BACKGROUND HUM

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DEPARTMENT OF ELECTRICAL ENGINEERING INDIAN INSTITUTE OF TECHNOLOGY BOMBAY



We are happy to bring yet another issue of Background Hum. Over the past year, we have witnessed a remarkable shift from the online realm to the offline world. With in-person classes now in full swing, the department has also seen the emergence of new facilities alongside a series of exciting events organised by our student council (EESA) and the department Alumni and Corporate Engagement (ACE) cell.

The editorial team has curated a wide array of articles that will provide you with an immersive journey through the various happenings of our department over the past year.

We are also thrilled to introduce "Know Thy Turf", a collaborative initiative by Background Hum and ACE to shed light on lesser-known labs and facilities in the department, offering valuable insights and spotlighting their unique contributions.

We are thankful to professors, lab staff, students and alumni for their continuous support and encouragement.

We would love to hear from you! Please send your valuable comments and suggestions to bh@ee.iitb.ac.in.





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HEAD'S MESSAGE



Prof. Kishore Chatterjee Head, Department of Electrical Engg, IIT Bombay

Welcome dear students and alumni to one of the largest and one of the best EE Departments the world over.

If you see the evolution of the department from the past to the present, when I joined in 1998 we had approximately 400 - 450 students in total - around 15 to 20 PhD students, 100 M.Tech students. with 200 300 undergraduate students. Today the EE Department is spread over four buildings in the institute. Our total student strength is around 1300 and out of this, 500+ are undergraduate students while the rest 700+ are postgraduate students. And our faculty numbers have grown exponentially in the past decade.

From the '90s to 2023, EE has changed primarily from an undergraduate teaching space to an undergraduate teaching as well as a research department. Not only that, 20 years back, the number of faculty members used to be around 30, now it is 70+. We have taken bold steps over the past decade. We firmly believed that if we consistently recruited young minds the department would grow in the right direction. I can now definitely say that we took the right decisions.

The faculty members of the department are eager to engage with the EE community of students, alumni and staff in all possible ways – be it professional, cultural or social. Especially after Covid years, we should take opportunities to interact with each other. To the students, I would suggest they take the maximum benefit of living on campus with peers and faculty members.

We have a new Alumni and Corporate Engagement Initiative that seeks to build more connections between students, faculty and alumni as well as industry and academic peers. They organize interactive events for connecting across student years and alumni batches, highlight department strengths to the industry and share department vision with alumni at large.

I hope you enjoy the selection of these articles that show the unity in diversity of our vibrant Department!

Event Highlights

The Department Fest

An MPULSE is all it takes!

After weeks of dedicated work by the student councils, the EE department fest made a comeback in a fresh and exciting format called Impulse, drawing a significant turnout of students and alumni. In this article, we provide a comprehensive overview of the event, highlighting the informal activities, informative talks, and mentoring sessions that fostered a renewed sense of connection among students and forged stronger ties between students and alumni.

Features







What exactly is a fest organised for? Fests are meant to provide a platform for students to showcase their talents through competitions and exhibitions and to network with professors, alumni and other professionals in the field, providing students with valuable insights and connections.

Thinking and brainstorming along similar lines, our EESA council went ahead with the inception of Impulse. Fests held by other departments and their success stories had also been a source of inspiration. It was a brand new launch after a dry spell of several years and was bound to be a delightful affair, as it turned out to be.

Another aspect of organizing a fest is the management of funding and logistics. On the part of Impulse, it is a bittersweet fact that there were no external sponsors, which makes us realize with even more severity that the fest had been organized on a considerably large scale using all that was available, and that is truly worth noting.

Our alumni played a significant role throughout the fest and helped with every ounce of resource they had, and now we know that their efforts were not in vain. Apart from them, Alumni and Corporate Engagement (ACE) was a primary contributor towards all the organizational aspects of the fest.

There was tremendous excitement on the night of 25th January 2023, during the EE Cult Night, when our EESA council announced the revival of our much-awaited department fest. The name had not been decided at the time of the announcement; but that is an entirely different story to be told!

Our department was getting a fest of its own for the first time after a seemingly indefinite void; no wonder people were on cloud nine. Avriti had been our department fest earlier but it went dormant for several reasons. Now, after a gap of many years, *Impulse* geared up to set in motion the revival of lost legacy.

Impulse was inaugurated with the Formals Night on 17th March at VMCC, the epicenter of all events. Several engaging events and activities followed on 18th March with special guest highlights per event. The most star-studded among them was "Meet the Team of Rocket Boys".

The entire conception and organization of the fest was a brave and commendable effort on the part of the organizing team. The audience had a whale of a time, reveling in the major events and splendid showcases, talks, performances, and beautiful artwork. Read ahead to delve deeper into the world of our fantastic fest, our *Impulse*!



WHAT'S IN A NAME? EVERYTHING!

The name Impulse strikes a chord and makes us feel a sense of completeness. After all, everything electrical starts with an impulse; it goes way back to the origin of all we know. But how did our fest end up being named Impulse in the first place? The story is a fascinating one.

TAN

As we all know, the previous department fest was called *Avriti*. But our fest deserved a fresh face, a fresh format, a more inclusive and broad scope as it was revived after a long time. Hence, a new avatar under a new name!

The organizing team mulled over this cogitative task but couldn't come up with a name as perfect, which would epitomize everything the fest was about. They weren't ready to settle for the ordinary at all. So, to widen the domain of creativity, and since our council has a knack for turning everything into a contest, here we were: *the Name our Fest Contest*. Now everyone had a chance to get their creative juices flowing and suggest a name for our fest that would be evoked and reminisced by all. The contest was announced with cool prizes for the winner.

It was finally during Cult Night when we could witness, on the projector screen, a list of some thought-out and appreciable names which fellow students had suggested. It was up to the audience to vote and determine the face of the fest. Obviously, everyone wanted a vote, they cast it, and that was it; pandemonium. Nothing could be heard over the din.

The next moment, everyone was tapping away into their phones to answer the online poll and the audience watched in anticipation as the bars toggled with every vote. Yet, no conclusion was reached that night, as two names, *Impulse* and *Vidyutsav*, were tied at the top. The atmosphere was enigmatic. After much consideration and deliberation on the part of the organizing team, *Impulse* turned out to be the final choice, and the rest, as they say, is history!

Formals Nite A Magnificent Kickstart to Impulse's Extraordinary Journey

Formals Nite resembled a beautiful mosaic of colour with everyone adorned in elegant formal outfits, exquisitely pleasing to the eye; it was nothing short of a fairytale, a truly magical rendezvous.



Group Photo: Thirdie Batch



Group Photo: Fifthies Batch



Inaugural cake

Formals Nite marked the launch of department f<u>est,</u> our our dear Impulse. The its fest and components were officially announced, leaving the audience in anticipation of what they were in for real. We celebrate Traditional Day in our department, so why not a Formals Nite too? This was the very crux of the idea that motivated the organizing team to bring forth this event. Just like people had donned Indian traditional wear, they now had a chance to flaunt themselves in Western wear. establishing а celebration of cultures. The chief guest for this event was Mr Kamal Kishore Kumawat, who had been the Overall Coordinator of Avriti in the past.

