is turned OFF with a negative gate voltage, as observed from the I-V characteristics shown in Fig. 3. This property is utilized in the MOFC, where all active switches are GaN transistors. For example, in the case of a two-output flyback converter (shown in Fig 4), while the primary switch is driven with a unipolar gate driver, bipolar gate drivers are used to turn ON the secondary and tertiary switches during two distinct intervals. Due to the use of negative turn OFF voltages, the secondary and tertiary windings conduct current in two distinct intervals. These two intervals, and consequently, the flow of current to each of the output capacitors is controlled using two PI controllers to independently regulate each output voltage, as shown in Fig 4.

To solve the cross-regulation problem of

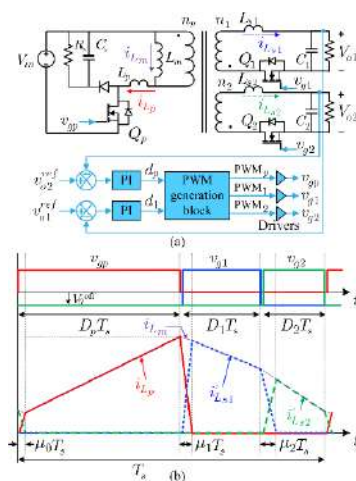


Fig. 4 GaN-based two-output flyback converter with independently controlled outputs: (a) circuit diagram and control scheme, (b) steady state representative waveforms of gate to source voltages and winding currents.

### Detailed principle of operation

The operating principle of the developed technique is explained with an example of a two-output flyback converter as follows. Referring to Fig. 4 (a), the primary switch ( $Q_p$ ) is turned ON, and the primary winding conducts similarly to a conventional flyback converter. When  $Q_p$  turns OFF, the secondary switch  $Q_1$  is turned ON. At the same time, the tertiary switch ( $Q_2$ ) is kept OFF with a negative gate bias. Current only builds up through  $Q_1$  in the secondary winding because  $Q_2$  is in reverse blocking mode, and it blocks the flow of current in the tertiary winding. After a particular duration,  $Q_1$  is turned OFF with a negative gate bias, and  $Q_2$  is turned ON. In this

case, the leakage inductance current continues flowing through Q1 in reverse conduction while Q2 also starts conducting. Once the leakage inductance current reduces to zero, Q1 enters reverse blocking mode. After the conduction of Q2, Qp turns ON again. Fig. 4 (b) shows the representative transformer winding currents of the converter during the above stages of operations at a steady state. The output voltages of the converter are tightly regulated by controlling the duration for which each of the output winding conducts.

## **Experimental Prototype and Results**

Arnab Sarkar (Ph.D. student in the Department of Electrical Engineering) also presented this work in the IEEE Industrial Electronics Society (IES) Student and Young Professional Competition 2021 and was awarded the third prize of \$500. The team is also working on various other aspects of WBG-based power electronics for E-mobility applications.

Research Paper: A. Sarkar, B. T. Vankayalapati and S. Anand, "GaN-Based Multiple Output Flyback Converter with Independently Controlled Outputs," in IEEE Transactions on Industrial Electronics, vol. 69, no. 3, pp. 2565-2576, March 2022.

Presentation Video: <https://www.youtube.com/watch?v=OoLTPoBm048>