ISSUE 7 | JANUARY 2026

# SANCHAR | সঞ্চাৰ

*The Annual Newsletter of the Department of*

**ELECTRONICS AND TELECOMMUNICATION ENGINEERING**
**ASSAM ENGINEERING COLLEGE, GUWAHATI**

## VISION AND MISSION OF THE INSTITUTE

***VISION***

**To be an institution for promoting and supporting sustainable development.**

***MISSION***

- **To prepare technical manpower with knowledge skills and values of sustainability.**
- **To take up relevant problems of society & industry as projects, research themes for study and to provide technological solutions.**

## VISION AND MISSION OF THE DEPARTMENT

***VISION***

**To be a center for quality education in Electronics and Communication Engineering.**

***MISSION***

- **To impart quality education for producing skilled manpower in electronics and communication engineering to cater for the need of the country and the society as a whole.**
- **To encourage students and faculty for research and innovation in electronics and communication engineering through industry-academia interactions.**
- **To facilitate an environment for shared learning, team work development of professional skills and preparation for higher education.**
- **To promote human values and ethics for a sustainable environment and society.**

## PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

- Graduates will attain sound theoretical and practical knowledge for pursuing a career in industry and research-and-development organizations or carrying out higher studies.
- Graduates will possess skills and creativity essential for innovation, entrepreneurship and creation of intellectual property.
- Graduates will imbibe human values, team work and social and professional ethics for building a better environment and society.

# With every brush stroke: Our Students

*Triparna Malakar, B.Tech 4h Semester, 2024-2028*

*Tushar Kanti Sahariah, B.Tech 6th Semester, 2023-2027*

*Hansik Sarma, B.Tech 8th Semester, 2022-2026*

*Hangshanila Bungrung, B.Tech 4h Semester, 2024-2028*

## MESSAGE FROM PRINCIPAL

*Dear reader,*

It brings me immense joy to pen this message for the 7th edition of Sanchar, the annual newsletter of the Department of Electronics & Telecommunication Engineering at Assam Engineering College. Similar to the preceding six years, this year's Sanchar promises to captivate its readers with noteworthy and high-quality content. Sanchar has consistently served as a valuable platform to showcase the department's activities to the wider audience.

I am confident that Sanchar will continue to serve as an inspiration for the vibrant and enterprising minds of the college, encouraging them to embrace sustainable and holistic development. My heartfelt congratulations to all the dedicated members of the ETE department for their exemplary efforts in bringing forth this edition of Sanchar.

***Dr. Bipul Talukdar***
***Principal***
***Assam Engineering College***

## MESSAGE FROM HOD

*Dear reader*,

It gives me immense pleasure to present the 7th edition of *Sanchar*, the *departmental newsletter* of Electronics and Telecommunication Engineering (ETE), Assam Engineering College. This newsletter reflects the collective spirit, achievements and aspirations of our department.

Over the past year, our faculty and students have been actively engaged in academic excellence, research initiatives, technical workshops, and industry interactions. These endeavours have not only enriched technical knowledge but also have fostered creativity, leadership and teamwork among the students.

Electronics and Communication Engineering is a rapidly evolving field, and we at the ETE department are striving our best to equip the students with contemporary skills and ethical values necessary to meet the rapidly evolving global technological challenges. I appreciate the sincere efforts of the editorial team and everyone who have contributed towards making Sanchar a vibrant platform for sharing thoughts and accomplishments.

Hope this newsletter reaches the target audience and serves as a mirror, reflecting the department's endeavours, events and activities; and that readers will enjoy it's contents. We eagerly anticipate sharing further updates and news about the department in coming days. I extend my best wishes for continued success and innovation in all future endeavours in the department.

***Dr. Rashi Borgohain***
***Professor, ETE***
***Head of the Department***

# Editoral Committee



## Editors' Desk

Dear Reader,

Welcome to the 7th issue of Sanchar, the flagship newsletter of our Electronics and Telecommunication Engineering Department. This edition brings you a diverse and engaging collection of insights, featuring thought-provoking articles authored by our esteemed alumni and dedicated faculty members. Alongside these, you will find inspiring accounts of invited talks and dynamic contributions from our talented students, reflecting the vibrant intellectual ecosystem within our department.

Over the course of the year, our department has remained a bustling center of innovation and learning, organizing an array of technical workshops, seminars, and collaborative projects that nurture curiosity and skill development. Special highlights include updates from our Robotics and Coding Clubs, where students are continuously pushing the boundaries of technology through creative and cutting-edge initiatives.

We are also proud to showcase the remarkable achievements of our students across academics, competitive arenas, and entrepreneurial ventures. Many of our students are making significant strides not only in technical fields but also in their entrepreneurship journeys, demonstrating leadership and innovation beyond the classroom. Complementing these accomplishments are the pioneering research efforts and publications from both faculty and students, underscoring our department's commitment to advancing knowledge and contributing to the broader field of electronics and telecommunications.

We hope this issue of Sanchar fuels your curiosity, celebrates success, and encourages you to embrace the spirit of innovation and lifelong growth.