One scintillating performance after the other kept all the spectators entertained. A band performance by students from the first and second years of our department made everyone's hearts race with the rhythm. Dancers from the inter-IIT team, fourth-year students in our department, got to witness the fruit of their week-long rehearsals as the crowd cheered them on, filled the hall with applause for a performance which brought everyone to the edge of their seats (or the stairs, for the unfortunate latecomers).

A photo booth, decorated with monochrome balloons, had been set up right outside the hall. It was the most popular fixture! Some claimed to have dressed up especially to look picture-perfect for the photos.

The response by the audience was overwhelming. The organizers had not anticipated that so manv people would turn up, the auditorium seemed to be bursting at the seams, and the audience's trust was not misplaced since it turned out to be an unforgettable night. And of course, what could have been a better chance for everyone to officially show off their Western looks?







Wired, DMM, LED!

Day 2 began on an intellectual note with Wired, the flagship quiz contest of Impulse. It was a spectacularly heated battle of wits, with each team vying to be at the top of the leaderboard, which seemed to be changing loyalties after each question. It was no less than an actual quiz contest, with smart and diligent guizmasters, Jainesh and Siddharth, second-year students from our department.

Apart from being an imperative fest event in itself, it also served as a pragmatic competition related to everything electrical, and it presented a challenge to us, a test of how much we know about our department, in every respect. Most importantly, the aim was that the audience must have fun: the efforts were not in vain. There were two rounds in total. Round 1 was an elimination round, in which the participants were asked 23 timed questions in total. and the leaderboard was displayed after each question. After this round, the top 7 teams entered Round 2, which was a buzzer round. Here, the competition became more intense, and the scoring scheme was brutal.

A major perk to the audience here was that if none of the teams could answer a question, it would get passed on to them, and for a correct answer, a cash prize of Rs. 400 would be given. The audience's excitement knew no bounds. The hall brimmed with electric energy and unbridled enthusiasm. The winners of Wired were Azeem Motiwala and Aditya Bhangale, second-year students of our department. They received a cash prize of Rs. 5,000 each.

The event was conducted quite skillfully and professionally. The aura was mesmerizing, and one felt like being part of an actual quiz contest, the likes of which we see on TV.

The flagship meme competition, DMM (Dede Merko Meme), received an overwhelming response from the freshies. The event witnessed a flurry of meme creations producing a multitude of memes capturing various aspects of campus life and playfully highlighting the differences between electrical and other branches. In recognition of their talent, the top two entries from each category were awarded cash prizes of Rs 1000 and 500, respectively.

Let Enlightenment Dawn (LED!) challenged students to create concept videos exploring various aspects of electrical engineering. Participants embraced their creativity and embarked on an imaginative journey elucidate complex to Impressed concepts. by the submissions, the organising team selected the finest entry to be showcased during the Formal Night, adding an extra layer of prestige to the event.

ALUMNI INSIGHTS

From Engineer to Entrepreneur



From circuits. To success.

enthusiastic alumni of Twenty our department, who had once been in our place, had created the same circuits we do and now are pioneers in core electrical, software, research finance. management, and backgrounds gathered to provide valuable guidance, and mentorship insights, to students looking to pursue similar paths.

The event offered networking opportunities and a chance to learn from their expertise, fostering meaningful connections and future success. About 60 - 80 students turned up to listen to advice, ask questions and clear doubts.

This event was custom-designed for students interested in core electrical engineering and looking at entrepreneurship as an option in the future.

The chief guest was Mr Sunil Sherlekar, Cofounder and Director at SankhyaSutra and an alumnus of our department(batch of 1978). He shared his journey of building his enterprise, his accomplishments, the difficulties he faced and how he encountered them.

He discussed the various steps involved in the entrepreneurial process (ideation, fundraising, marketing, and scaling) and the need for young entrepreneurs in India. No wonder that, as the talk proceeded, several questions began bubbling in the audience's mind, and they were eager to get them answered by the veteran visionary.



Meet the Tech Giants



Mr. Munir Sayyad (Asst. Vice President, Jio), Mr. Ravindra Shet (Head, IoT, Samsung) & Mr. Rahul Tallamraju (Sr. Technical Lead, Computer Vision, Mercedes) were the distinguished speakers for this event.

It was an incredible experience to sit back and listen as these influential personalities recounted their success stories and had some pointers in store for the awestruck audience. This was yet another of the brilliant efforts made by the organisers in bringing to life an event which had something for everyone and indispensable take-home messages in the end.

The event was a brainchild of ACE (Alumni and Corporate Engagement), who put together everything to bring three notable pioneers under one roof, and the rest is history.



Impulse Supported by IITB AA and EE ACE

All of this couldn't have been possible without the IITB AA and the EE ACE team, who played a major role in providing necessary assistance. They contributed resources and experience and left no stone unturned in ensuring the event was a grand success and full of useful takeaways for the students.

The relationships fostered in a few hours that day would continue to live and prosper. The event succeeded in creating thriving networks, these essential primordial circuits which would become an intricate web of connections over time, leading to a more connected EE community.

An impulse is indeed all it takes!

From Hype to Reality CRYPTOCURRENCY MARKET

Over \$150B.

That's how much money the top 15 cryptocurrencies lost in three days. The collapse of FTX, a growingly popular cryptocurrency exchange and crypto hedge fund, in November '22 sent shockwaves throughout the cryptocurrency industry.

On November 2nd, crypto news site CoinDesk published a report from a leaked Alameda balance sheet which showed that of the \$14.6B in assets, over \$5B were held in FTT, the token (cryptocurrency) of Alameda's sister company, FTX, instead of being in a currency or other fiat cryptocurrencies. In response. Alameda CEO Caroline Ellison tweeted that the balance sheet was incomplete and that the financial situation was "under control." However, nobody bought this, and soon people started withdrawing from FTX. FTX's prices plummeted.

The situation escalated on November 6th, when Binance, the largest cryptotrading platform by volume and an initial investor in FTX, said it would liquidate hundreds of millions of dollars worth of FTT. Hysteria spread like wildfire and soon sparked mass withdrawals. Over \$4B of transactions took place that day, many times the usual number. A day later, the number ballooned to \$6B, and by November 8th, FTX's financials were in crisis. FTX announced its liquidity crisis and sought a bailout from venture capitalists and later Binance.

Binance announced that it would acquire FTX's non-US businesses, and things were taking a positive turn. It seemed like FTX had managed to solve its problem. But on the very next day, Binance backed out of the non-binding agreement, raising concerns about the mishandling of customer funds, among other issues, after conducting due diligence. The Wall Street Journal reported that FTX was using billions of dollars worth of customer funds to make risky bets through its trading firm, Alameda Research. What people had long speculated finally came to light. The Bahamas froze FTX's assets. On November 11th, Sam Bankman-Fried resigned as FTX CEO and filed for bankruptcy. He's currently facing trial.