# List of Faculty Members

**Dr. Rashi Borgohain**
*Professor & HoD*

**Specialization:**
Biosensor, Nanotechnology,VLSI

**Prof. Dinesh Shankar Pegu**
*Associate Professor*

**Specialization:**
Signal Processing

**Dr. Navajit Saikia**
*Professor*

**Specialization:**
Signal Processing, Communication

**Dr. Bijoy Goswami**
*Associate Professor*

**Specialization:**
Microelectronics and VLSI design, TFET, MOSFET, Analytical Modeling, Simulation of Semicon. Devices, Spice Simulation ,Circuit Analysis

**Mr. Niranjan Jyoti Borah**
*Assistant Professor*

**Specialization:**
VLSI

**Dr. Ananya Choudhury**
*Assistant Professor*

**Specialization:**
Gesture Recognition, Machine Learning, Computer Vision, Signal processing

**Mrs. Swapna Bharali**
*Assistant Professor*

**Specialization:**
Semiconductor Devices and Nano-Electronics

# List of Technical and Office staffs

## List of Technical Staff

**Mr. Gagan Kalita,**
*Scientific Assistant*

**Mr. Kishore Das,**
*Laboratory Assistant*

## List of Office Staff

**Mr. Anil Das**

**Mr. K.K Rabha**

**Mr. Pranjal Deka**

**Miss Manisha Swargiary**

**Miss Sandeswari Rongpi**

PREFACE

# *Assam-2030: Driving Sustainable Development through Technology and Innovation*

***- Sneha Dey, B.Tech. 8th Semester | 2022-2026***
***- Dr. Navajit Saikia, Professor, ETE***

The Sustainable Development Goals (SDGs) are a set of 17 global goals adopted by the UN in 2015 to guide the world toward a future that is socially fair, environmentally safe, and economically viable by 2030. They aim to balance the three dimensions of sustainable development - social inclusion, environmental protection, and economic growth; and replaced the Millennium Development Goals that ran from 2000–2015. SDGs were framed to be universal, measurable, and interconnected - not just about poverty or the environment, but also about how everything fits together. They target to stimulate actions over a duration of 15 years starting from 2016 in the framework of "5 Ps" - People, Planet, Prosperity, Peace and Partnership. The 17 SDGs are: *no poverty; zero hunger; good health and well-being; quality education; gender equality; clean water and sanitation; affordable and clean energy; decent work and economic growth; industry, innovation and infrastructure; reduced inequalities; sustainable cities and communities; responsible consumption and production; climate action; life below water; life on land; peace, justice and strong institutions; and partnerships for the goals.*

Government of Assam has drawn a vision plan to transform Assam into a sustainably developed State by 2030 with future-ready good governance innovatively applying world's latest technologies and management techniques; to ensure full utilization of the invaluable natural and human resources of the state. The Government of Assam has launched an initiative titled "Assam-2030 in light of SDGs", and has started implementation of the SDGs in the State with effect from 1st January 2016 [1]. Assam thus became the first Indian State to implement the SDGs, setting a precedent for localized adoption of the 2030 Agenda [2]. The State's vision, "Assam-2030", emphasizes leveraging technology and innovation to achieve holistic development, directly connecting to goals like Quality Education, Good Jobs & Economic Growth, and Industry, Innovation & Infrastructure.

In light of these, the Government has been rapidly increasing the number of engineering colleges and polytechnics laying the groundwork for a tech-savvy workforce [3]. It is also promoting digital literacy and encouraging vocational training to ensure equitable access to quality education as well as to bridge the digital divide. Technology in education aims to foster innovation in areas like renewable energy, sustainable agriculture, and climate resilience; which is crucial for Assam's unique ecology and economy. Tech-focused education is to create pathways for better employment, fostering entrepreneurship and sustainable livelihoods; moving beyond traditional sectors to build a resilient economy.

As we navigate a rapidly changing world, the need for inclusive and sustainable development has never been more pressing. Therefore, the initiatives of the Electronics and Telecommunication Engineering Department — both large and small — tries to align with the global call to end poverty, protect the planet, and ensure prosperity for all. We believe in the power of collective action, and hope that this newsletter will encourage each of us to embrace our role in creating a more sustainable future.

**References**

1. "Assam 2030 Our Dream, Our Commitment : Sustainable Development Goals (SDGs)", *https://pnrd.assam.gov.in/latest/assam-2030-our-dream-our-commitment-sustainable-development-goals-sdg*
2. *"SDGs Implementation Status in Assam", https://transdev.assam.gov.in/portlet-innerpage/sdgs-implementation-status-in-assam*
3. *"Sustainable Development Goals:Technical Education", https://dte.assam.gov.in/sites/default/files/swf_utility_folder/departments/dte_medhassu_in_oid_5/menu/right_menu/right_menu/Sustainable_Development_Goals.docx_01.pdf*

# TABLE OF CONTENTS

# Semiconductors: *The Invisible Technology Powering the Modern World*

*– Dr. Mukut Senapati, Alexander von Humboldt Research Fellow, Germany, Former Assistant Professor at ETE*

Every time we unlock a smartphone, charge an electric vehicle, communicate via satellite or measure health parameters using wearable devices, we are relying on the semiconductor industry. These chips are manufactured through hundreds of ultra-precise steps inside cleanrooms where even microscopic dust can destroy entire wafers. This invisible infra-structure forms the foundation of the digital age.

## Why Silicon Still Dominates?

Silicon remains the backbone of electronics not because it is the most exotic material, but because it is the most manufacturable. Its ability to naturally form silicon dioxide enabled the MOS transistor, the fundamental building block of modern computing. Abundance, mechanical strength, thermal stability and compatibility with oxidation, implantation, plasma etching and polishing processes made silicon ideal for large-scale production.

Silicon did not become universal by chance - it was *engineered* into *dominance*.

## Beyond Silicon: New Materials for New Challenges

As technology moves toward higher power, faster switching and harsher environments, new materials are rising. Silicon carbide is now central to electric vehicles and renewable-energy converters. Gallium nitride drives fast-charging systems and high-frequency RF electronics. Gallium arsenide supports satellite and microwave communication, while two-dimensional materials such as graphene and $MoS_2$ are being explored for future ultra-scaled devices.

## Sensors, Biosensors and MEMS

Semiconductors are no longer limited to computing. MEMS devices such as accelerometers and gyroscopes are embedded in smartphones and automobiles. Gas sensors, pressure sensors and biosensors fabricated using semiconductor techniques now enable medical diagnostics, food-quality monitoring and wearable healthcare systems.

This fusion of electronics, mechanics, chemistry and biology defines the next technological frontier.

## The Semiconductor Industry as a Global Stack

The semiconductor world is organised into a tightly coupled ecosystem. Product companies such as Apple and Tesla define system requirements. Fabless design firms like NVIDIA, Qualcomm and AMD translate those requirements into chip architectures. EDA software companies such as Cadence and Synopsys provide the tools that enable design implementation. Foundries including TSMC, Samsung Foundry and Intel Foundry manufacture wafers. Equipment giants such as ASML, Applied Materials and Lam Research build lithography, deposition and etching tools. Materials suppliers such as Merck, JSR and Shin-Etsu provide wafers, photoresists and specialty gases, while packaging houses like Amkor and ASE assemble and test finished chips. Every electronic device is the result of collaboration across this entire stack.

## Industry Roles

Within this ecosystem work process engineers who develop fabrication recipes, yield engineers who improve production efficiency, device engineers who design transistor architectures, equipment engineers who maintain complex tools, packaging engineers who develop advanced assembly methods, automation engineers who build fab control systems, and data scientists who use machine learning to detect defects and predict failures. A modern fab runs as much on code as it does on silicon.

## Research and Manufacturing Are Now One

In earlier decades, research happened in universities and manufacturing in factories. Today they are inseparable. Advanced device simulation, plasma process modelling, nanoscale characterization and AI-driven yield

optimization are performed directly inside manufacturing environments. Semiconductor fabrication has become a living research laboratory.

## Higher Studies, Internships and Global Opportunities

Students aspiring to work in the semiconductor domain can pursue master's programmes in microelectronics, nanotechnology, MEMS or materials science, where they gain hands-on exposure to cleanroom processing, TCAD simulation and device characterization. These programmes typically require strong foundations in solid-state physics, semiconductor devices, VLSI design, analog electronics, materials science, plasma physics, thin-film deposition techniques, and microfabrication processes.

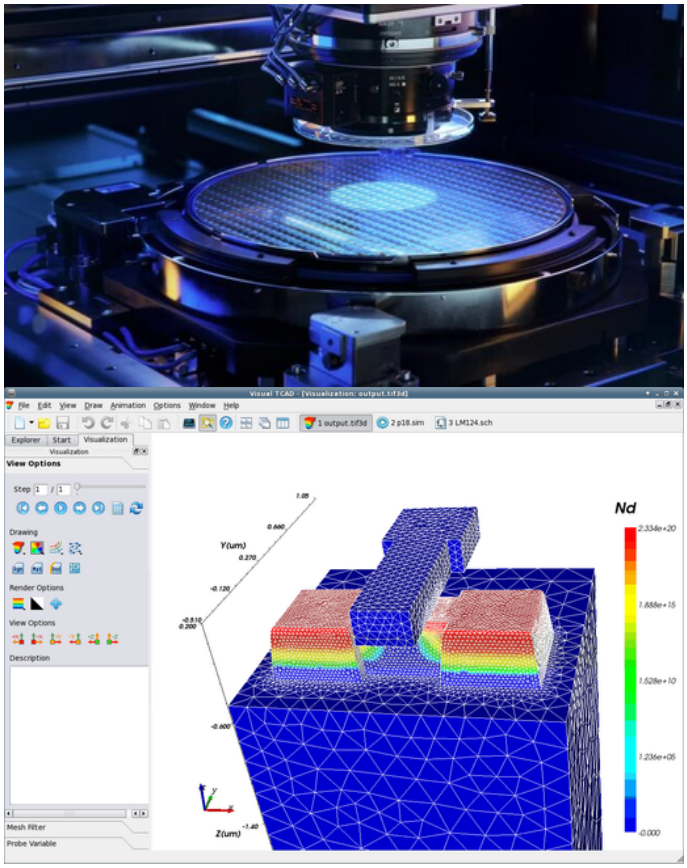
Internships at semiconductor foundries, sensor startups or research institutes are extremely valuable. During internships, students should aim to work on wafer processing, photolithography, device testing, process optimization, MEMS fabrication or sensor development projects. Such experiences not only strengthen technical competence but also introduce students to the discipline of industrial manufacturing environments.