FTX's crash overhauled the crypto market entirely. But it has been getting a lot of traction over the past couple of years. So what exactly is the cryptocurrency market? How did it spring into existence?

The first paper on Bitcoin was released in 2008, and fast forward to 2023, the identity of its creator is still unknown. Published under Satoshi Nakamoto's pseudonym, the paper challenged the trusted financial institutions (banks). It proposed a new peer-to-peer electronic cash system. As long as the majority of the population wasn't colluding to sabotage the system, the network was safe (but not in anyone's hands). Since then, about 22,000 other cryptocurrencies have emerged. Ethereum, Bitcoin, and Dogecoin are some of the most popular ones. But not all of them provide the same functionalities as your standard currencies. Ethereum has smart contract capabilities, enabling the automation of complex financial transactions and creating decentralized applications, but Bitcoin doesn't. However, all of them are built upon the same framework, the Blockchain. Introduced in 1991, it boomed only after 2008 with the advent of Bitcoin. **Blockchains** maintain a secure and decentralized record of transactions. Blockchains use cryptography to create an mmutable ledger.



Each block in a blockchain contains a unique cryptographic hash, which acts as a digital fingerprint of the block's contents. These blocks are then chained together sequentially, creating an unbroken chain of data. The immutability of a blockchain is ensured by the interconnectivity of the blocks. As new blocks are added to the chain, they contain the previous block's hash, which in turn includes the hash of its last block. creating a chronological and linked sequence of blocks. If an adversary tries to tamper with the data stored within a block, it will cause a ripple effect throughout the chain. The hashes of subsequent blocks will no longer match the previous ones, creating a discrepancy that other nodes in the network will detect and reject. This consensus mechanism ensures that the integrity of the data stored within the Blockchain remains secure and tamper-proof.

After the advent of blockchains, the research on applied cryptography has grown multifold. For example, take the case of Zero Knowledge Proofs (ZKPs). Suppose you want to take a loan from a bank; however, you want to keep your wealth and assets private but want to prove that you have enough collateral to provide. ZKPs let you do just that. Imagine giving feedback on ASC and having proof of it that it is completely anonymous!

The math involved here is complex, but it's phenomenal just how much we have progressed. But how much of it is even practically used in our society? Can we imagine someday transacting regularly with cryptocurrencies?

with Prof. After а quick chat Saravanan here at EE, it came to light that even after all the advancements that have taken place in the field we are still a long way from transacting bitcoins in our day-to-day lives. One of the major reasons is the reluctance of governments across the world and the current financial institutions to adopt it. Since today's banks primarily rely on loans, the introduction of cryptocurrencies may lead to bank failures. Despite all of this, research in the crypto domain cannot be hotter than it is now. Hop in at Trust Lab to discover more about it!



Prof. Saravanan Vijayakumaran is an Associate Professor in the department of Electrical Engineering at IIT Bombay. His research interests include Cryptocurrency technologies, High-Performance Computing, Error Correcting Codes, and Signal Processing.

He currently works in areas around ZKPs, smart contracts, and privacy aspects of cryptocurrencies. He has taught courses such as Error Correcting Codes (EE 605), An Introduction to Number Theory and Cryptography (EE 720), Advanced Error Correcting Codes (EE 754), and Cryptocurrency and Blockchain Technologies (EE 465) and more Journey of Mapit.ai: An IIT Bombay Startup

MapIT.ai is a cutting-edge startup founded by a team of IIT Bombay students specializing in developing Internet of Things (IoT) solutions for a wide range of applications. We reached out to one of their co-founders Harshit Jain, a third-year undergraduate student in the EOlectrical Department. Following are some excerpts from the conversation that followed:

A startup at a young age is not a usual thing. What motivated you to do so?

Starting a business at a young age is not a common path, but it's been a natural decision for me. There are several reasons why I chose to start my own business.

Firstly, I wanted the freedom to work on my terms and values, something that's not always possible in a corporate environment. Being an entrepreneur gives me the space to explore and be creative, something I've long longed for.



Another motivation for me is the desire to create something that has a lasting impact and adds value. With my startup, I have the opportunity to build something that can make a real difference in people's lives.

From a philosophical standpoint, being an entrepreneur allows you to define the future. It gives you the power to influence how people think and experience things. I wanted to create something that truly mattered to me and aligned with my values rather than being trapped in a reward cycle based solely on money and hierarchy.

Lastly, entrepreneurship is a mindset not constrained to a specific age or type of company. It's about taking risks, adaptable, and being constantly learning and growing. Starting а business has been an incredible journey for me, and I'm excited to continue learning and building a company that reflects my vision and values.

What is Maplt.ai about?

Mapit.ai is a custom IoT solution provider specialising in indoor positioning and automation systems. Indoor Positioning System (IPS) is useful in indoor spaces such as airports, hospitals and warehouses where GPS signals may be weak or unavailable. For instance, it offers airports the advantage of providing users with apps that help them easily navigate by providing important information such as the locations of nearby check-in lines, distances to gates, boarding times, and real-time asset tracking capabilities that enhance the convenience of finding luggage, wheelchairs, and other necessary items within the airport. Shopping malls and museums have also started using IPS to help customers navigate different sections and provide audio guidance to improve user experience.

IPS can use various technologies such as Wifi, Bluetooth, Infrared and ultrasonic to accurately determine the objects' location. MapIt's solution uses Bluetooth Low Energy (BLE) beacons or transmitters, which are cost-effective, consume low power, and are easy to deploy. Our technology utilises Trilateration, Dead Reckoning, and Sensor Fusion algorithms to estimate a user's location in real-time.

The process begins with extracting RSSI value from Bluetooth signals transmitted by Bluetooth beacons (which send Bluetooth signals at a particular frequency) which are then cleaned using Kalman filtering. The distance from the beacon is estimated using an adaptive path loss model, and coordinates are determined through Trilateration. To increase accuracy, Dead Reckoning is also applied to calculate coordinates. The final location is calculated through sensor fusion of Trilateration and Dead Reckoning.

The location is implemented on the pre-fed local map on the Android application. This data is then transmitted to the cloud server for real-time Al/ML analytics, which appears on the Admin web application with real-time analytics.

Our mission is to empower individuals and organisations to gain greater control over themselves and their processes. We are driven by the belief achieving this control that can contribute to a more seamless functioning of society, ultimately making the world a better place. We want to automate the boring stuff so you can focus on developing your business. After all, "True freedom comes from autonomy!" isn't it?

What challenges did you face during the process, and how did you overcome them?

I have had a relatively incredible journey. Thanks to all the support from alums who guided us in getting funding, industry perspectives and helping us perfect product market fit.