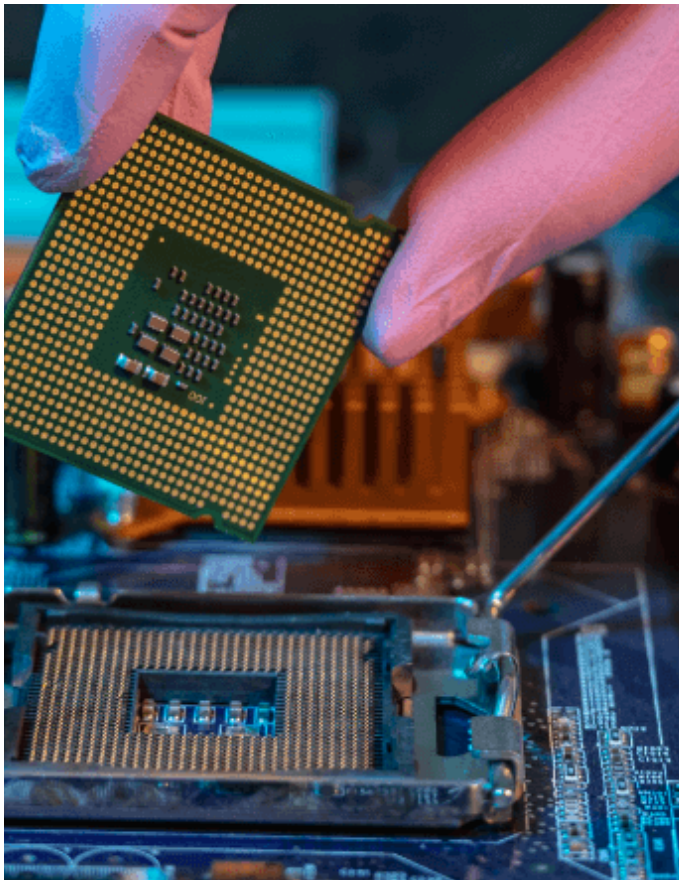
Doctoral research enables deep specialization in semiconductor devices, MEMS, biosensors, nanomaterials and power electronics. It typically involves advanced training in device modeling, TCAD simulation, nanoscale characterization, process integration and data-driven yield optimization, preparing researchers for leadership roles in industrial R&D and advanced manufacturing.

## Conclusion

Semiconductors are not merely electronic components - they represent the intersection of physics, chemistry, mechanics, biology and computer science. With India building its semiconductor ecosystem and sensor technologies, today's students stand at the edge of a historic opportunity.

The next revolution will not only be written in software - *it will be engineered into silicon, sensor by sensor, atom by atom.*



**SDG GOAL #1:** *"End poverty in all its forms everywhere"*

# Be a chip designer

*– Prof. (Retd.) Pradip Kr Brahma, Ex Principal AEC; Former Prof. & Head, ETE*

Did you know that ISRO had, around 2009, designed a 16 bit microprocessor and had it fabricated at the SCL (formerly called Semiconductor Complex Limited, at Mohali, Chandigarh; now it is called Semiconductor Laboratory). The fabrication process used a 180 nanometer technology.

The processor was called the VIKRAM1601 and it was used in ISRO's space missions. This success led to the development of the next 32 bit processors, around 2024, called VIKRAM3201 and KALPANA3201 which were then used in 2025 launches. I only came know about this feat recently and was somewhat surprised to learn that this country had the capability to design and build such complex digital systems – for some reason such achievements are not publicised widely.

This January 5, 2026 a news strip in the Assam Tribune says: Centre sanctions 24 chip design projects: As many as 24 chip design projects have been sanctioned across areas such as video surveillance, drone detection, energy meters, microprocessors, satellite communications, broadband and IOT systems-on-chip (SOC)s under Centre's Design Linked Incentive Schemes. ....etc. The point to note is that "very lately" our country (actually the powers that be) has realized the importance of chip making – our own Jagiroad IC assembly and testing plant and other projects, under construction, is an effort in this direction.

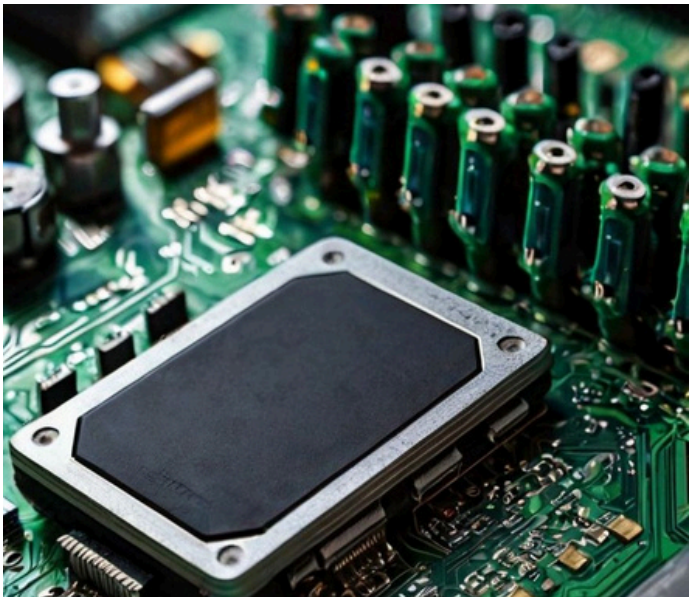
So as students how do you go about learning the art of chip making? Well the first thing is to understand the nature of hardware organization. Not just simple gate level circuits but full systems or subsystems that requires programmable hardware.

A typical example would be a, say, special central processing unit needed for some military project. So to accomplish this task one would use a hardware descriptive language such as VHDL/VERILOG/SYSTEM VERILOG ( there are a few others) to build the hardware – it will be an abstraction actually.

Then a chain of software tools will create a netlist and a "bitstream" of the described hardware. From this "bitstream" a FPGA (field programmable gate array) or a CPLD (complex programmable logic device) can be configured (establish connections) to implement the designed hardware.

Very soon I understand that the ETE department is acquiring, through a gift, full training materials for this purpose So the point of this piece is to encourage, to egg, you, at least some of you, to get interested in this area of electronic design.

Here is a problem you might consider. The very first microprocessor the Intel 40004 was manufactured in late 60s; it was a 4 bit processor and supported 46 instructions (you can download the full derailed architecture from the net).
*How about taking this up as project and build a FPGA version?*



**SDG GOAL #2:** *"End hunger, achieve food security and improved nutrition and promote sustainable agriculture"*

# 6G and the Silicon Reality: *Why Hardware Still Matters?*

*– Dr. Amit Sravan Bora, Postdoctoral Research Associate, Technische Universität Dresden, Germany| Alumnus, B.E. 2013-17*

The race to 6G is on, and if you follow the headlines, you would think it is all about artificial intelligence, terahertz frequencies, and holographic communication. While these are exciting developments, there is a quieter but equally critical conversation that needs more attention: the role of hardware and VLSI in making 6G actually work. Having worked on wireless communication systems across Taiwan, Australia, and Germany, looking at problems from both theoretical and hardware angles, one thing became increasingly clear: there is often a significant gap between what gets deployed and what stays in papers. The most elegant algorithms can stumble when they meet the realities of silicon.

## The Waveform Dilemma: Performance vs. Practicality

To understand where we are heading with 6G, we need to appreciate where we have been. Orthogonal Frequency Division Multiplexing, or OFDM, has been the backbone of wireless communications since the late 1990s. The core idea is simple: instead of transmitting data over a single wideband channel, you split the available bandwidth into many narrow subcarriers. Think of the difference between a faucet and a shower. A faucet has a single stream; any blockage stops the entire flow. A shower has many independent streams; one blockage does not interrupt the whole system. Each subcarrier in OFDM experiences relatively flat fading, making equalization straightforward. Add a cyclic prefix to handle multipath delay spread, and you have a system that is both spectrally efficient and easy to implement using Fast Fourier Transforms.

OFDM carried us through WiFi, 4G LTE, and 5G. It works well for many scenarios, but it has fundamental limitations. The cyclic prefix represents pure overhead. More critically, OFDM struggles in high Doppler environments. When users move at high speed or channels are rapidly changing, the orthogonality between subcarriers breaks down, causing inter-carrier interference and performance degradation.

For 6G, with visions of seamless connectivity in high-speed trains, drones, and satellites, OFDM's limitations become harder to ignore.

This is where OTFS (Orthogonal Time Frequency Space) emerged around 2017-2018. The key insight was to stop fighting the time-varying nature of wireless channels and instead embrace it. Rather than working in the time-frequency domain like OFDM, OTFS operates in the delay-Doppler domain.

Here is why that matters: wireless channels are fundamentally characterized by multipath and Doppler shifts. In OFDM's time-frequency representation, these effects show up as complex distortions spread across multiple symbols and subcarriers. In the delay-Doppler domain, however, the channel becomes sparse and nearly time-invariant, even when the physical channel is changing rapidly. OTFS spreads each information symbol across the entire time-frequency grid. This means even if parts of the resource experience deep fades, the information can still be recovered because it is distributed everywhere. The simulation results were compelling: OTFS showed 3-6 dB gains over OFDM in high-mobility scenarios with more robust channel estimation.

OTFS was not alone. OTSM used Walsh-Hadamard transforms, AFDM brought chirp-based approaches from radar, and ODDM offered its own delay-Doppler variant. Each promised better performance than OFDM in specific scenarios.

## The Hardware Reality Check

So, what happened when 3GPP finalized waveform choices for 6G? They stuck with CP-OFDM and DFT-s-OFDM. Essentially the same fundamental approach as 5G.

The decision was not because OTFS does not work. It was made because of what happens when you try to build it in actual hardware. In OFDM, equalization is remarkably simple. You multiply the received symbol by the inverse of the channel coefficient for that subcarrier. It is a one-tap equalizer. Computationally cheap, minimal power consumption.

OTFS requires full-frame processing with complex transforms to convert between delay-Doppler and time-frequency domains. The channel matrix, while sparse, is still a matrix. You need sophisticated algorithms like message passing or iterative methods. The receiver needs larger memory buffers, computational complexity increases by an order of magnitude, latency grows, and critically, power consumption shoots up. For a base station, this means larger electricity bills and cooling infrastructure. For mobile devices, faster battery drain. When deploying hundreds of millions of devices globally, a theoretical 3 dB gain does not justify doubling receiver complexity and power consumption.

CP-OFDM has another advantage: maturity. We have optimized FFT implementations in VLSI for decades. The IP blocks exist, they are proven and efficient. Introducing a fundamentally new waveform means rebuilding infrastructure from scratch: new chip designs, verification processes, manufacturing challenges. The industry is conservative for good reason.