One of the challenges we face is forming a great team to work on our various projects. You can't decide to recruit a person in your core team based on a resume and interview. So, we provide internships to learn about people's work ethics and if they can adapt to collaborate with us. We then allow these interns to join our core team.

Another challenge is that of commitment. As a student in the electrical engineering department, time has always been a constraint. But managing it comes with challenges and rewards at the same time.

Concluding remarks

I want to express my excitement about the future of MapIT.ai and invite anyone who shares our vision to join us on this journey. If you are passionate about technology and want to make a meaningful impact, we'd love to have you on our team. At MapIT.ai, we're not just building a product; we're building a community of innovators passionate about creating cutting-edge solutions. So, if you're ready to be a part of something groundbreaking, don't hesitate to contact us. Together, we can revolutionise the way people interact through IoT.





MapIT team: Harshit Jain, Sachin Kumar, Balbir Yadav and Auro Soni

Know Thy Turf

'Know Thy Turf' is an initiative by Background Hum and ACE, designed to shed light on lesserknown labs within the department and raise awareness about the numerous facilities they offer. In this edition, we provide comprehensive information about the forthcoming power train lab and Semix lab, the PQUEST lab, the Machines lab and the recently established facilities in WEL.

> If you have any feedback or would like to feature your lab in the upcoming edition, feel free to contact us via email at <u>bh@ee.iitb.ac.in</u>.

IT Bombay establishes EVPOVER TRAINLAB

Alumni from the Batch of '73 fund cutting–edge research facility to propel EV research

To catalyse the growth of the electric vehicle (EV) industry in India, IIT Bombay is gearing up to establish the EV Power Train Lab. The initiative, made possible through generous funding by the college's esteemed alumni from the batch of '73, aims to address critical challenges faced by the Indian EV ecosystem. This stateof-the-art research facility will focus of on various aspects FV development, ranging from working with companies in vehicle design to chip manufacturing, and involve a multidisciplinary team from different branches of engineering at IIT Bombay.



We reached out to Prof Sandeep Anand to learn more about the upcoming facility. Following are some excerpts from the conversation that followed.

Driving Force behind the EV Power Train Lab

The decision to establish the EV Power Train Lab emerged from extensive discussions among the batch of '73 alumni. Their primary objective is to promote indigenous research at IIT Bombay, specifically catering to the unique demands of the Indian EV market. Recognising the significant potential in the twowheeler segment, which dominates the Indian landscape, the alumni aim to explore solutions and innovations that will transform the sector. Beyond financial support, the batch of '73 will provide valuable industry expertise and mentorship, ensuring the lab's self-sustainability in the future. The EV Power Train Lab is expected to contribute substantially to the growth and development of the EV industry in India. By focusing on research areas that directly address challenges faced by Indian players across the EV supply chain, the lab aims to foster innovation and facilitate localised design and manufacturing.

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Research Areas and Collaborations

The lab will initially concentrate on power-related aspects of EVs. including charging technologies and battery management systems (BMS). Collaborations with industry partners such as India Nippon Electricals Ltd., Cummins, and Log9 are already in advanced stages, showcasing the lab's commitment to forging partnerships that accelerate innovation. These collaborations will provide invaluable opportunities for researchers to work on cutting-edge projects and realworld problem-solving.

The EV Power Train Lab recognises the importance of involving students in its research endeavours. Students from various departments, including electrical. mechanical, chemical engineering, and chemistry. can engage in projects related to battery pack design, BMS, cooling systems, and other electrical aspects. Through supervised learning projects, bachelor's and dual-degree theses students will gain hands-on experience in the dynamic field of power electronics and contribute to of the future sustainable transportation.





Looking ahead, Prof. Sandeep Anand envisions a full-fledged EV research facility that tackles а broader spectrum of challenges, including autonomous driving and battery chemistry. The lab's long-term goals include fostering the indigenisation of EV manufacturing design and processes, reducing reliance on and nurturing outsourcing, local talent. By pioneering groundbreaking The lab research. aims to revolutionise mobility, spearhead innovation, and shape a greener future for India's transportation sector.

The EV Power Train Lab will house cutting-edge equipment and facilities to support its research activities. Hydraulic presses for lifting EVs and dynamometers for motor testing are just a glimpse of the advanced resources available. These state-offacilities will the-art empower researchers to conduct in-depth studies, develop prototypes, and test emerging technologies, ultimately contributing to the advancement of the Indian EV industry.

Charging Technologies and India's EV Revolution

Professor Sandeep Anand shared valuable insights about charging technologies during the interview. While the focus on charging infrastructure has been prominent globally, the professor believes India's specific commuting patterns may require a different approach. With shorter daily commuting distances for most workers, home charging may suffice. However, the lab acknowledges the need for fastcharging infrastructure for longdistance trips. Startups entering the market are taking initiatives to develop India's charging infrastructure, enhancing accessibility for EV owners.

Regarding specific charging technologies, the professor expressed scepticism about the widespread adoption of Vehicle-to-Grid (V2G) technology due to battery lifespan concerns and the challenges of incentivising car owners.



charging was Wireless deemed inefficient and challenging, with potential applications limited to heavy-duty vehicles that could benefit from smaller batteries if wireless charging through roads became feasible. Regarding Battery Management Systems (BMS), the professor highlighted the prevalence of passive cell balancing technology in upcoming EVs, which offers costeffectiveness and ease of implementation.

With the establishment of the EV Power Train Lab at IIT Bombay, the Indian EV industry is poised to witness significant advancements. This new research facility, funded by the batch of '73 alumni, will propel innovation in the EV sector. addressing challenges specific to the Indian market. By engaging students, forging collaborations, and leveraging state-of-the-art facilities, the lab aspires to drive indigenisation, nurture talent, and contribute to India's sustainable transportation revolution. With its multidisciplinary approach and focus on critical research areas, the EV Power Train Lab promises to play a pivotal role in shaping the future of electric mobility in India.

Tête-à-Tête with Prof. B. G. Fernandes

Introduction

Prof. Baylon Fernandes has a long and fruitful association with IIT Bombay and the Electrical Engineering Department in the Power electronics and Electrical machines domain.

He began as student, completing his PhD from the Electrical Engineering Department, IIT Bombay in 1993, and is still going strong as alum, faculty and colleague. He has served as the Head of the Department for two terms in the past decade. He has consistently been a popular teacher, mentor, a wonderful friend and a hard worker. Over the years, he has been a driving force behind revamping the Electrical Machines Lab.

Preethi Malyala, fourth-year B.Tech and General Secretary EESA, sat down for a chat with Prof. Fernandes, fondly known as BGF about the history, development, and present state of the popular Electrical Machines Lab.



Prof. B. G. Fernandes showing Machines Lab to Alumni '96 batch

Q: Tell us about the origins of the Machines Lab. How has it developed over the years to what it is now?

The existing lab that you see now is a second-generation lab. In the sense that, the first generation was with motors given by the Russians. At that time, we had three big labs – high power machines, small machines and an undergraduate lab. In the undergraduate lab, the rating of the electric motors was around 5HP, and each set had two motors per two machines.

So if I perform an experiment on a generator, it requires a prime mover. If I'm operating a motor, I need a load. So two 5HP machines occupying one table and various meters – that was the first generation. The method that was used to control the speed using conventional methods – the entire table used to get crowded.

Another thing that used to happen was that students belonging to a batch did different experiments, whereas we wanted to ensure that the entire batch does one experiment. Okay?

So this generally happens in electronics labs where you require a power supply, an oscilloscope and a breadboard and a PCB whereas here, I told you, this is a Machines lab so with two 5HP motors it is difficult to have a multiplicity of such machines. So we wanted to incorporate new concepts. This is way back in 2000 we wanted to do it with the Rheostat, which is highly inefficient. So, we used power converters to feed the motors. We reduced the power ratings and had twelve tables, each table having one machine set, in which are mounted three motors.

Q: What did this help you do?

Logistically it was now easier for the instructor. It's easier to handle.

What used to happen was that when the theory and the lab, if it was held in the same semester, and if the students were doing different experiments, it would happen that some of them were doing the experiment without learning the theory in class.

Whereas now the entire batch is doing the same experiment and the instructor taking the lab ensures that theory is first covered in class. Only after that do students perform the experiment. So, essentially we learned from our initial conduct and tried to smoothen the hands-on teaching-learning component. This change towards was а more streamlined teaching-learning.

Q: How about lab conditions?

Yes, over the years, we completely refurbished the Machines Lab – it used to be gloomy and not well ventilated. Now you see the labs are very well lit, well ventilated, and things work.

Q: Can you tell us briefly about the research and project side of the lab? What kind of projects are going on there and the research activities? And who are the people who are basically doing this?

l've been talking the See, in undergraduate classes about this. Two technologies will dominate the landscape in the coming years. That is EV (electric vehicles) and ΡV (photovoltaics). Both EV and ΡV require power electronics. In addition, EV requires electric motors.



Prof. B. G. Fernandes with Young Alumni Achievers Shahnawaz and Ashish Bhat

We have been working in electric motors for the last 25 - 30 years of so. IIT Bombay is the first IIT that started working in permanent magnet machines. That motor is being used in electric vehicles etc. And we've been working for the past 15 years or so on most of the novel machines SWITCH... machines - axial flux machines. When the diameter by length (D/L) ratio is very high then axial flux machines have an edge over radial flux machines.

Now we are concentrating on improving efficiency, optimizing power density etc.

Q: Any future projects that are coming up?

The coming two decades need to see a lot of innovations in EV and PV. The whole globe is going through a revolution in EVs and permanent magnet machines are being used there. The permanent magnet material i.e. Neodymium magnet (NdFeB) ... which is made from an alloy of neodymium, iron, and boron is available in only some parts of the world.

Neodymium is a rare-earth magnet... I'm no God but my prediction is that we may need to come up with alternate technology because one country supplying the material...well, there could be a shortage.

Q: What are the resources that go into running the lab e.g. projects?

Electric machines – you need Finite Element Method packages. So first you conceive the idea, then simulate it, then if the performance is satisfactory, we make a prototype, test it and maybe if there are obvious flaws, a second student takes it over.

Q: How has the alumni interaction been with the Machines lab?

See, the Machines Lab was not popular 15 – 20 years ago. But this became one of the best labs over the years because a lot of effort has been taken to develop the lab. Students appreciate that things are working there.

Every year the Silver Jubilee batch visits campus. One of the alums remembered the lab and said, "Oh, nothing worked in that lab." I told him, "That was then. Things are different now!" I think, 2004 onwards, if you ask, alumni would say Machines Lab is one of the best labs!

I'd like to know your opinion too.

Sure sir!

Another thing I want to highlight. Theory is being done in class. There's a comprehensive lab manual available online. In addition, before students do the experiments, each batch is briefed for at least half an hour or so. It is for all the batches that the instructor repeats. We invest a lot of time and effort in our teaching. And I think students appreciate our efforts.

I was telling my friend, I remember last year when we took the course, we had a lecture in one of the ground floor classrooms in the GG building before we headed for the lab.

This is good to know.

Q: What are the resources required for some projects that alumni can contribute?

We take teaching labs very seriously, and the Machines lab is a basic undergraduate lab but ends up as a high load on the instructor given infrastructural constraints. If they can be eased, it will make things much better. We need the double of what we make do with now, to sustain such depth of hands-on teaching.

I'll just explain. The Machines lab began in 2003 when we had 45 B.Techs per batch. Now the intake is 200. We have 12 big tables, so 2 students per table made 24 students, so we tackled lab sessions for two days per week in the early 2000s.

Given increased student numbers in the same space and with the same equipment, now the lab starts at 1:45 pm and goes up to 5:30 pm for three afternoons and is highly condensed into shifts. As a point of comparison, theory classes are three hours per week. And the Lab comes up to ten hours a week. Therefore, given an instructor's other duties, this is considerable pressure on one instructor as well as students (to time and finish experiments) in given slots.

Alumni can help us with upgrading the lab so we can shift this lab to a bigger space and procure more equipment to bring it back to a two days a week schedule, more manageable for students and faculty alike.

Q: Would you like to add more?

Yes, I'd like to highlight something else. We have a DD in the Power area also. There is six credit а Machines/Power lab that requires specialised space. Similarly, EV is coming up. We require specialized equipment and we're finding it difficult to function in a cramped space. Now there are upto 4 students per table ... and more than two is a crowd.

Q: How can students who are interested go forward in this? Can they come and experiment?

Anytime! We never said no to anyone. There were in fact two DD students last year, who spent the entire summer with us. There's another student this time who is continuing after spending the summer with us. We are done with our questions. We're happy to hear anything else you want to add about the lab.

I've been pleasantly surprised this year. I've been teaching the first-year course module, Energy Systems. This is the first time that two-three different students asked different things about machine windings. So we simulated the entire winding process. Conventional machines are not being used in EVs, so the winding layout is completely different. We showed them. Based on my presentation we held a quiz. I expected a washout... that students may not answer because thev were not easy questions.

Four students got 10/10 and one student got 9.5/10. I went to class to congratulate those students because to understand the concept and answer questions in the very first semester - it wasn't easy, okay? It was a pleasant surprise.

I told them to take this area seriously. Today the trend is to go for AI - which are basically tools.

When EVs and PVs are going to dominate - the three important things are power electronics, machines and energy storage. Only when we have an efficient system can we have AI there.