## Hardware-Aware Research: The Missing Piece

VLSI constraints are not an afterthought in system design, they are often the primary constraint. An algorithm that is optimal theoretically but requires impractical hardware is just an academic exercise. Power consumption is critical. In mobile devices, it determines battery life. In base stations, it translates to operational costs and environmental impact. Area on a chip matters too. Larger chips cost more, have lower yields, and create thermal challenges. For 6G, we are looking at heterogeneous architectures: ASICs for high-throughput operations like FFTs, programmable accelerators for adaptive functions, and processors for control operations. Designing algorithms that map efficiently to such architectures requires thinking about hardware from the beginning.

The energy challenge becomes starkly visible when we look at the trajectory across wireless generations. As shown in Figure 1, while network capacity has grown exponentially from 4G through 5G to projected 6G capabilities, energy usage threatens to follow an equally steep curve. The 6G era promises orders of magnitude higher data rates and network capacity, but without careful hardware-aware design, this performance leap could come at an unsustainable energy cost. The gap between the lower energy-efficient path and the steeper consumption trajectory represents the difference between sustainable 6G and an environmental crisis.

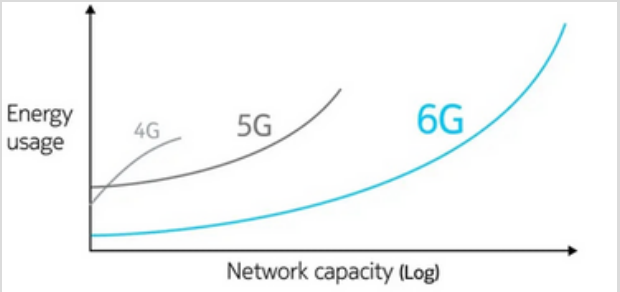



*Figure 1: Network capacity vs energy usage in 4G, 5G and 6G networks*

Too many papers propose algorithms that would be nightmarish to implement. They assume unlimited computational resources, ignore latency constraints, and treat power consumption as someone else's problem. The AI boom made this worse. Papers proposing deep learning for everything flood conferences. Many show marginal improvements over classical methods but require training massive models or running inference with millions of parameters.

## The Path Forward: Co-design and Sustainability

The solution is co-design: developing algorithms and hardware together. This requires collaboration between communication theorists, signal processing researchers, VLSI designers, and circuit engineers.

As illustrated in Figure 2, practical 6G solutions emerge only at the intersection of three critical domains: algorithm design (including communication theory, signal processing, and AI/ML), VLSI/hardware implementation (encompassing low-power design, circuit optimization, and ASIC design), and industry deployment constraints (cost, scalability, standards and manufacturing). Currently, this intersection remains too small. Most research stays siloed within individual domains, leading

to elegant algorithms that cannot be built efficiently, or hardware optimizations that do not align with what algorithms actually need, or theoretical advances that ignore what industry can realistically deploy. Expanding this intersection is essential for making 6G a practical reality rather than just a theoretical possibility.

When designing channel estimation algorithms, work with VLSI teams to understand the cost of different operations. A slightly less optimal algorithm using simpler operations could be dramatically more power efficient. An iterative algorithm that converges in four iterations on paper might take too long in hardware, requiring a one-shot approximation instead. We need better analog-to-digital converters for high-frequency signals, more efficient power amplifiers, low-power RF front ends for massive MIMO, and energy-efficient baseband processing blocks.

Emerging paradigms like in-memory computing could be transformative since wireless processing involves massive data movement that consumes significant power.

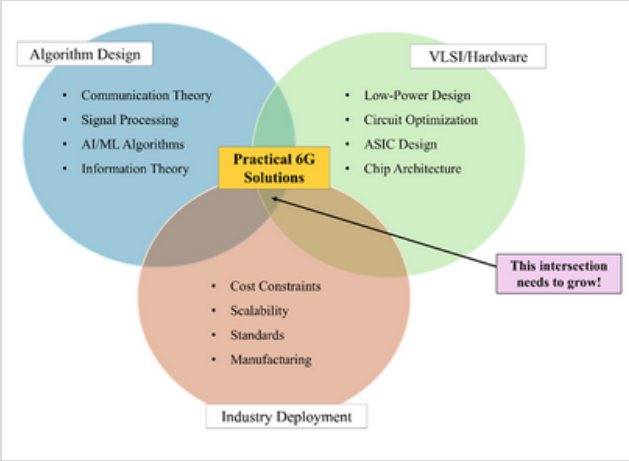



*Figure 2: The hardware-software co-design gap in 6G research.*

Sustainability must be central, not an afterthought. The telecommunications industry already consumes significant global electricity. If 6G simply adds more power-hungry technologies, the environmental and economic costs will be severe. True sustainability starts at the silicon level: efficient power amplifiers, smarter power management, better sleep modes, efficient modulation schemes that achieve good performance without massive processing complexity. It also means being selective about deployment. Just because we can add AI-based optimization everywhere does not mean we should. Sometimes a well-designed classical algorithm outperforms a mediocre neural network when you factor in implementation efficiency.

The OTFS story is instructive. OTFS represents genuine innovation with real benefits in specific scenarios. It might find applications in niche use cases where performance justifies complexity, perhaps military or satellite communications. But for mass-market 6G, hardware complexity was too high. Innovation has to be practical. The research community needs to value implementability as highly as theoretical performance. We need papers that include power consumption estimates and chip area projections alongside performance curves.