POJEST LAB Prof. Kasturi Saha

Department of Electrical Engineering, IIT Bombay

PQUEST Lab (Photonics and Quantum Enabled Sensing Technology Laboratory) was established in our department in 2017. The primary focus of the lab is to harness the power of quantum mechanics to develop quantum-engineered systems using colour defects in diamond and other quantum materials. Diamond crystals have point defects called nitrogen-vacancy centers or so-called NV-centers that have the ability to process quantum information, sense magnetic fields, temperature, electric fields and strain with extraordinary sensitivity and unprecedented spatial resolution.

At PQUEST lab, we explore applications of NV centers in condensed matter physics, quantum information science, bio-sensing, circuit, and chip testing, and developing miniaturized NV platforms. We are currently a group of seven PhD students and two post-docs.



Shishir, a PhD student works on sensing dynamic features of magnetic materials with the magnetic microscope. The speed at which a magnetic material reacts to an external stimulus is important for magnetic memories and logic devices. We have measured the magnetic susceptibilities of permalloy magnetic disks using the magnetic microscope.

Madhur, a post-doc, works on using the magnetic microscope to sense neuronal activities. Neurons communicate with each other by sending small currents. A small magnetic field is associated with these currents, which can be seen through the magnetic microscope. Using advanced instrumentation techniques, for the first time, we were able to do video rate imaging of magnetic fields, which is a step forward in imaging neuronal activities, as these are not static signals but are very dynamic in nature.

Ayan, a PhD student, is working on a quantum repeater. When we talk on the phone say to someone 1000 km away, the signal our phone generates does not contain enough power to travel such long distances. A repeater is used to enhance at regular intervals to enhance the signals. A quantum repeater does the same but for information carried by a quantum qubit.

Anuj, a PhD student, works on nondestructive testing of microchips using a magnetic microscope. By imaging the magnetic fields from a micro-circuit, the circuit functionality and faults can be tested without having to destroy them.

Shubham, a new PhD student is exploring quantum materials, that can generate quantum states of light. A quantum state of light has many applications in advanced physics.



Aparajita, a PhD student works on using quantum coherence properties of NV centre to detect biological cells. The lifetime of a quantum system is affected by its environment. This lifetime is technically called the coherence time of the quantum system. By embedding a small nano-diamond inside a living cell and measuring its coherence time, the cell's environment can be understood.

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Sonia and Himanshu, two PhD students, are working on making a portable NV-based sensor. Sonia has developed a special FFT-based algorithm to simplify the signal processing involved in NV magnetometry, which in turn, simplifies the electronics involved.

Fabitha, a post-doc is working on developing a microwave cavity, with which the magnetic field sensitivity of the NVbased magnetometer can be enhanced. A microwave cavity, being a resonant structure, enhances the microwave interaction between NV centres and the applied microwave fields.

Abhishek, a final-year undergraduate student is using NV centres to simulate topological states of matter. A topology of a quantum state can be imagined as an invariant that remains constant deformation of the state.

Working in such a diverse field of research gives a lot of exposure to the students and great ideas to use our research in broad interdisciplinary subjects. Our experiments involve optics, microwave electronics, signal and imaging processing, and instrumentation and control. As most of the applications and experiments we perform are not yet commercialized, we built the experimental setups from scratch. Building an experimental setup from scratch is always a very enlightening experience.

Though, it can be tedious, tricky and time-consuming to understand what went wrong. The answer to such questions can range from being silly and trivial to having to develop a deep understanding of the underlying Physics which ultimately leads to novel applications.

EMC TESTING



EMC testing chamber at WEL

Electromagnetic Compatibility (EMC), is a term used to describe the ability of electrical equipment to function properly and coexist with other equipment without causing harmful interference. It refers to the equipment's capability to operate as intended in the presence of electromagnetic energy emitted by other devices. Compliance with EMC standards ensures that electrical equipments can operate without disruptions or unwanted interactions with other nearby equipment.

In this context, an EMC Pre-Compliance Chamber was set up in the WEL lab in January by TEKIKNOW, a private firm specialising in testing equipment. The firm organised a session to explain the two components of EMC testing: emission and immunity testing. Under each of these categories, there is a need to conduct radiated and conducted tests.

Radiated emission tests assess the emission of electromagnetic energy from an electronic device through a non-physical medium. It is performed in an anechoic chamber where the device under test (DUT) is connected to an EMI receiver, and measurements are taken at various frequencies. One such chamber has been set up in the WEL lab by TEKIKNOW. In the Immunity test, the DUT is exposed to electromagnetic fields generated by an antenna and its performance is analysed.

On the other hand, conducted tests evaluate the release of electromagnetic energy from an electronic device through a physical medium. During the emission test, the Device Under Test (DUT) is connected to an EMI receiver using a coupling network, and measurements are conducted at different frequencies. In the immunity tests, the DUT is exposed to disruptions generated by a signal generator.



Open-BCI based EEG recording



Soil Health Monitoring2

EXPERIENTIAL LEARNING LABORATORY

The Experiential Learning Laboratory (ELL) is a facility that promotes hands-on learning. It was established through the generous support of the Maker Bhavan Foundation, a charitable organisation founded by IIT Bombay alumni to enhance engineering education in India. The ELL features a dedicated maker area enclosed by double-paned glass walls, which houses a variety of equipment essential for project development, including 3D printers, a laser cutter, a vacuum former, a desktop CNC milling machine, a 3D scanner, a lathe, and hand-operated power tools for machining and fabricating fixtures.

Reflow-Oven

The images show some of the projects from last semester that utilised these resources in the Electronic Design Lab (EDL) course.



2-D Mapping

CENTRE FOR SEMICONDUCTOR TECHNOLOGIES (SEMIX)

@ IIT Bombay

first yea

Introduction

for Semiconductor The Centre Technologies (SemiX) was founded in 2022. The term "SemiX" is coined by the integration of two words - "Semi" stands for semiconductor and "X" represents the integration of various semiconductor solutions materials. equipment. devices. circuits. packaging, and software.

This multidisciplinary center consists of 45+ faculty from different departments Metallurgical like Engineering and **Materials** Science, **Mechanical** Engineering, and Electrical Engineering Department, etc. SemiX enables the growth of cutting-edge semiconductor R&D research with an industrial focus, catalyzing the start-up network, and developing the next-generation workforce for fostering the semiconductor ecosystem in India.



Semiconductor technologies are a national priority spearheaded by the India Semiconductor Mission (ISM) with aims to build a vibrant semiconductor ecosystem to enable India's emergence as a global hub for electronics manufacturing and design. Centre Semiconductor The for Technologies (SemiX) is going to play a pivotal role in talent development, research, and innovation in this context - which are the essence of a vibrant semiconductor ecosystem.

SemiX provides a knowledge platform with world-class labs developed through large projects like the Centre of Excellence in Nanoelectronics (CEN), the National Centre for Photovoltaic Research and Education (NCPRE), and the Skilled Manpower Development Program (SMDP) and with a deep outreach network through Indian Nanoelectronics Users Program (INUP). SemiX promises to contribute to the mission of ISM with IIT Bombay's deep knowledge to enable a vibrant industry-academia connection.

Be the nodal point at IIT Bombay with faculty from multiple departments to facilitate semiconductor-related R&D, Training, Translation, Incubation, and formulation of Policy inputs.

SeimX will develop an industrial workforce and innovation focussed training, by leveraging industry knowhow mixed with the traditional worldclass curriculum of IIT Bombay to the generation train next of semiconductor workforce and leadership. SemiX will offer several certification courses, which are either general or industry-specific.

Short-term course on Semiconductor Manufacturing Technology with Hands-on training

This certification course on semiconductor technology is to be offered by IIT Bombay in association with Applied Materials and GlobalFoundries. The 5 days course will start from 3rd July to 7th July 2023 at IIT Bombay.

Our Vision

- To become a world-class platform for collaborative research between academia, government, and industries specifically on semiconductor technologies.
- To become an epicenter for talent development for the future semiconductor industries.

Our activities

Master of Engineering program in Semiconductor Design & Technologies

This program will soon be offered by IIT Bombay for students as well as for working professionals. These programs are based on 1) Circuits & Systems and 2) Devices

Grow industry partnership program to address the industrial research and training needs

SemiX is offering an Industry Affiliate Program (IAP) for large and small semiconductor manufacturing industry partners to associate with SemiX to exchange knowledge, share cutting-edge research, build collaborations & partnerships, and overall facilitate the growth of the semiconductor ecosystem in India.

Drive an entrepreneurship program to facilitate incubation, particularly in semiconductorrelated areas in collaboration with SINE

SemiX is focused on the translation of research ideas to commercialization through established companies as well as the incubation of startups in the semiconductor space, which requires specialized talent, long incubation periods, and deep customer connections to thrive and grow.



Your Best Friend is Calling: Where are you?

Dr. Shreya Agrawal PhD Nanomedicine IITB alumna

Our Best Friend

Most of us have come across shocking news of fatal disease like cancer / unprecedented heart attacks of youngsters - famous and the non-famous alike, in recent years.

What has been going wrong with our wonderful best friends (i.e. our bodies) and when did they announce, "NO, I really can't take it anymore."?

Did it not give you sufficient signals and alerts before succumbing?

Well, let's take a closer look at our equation with this incredible fellow called as human body.

Dynamic Systems

Have you noticed how a small strand of hair is discriminated from the morsel of food and thrown out of the mouth in no time? Or when a barely visible particle makes the eye go itchy, the eyes water to wash it away? Have you experienced a bunch of unfriendly bacteria triggering sore throat and runny nose? A microscopic splinter in the foot sending pain waves across the body? Do your ears also go buzzing when a little grain or water drop sneaks inside? The body is such a dynamic system, always on red alert, like a ceasefire line. Any intruder, trespasser is immediately seized and brought to its knees! This is to make sure that your million-dollar gizmo is safeguarded against all that may trouble it or affect its structure and function.

We may be treating it as а lackadaisical, dull fellow being dragged to work every day but the truth is that our bodies are much more astute than we can imagine. Their agility and promptness towards internal and external signals is majestic, but there are a number of actions that keep adding to our body's debility in the long run.

I'm sure that you must have felt the

- Relief after slipping into loose, worn-out shorts after a party
- Joy of crashing on bed with closed eyes after a hyperlink screen odyssey
- Satisfaction of having simple home-cooked khichri after a long trip
- Relaxation upon looking at the open sky after a hectic day.

In the words of Marion Rosen - "Pain is the body's cry for help. You are doing something that the body can't take any longer. The body is very patient. It takes a lot of tension and abuse before it makes pain." Bad fats, high sugars, ultra-processed edibles, late nights, screen time, disturbed body clock, unaddressed states of stress, poor posture, no exercise, no sunlight, no fresh air, constant worry, and what not to abuse this poor, friendly body?

Months or years later, we end up facing agonising, chronic after-effects such as aches, tiredness, weakness, disturbed bowel movements, frequent infections, weight fluctuations, mood disorders, stiffness, brain fog, infertility, cancer, migraines, arthritis, or premature ageing (just to name a few).

Listening and Attending

Most essential is to pay close attention in daily life such as: What foods consistently trouble you? What work hours keep you efficient? Do you feel heavy if you sleep at odd hours in daytime? How does your mouth taste in the morning after having a simple meal versus after having a highly processed last meal at night?

How do you feel after chewing mindfully versus merely gulping your food?



Try to incorporate practices such as yog nidra, mindful walks, listening to chirps, waterfalls or raindrops, breath meditation, star gazing where you connect to yourself amidst nature. Be creative with whatever hobbies you like and invest in your body and mind on a regular basis.

No matter what degree you have earned, what goals you have on your vision board, or how much you want to earn - You need to pause, listen to your body and befriend it.



Otherwise it'll be NOW or never.

"

"**I learned that knowledge, not yet in my mind, was in my body**" - Ellen Goldman



Dr. Shreya at Bambhoria village for awareness on food and nutrition



Officers training at the Rajasthan State electricity board



Campaigning for plastic waste management at restaurants.

Dr. Shreya finished her PhD in Nanomedicine from IIT Bombay in 2017. Realising her calling, she founded Sattvaj (Lifestyle and diet correction consulting services) after spending years as a researcher and a formulation scientist. She has been conducting sessions towards holistic wellness, preventive healthcare and eco-friendly practices at various universities and organizations such as Infosys, TechMahindra, State electricity board and Bosch etc. She also consults individuals as а certified practitioner, majorly for lifestyle diseases.

She truly believes that without a healthy planet, we cannot sustain health and peace and it's high time when the beauty, resilience and tolerance of the body and environment be respected and safeguarded. She can be reached at <u>shreya@sattvaj.com</u>.

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EARNING FITNESS, Calm and a House Full of Love

Introduction

In previous articles of this series, we explored the power of taken-forgranted everyday actions like waking up and turning them toward mindfulness i.e. waking up 30 minutes before schedule, taking the time to check in with your breath, your body before plunging into the day.

We discussed how pressures of being on campus can shape you in constructive ways when you forge authentic connections with the big four – friends, family, foe and guru/teacher.

In the third article, we opened a single moment and investigated the kind of control we have over the small choices we make – like swiping a coke for a glass of lemonade instead – that can make us stronger individuals over the course of the four or more years of living here.

Today we're looking at non-monetary assets that are essential to good living and can go a long way where money or talent cannot.

"A fit body, a calm mind, a house full of love. These things cannot be bought – they must be earned." – Naval Ravikant, entrepreneur and investor.

> Ms. Neha Chaudhuri is Liaison Officer @ EEACE. Reach out to her on eeacr.iitb@gmail.com

1. Plan and Practice: Vision and Strategy

What is a fit body or a calm mind? What does it look like to you? Have you seen people with fit bodies and calm minds? Have they inspired you to try the same? What steps have you thought were the right ones to take to develop a fit body and a calm mind?