## The Assam Opportunity

This becomes particularly relevant closer to home. Assam has been making serious moves in semiconductors over the past few years with genuine policy support for building local capabilities in chip design and manufacturing. For students here at Assam Engineering College, this creates a unique opportunity. While global 6G research focuses on algorithms and theoretical performance, there is pressing need for people who understand hardware. The skills required (low-power digital design, RF circuit design, signal processing architecture, hardware-software co-design) bridge the gap between 6G aspirations and practical deployment. These skills are in demand not just for research but for the semiconductor industry taking root in our region.

My own journey offers some perspective on this. I started at National Yang Ming Chiao Tung University (NYCU) in Hsinchu, Taiwan, often called the Silicon Valley of Asia. Being surrounded by semiconductor giants like TSMC, the hardware perspective was not optional, it was everywhere. You could not study wireless communications there without understanding that everything ultimately has to fit on a chip. Later, at Monash University in Australia, I dove deep into the theoretical side, working on OTFS and exploring what is possible in the delay-Doppler domain. The research was exciting, the mathematics elegant, but questions about implementation were always lurking in the background. Now at Vodafone Chair, TU Dresden, with its strong industry partnerships, I see both worlds colliding daily. Companies want solutions that work, not just on paper, but in real networks with real power budgets and real cost constraints. These experiences reinforced a crucial lesson: the gap between academic research and industry deployment is real, and it

is primarily a hardware gap. For students here in Assam, this is your moment. You do not need to go halfway across the world anymore. The semiconductor ecosystem is being built here, and there will be growing demand for engineers at the intersection of wireless communications and VLSI. As 6G standards evolve toward deployment in the 2030s, there will be opportunities to contribute to actual implementation. Being in a region building semiconductor capabilities while having expertise in both wireless communications and hardware design is a powerful combination.

## Conclusion: Hardware Isn't Boring, It is Essential!

There is a tendency to view hardware implementation as the boring part after interesting algorithmic work. This needs to change. Hardware constraints are fundamental to system design, not minor details. To fellow researchers and students: do not just chase algorithmic novelty. Think about silicon. Ask whether what you are proposing can actually be built. Talk to hardware engineers. Learn power and area estimation basics. Understand implementation trade-offs.

Algorithms will keep evolving, but the real battle for 6G will be won in the silicon that runs them. Hardware isn't just a limitation to overcome—it's a design space to explore, optimize, and innovate, where efficiency, speed, and reliability are shaped at the core.

With Assam steadily building its semiconductor ecosystem, and Assam Engineering College having strong foundations in electronics and telecommunications, we are in a unique position to contribute on both fronts—advancing smarter algorithms while also designing the hardware platforms that make them practical and scalable. The future of 6G isn't only in software—it's in the silicon that makes those ideas real.
And that future is one we can help build.


***SDG GOAL #3:*** *"Ensure healthy lives and promote well-being for all at all ages"*

# The Role of Technology in Today's Warfare

*– Chittaranjan Ojah, Sr. Supdt. of Police (Communication), Assam Police Radio Organisation | Alumnus, B.E. 1986-90*

In present day scenario, technology plays major role in the Warfield. Earlier soldiers were in the front line holding the Rifles in their hands. Casualties were in higher side.

Now, unmanned vehicles, drones, unmanned war plane are extensively used in the war. Let us examine the **Russia – Ukraine** war. Before the invasion starts, Russia started cyber attack and tried to destroy entire Computer Servers of Ukraine that might paralyze the normal functioning of the country. Fortunately the servers of Ukraine are well equipped for cyber attack so that Russia could do little damage. Further, there are significant use of electronic warfare in the battle field disrupting Fibre cable, communication towers, radar system etc which eventually destroyed internet connectivity, GSM mobile connectivity across the Ukraine region. Interestingly, immediately after Russia's attack, President Zelenskyy sent an SOS message in Twitter to provide Starlink Satellite Phone. CEO of SpaceX, Elon Musk within 2 days supplied 2500 nos of Satellite phone to Ukraine. As of now, there are 150,000 nos of satellite phone of starlink have been used in Ukrain, most of them are in use for defence purpose.

US president also played a major role in financing Satellite phone in Ukraine. A few month ago, US Govt in its statement stated that "*We continue to work with a range of global partners to ensure Ukraine has the resilient satellite and communication capabilities they need. Satellite communications constitute a vital layer in Ukraine's overall communications network and the department contracts with Starlink for services of this type*".

The lesson we learn from Ukraine War is that heavy tanks, warships, and fighter planes can no longer assure battlefield dominance. In reality, it is found that Russia had substantial losses when its tanks were attacked by the Ukrainian forces equipped with shoulder-carrying defensive US Stinger (MANPADS) and Javelin Anti-Tank Guided missiles.

At the beginning of the war, most us thought that Ukraine within a month or two had to surrender before powerful Russia . However, by the use of sophisticated technology viz Drones, Artificial Intelligent, Satellite imagery and Simulation techniques they could save their country from invasion by Russia. As of now, war in Ukraine is the most hi-tech war the world has ever seen.

Probably after one decade, instead of human soldiers, robot will be used to fight with each other. In addition to publishing report on casualty in war, agency will publish the nos of robot that is neutralized in the war. By use of Artificial Intelligence, robots become more powerful day by day.