In my experience, earning a fit body or a calm mind is often thwarted by every single thing that comes at you all day long - whether you're a student, a faculty, a staff member or an alumni.

Everybody has a plan until they get punched in the face. - Mike Tyson

Isn't it amazing the things we have in common! We all get punched in the face. Every single day - no matter where you are in the performance scale of your life - all attempts to fitness and calmness are constantly thwarted these days - by the food we eat, the drinks we drink, the clothes we wear, the way we live and the environments we work in.

So if you're anxious by nature, it's quite justified. You're fielding the punches without proper training. Anxiety is the body signalling overwhelm at the volume of work in a day, the pressures of expectations from your own self and others, and the weight of multiple things on your plate. Everybody has a plan until they get punched in the face. – Mike Tyson

It is not like "rampant disease, random violence, and lawlessness that our suffered ancestors through for millenia" and many face even today are easy things. Modern pressures of assignments or the constant uncertainty of being fired or a boxing punches ring of is easier in comparison.

How do the ones who do handle the pressures manage it though? They begin with practice.

Inside of a ring or out, ain't nothing wrong with going down. It's staying down that's wrong. - Muhammad Ali

The practice of getting back up, each action with awareness of their core operational values. Done everyday.

2. Build Operational Values as Foundation

Operational values are essentially intangible values you repeat in physical actions - for example, in helping an elderly person cross the street, you're practicing kindness.

The successful warrior is the average man with laserlike focus - Bruce Lee

In repetitively attending class, you're developing the habit of consistency. In showing up for a quiz - you're practising courage despite the anxiety of not having prepared well enough.

Practising such values with the focus Bruce Lee talks about tends to develop your character. Your character becomes your armor. The more you repeat such actions i.e. practice, the easier it becomes to tackle the quiz, to regularly attend class, to help the elderly or sick or those in need.

The material, tangible fabric of the world - that which you can touch, see, taste and hear - is draped upon the skeleton of operational values that create order in systems. This skeleton - hewed from operative values like diligence, persistence, patience, and compassion holds up the material world. Across generations, religions and lifestyles, these skeletal values have been generative to Life and allow for ease in Death.

We attend courses to learn to earn tangible assets. What about skills for earning intangible assets?

3. Move Out of Comfort Zones

According to ancient martial Indian moving practices. the body throughout the day is essential to earning fitness. Movement is an essential of body's need the biological, chemical and electrical impulses, cellular building up and muscle maintenance.

"The body is a stream of matter, which changes continuously. When the forces that hold together slip away, the body falls." (Vajramushti the ancient martial arts of India, Chp1, Pg 29)

For starters, every time you skip the elevator for the stairs, ditch sitting in front of the laptop to go running in the gymkhana grounds, or work standing up - you're earning brownie points from the body's basic mechanisms that need fluidity, flexibility and strength to work optimally. You're working with forces that hold the stream of matter together instead of against them.

A combination of cardio, strength training, flexibility with awareness towards each exercise and its aftereffects on the body - can earn you a fit body over a number of months. There are several levels of fitness - but one easy go-to test for overall body stamina, and lung strength in particular is to see whether you're able to go for a medium-paced run and talk with a friend, while running, without becoming breathless.

Is moving enough though? According to the ancient martial arts practices,

- Information from the environment contributes to upto eighty percent of fitness building. What is the information you're exposed to and actively digesting each day?
- Sleeping well and spending time in an open, clean, natural environment comes next.
- Relationships follow after in third priority
- The last but crucial two-percent is made up of food intake.

Like any lab instrument you work with, but far more complex is the human form – right from the tips of hair on your skull down to the ends of your toes – you are a veritable copyrighted, patented owner of a biological system housing – emotional, mental, physical, spiritual – layers. Given such complexity, fitness becomes a combination of attention paid to all these aspects of you.

Exercising the body with the balance of food, sleep and emotional relationships and constructive mental work – is what truly earns you fitness.

4. Calm is the One before A Storm

We have all heard, seen and been in storms. Very few people remain calm when there's a storm. What do you do when faced with a storm (literal and figurative)? The best way of practicing and remaining calm (yes, you guessed it, calmness is an operational value that you exercise like your muscles) - is developing awareness of body posture during times of high tension. Mapping different states of tensions in day-to-day activities helps - what tightens, what loosens, what shoots up and what tends to sink.

Split-second decisions during times of crises are actually the cumulative result of repeated actions in daily life.

For example, during certain times in the day, when you are under pressure, usually, the mind races, blood pulses and emotions throb at the gut. Exhaling counters the racing blood pressure, slowing body fluidity and pushing the neck backward (lessens blood slow to the brain) and straightening the spine counters a racing mind which brings about a certain degree of detachment and arms you to face a mini-storm (e.g. of your friend's or family's frustration or anger) in comparative peace.

Physically practising detachment (yes, an operative value) by not running away or cutting off but by releasing your stake in a tense situation allows for calm to generate and flow. That usually changes the direction of the figurative storm or diffuses it. Subtle training of these operational values can be done in every situation of daily life. Hence, there are no set courses for it!

We just need a mental shift from thinking of disturbances for example, a sudden change in curriculum or hostel policy to challenges meant to make you stronger for having faced them.

5. A house full of love - Understand and respond, not react

What kind of a house is your own body? Is it a sacred space to protect and nurture, a place to leave open to all influences or a place for plunder and loot? The way you approach your own self is largely the way you will approach others.

The tools assisting your practice are circuits of acceptance, power stations of forgiveness and neural signal processes activated by letting go.

I'd like you to slow down and think about how you behave with yourself.

Are you extending the body's biological/mental/emotional systems beyond their limits? If so, do you recalibrate your choices fast enough - like getting back to a better sleeping routine, eating routine, back to working out?

Love as an operational quality can be practiced everyday. If you practic) being honest, open, diligent, persisting and determined (i.e. getting back up after being knocked down) - you will not exploit people. Which is the first step towards building a house full of love.

The better you know your shortcomings, and the harder you work on chipping them away, the more understanding you will be of others' missteps and mistakes.

We all don't have honesty, openness, integrity, persistence, endurance in the same measure. Building on yours allows for strength to respond to the ones who are on their journey. Working on them along with courses and cultural events will ensure a stronger inner foundation that no onslaught of the unexpected can rupture. Those are the building bricks of a house full of love.

Informal Section

EE Creatives! The Art Series



Debasish Panda, 2nd year DD



Siddhant Chourasia, 2nd year B Tech



V L Pravallika, 3rd year B Tech



V L Pravallika, 3rd year B Tech



Neha Vyas, 4th year B Tech



Garima Dewangan, 4th year DD

Sumit Londhe, 2nd year B Tech



Sumit Londhe, 2nd year B Tech

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Background Hum

For any queries or feedback, contact us on bh@ee.iitb.ac.in

Thanks for reading! Team BH and Team ACE

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