This is the reason why all time great science fiction **Author Isaac Asimov** laid down three sets of rules for robots. These *laws* are as follows:

**First law of Robot:** A Robot may not injure a human being or, through inaction, allow a human being to come to harm.

**Second law of Robot:** A Robot must obey the orders given it by human beings except where such orders would conflict with the First Law.
Third Law of Robot: A Robot must protect its own existence as long as such protection does not conflict with the *First* or *Second* law.

Asimov later added another law the **fourth** or **zeroth** law stating that *"a Robot may not harm humanity, or, by inaction, allow humanity to come to harm."*

Asimov's laws are not scientific law, these are the instruction to be followed to avoid misuse of Robots by human. One day Robot might become Frankenstein and overpower human. Let us see whether human listen to the laws framed by Isaac Asimov in future. Else we could see a disaster situation when Robots will be used to kill human and a country will be overpowered through using human created Robots.


***SDG GOAL #4:*** *"Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all"*

# Non-Linear Career Path : *a tabu or blessing*

*– Dr. Geetima Das Krishna, Senior Economist| Alumna, B.E. 1983-87*

For a long time, we have been conditioned to believe that a successful career follows a linear trajectory. Many of us grew up watching our parents retire from the very organizations where they began their professional journeys. We were taught that careers should move in straight lines —complete school, earn a degree, secure a job, climb the ladder, and eventually retire. On paper, it looks like a perfect staircase neatly illustrated on a presentation slide.

This linear path has traditionally been viewed as the safest and most respectable route to professional success. Yet, for many of us—particularly women—this idealized pathway often gives way to realities such as work–life balance, family responsibilities, personal fulfilment, well-being, and evolving aspirations. Life, after all, rarely unfolds as neatly as a diagram on a PowerPoint slide.

A non-linear career path is one that does not confine growth to upward movement within a single organization, industry, or profession. Importantly, non-linearity is not always a choice or a luxury. Many professionals are compelled to pause, pivot, or reinvent their careers due to family responsibilities, caregiving roles, economic disruptions, or circumstances beyond their control.

### My Own Journey

My career has been anything but linear. After completing my undergraduate degree in engineering, I was convinced that academia would be my lifelong calling. I pursued that path with commitment, investing nearly a decade in that vision. However, personal circumstances required me to pivot—into a *new industry, a new sector,* and even a *new country*.

That transition was far from easy. It demanded courage, adaptability, and deep faith in my own abilities. I moved into finance and investments in the private sector and later transitioned into macroeconomics. Each move felt like starting from scratch.

At times, I shifted from senior roles in smaller organizations to mid-level positions in larger ones with salary hikes before gradually climbing the corporate ladder again. *"Was I failing?"* Some certainly thought so. Letting go of a long-held vision came with its share of heartache. Yet, with hindsight, those detours shaped me in ways a straight path never could.

At the time, it is difficult to see the larger picture when circumstances force you to change direction. But looking back, every role and every bend added depth to my professional growth. I developed strong practical skills, honed my writing abilities, and built relationships that continue to serve me well.

In one role, I learned how to craft compelling presentations and pitch ideas to clients. In another, I had a front-row seat to the global financial crisis of 2008, the sovereign debt crisis that followed, the U.S. taper tantrum, and India's phase as part of the **'Fragile Five'**. I learned to navigate uncertainty, analyze risk, and support fund managers through turbulent times.

A later detour into policy advocacy gave me a seat at the table alongside key voices in the policy ecosystem—an experience that ultimately paved the way for my PhD. About five years ago, when I moved back to Guwahati, I once again stepped into something new. I embraced it as a challenge and found immense joy in the learning it offered.

Some roles feel like discovering purpose where—what you are good at, what the role demands, and what you have been preparing for all along finally converge.

Lessons learnt for me:

- Career does not have to be linear. Changing direction does not mean you have failed.
- Job titles matter less and can be misleading. Skills you pick up are more important.
- Starting again is not starting over. You carry your experiences with you, even when you change fields.
- Move out of comfort zone. Discomfort is often a sign of growth.

### Non-Linear Careers: The New Normal

There has been a fundamental shift in how non-linear careers are perceived. Two decades ago, deviations from a straight path were often viewed as signs of failure or lack of commitment. That is no longer the case.

Today, organizations are increasingly open to resumes with twists and turns, recognizing the value of diverse experiences. Human resource teams actively encourage employees to realign roles with evolving interests and aspirations to enhance engagement and retention. Organizations no longer hire CVs alone—they hire people for their adaptability, courage, passion, and ability to create meaning amidst uncertainty.

Rapid technological change, evolving employment patterns, and a post-pandemic reassessment of priorities have made non-linear careers not only common but necessary. The current generation is actively exploring diverse opportunities in search of purpose and fulfilment in a dynamic world.

There is undeniable beauty in a straight-line success story, and we should celebrate those who achieve remarkable milestones early— those who make it to **"30 under 30"** lists in their chosen fields. But pivoters and late bloomers are no less accomplished. History is filled with individuals who began their most impactful work in their forties, fifties, or even later.

Research supports this reality. A McKinsey report notes that leaders with cross-functional experience are *2.4 times* more effective at navigating disruption than narrow specialists. Deloitte research suggests that professionals who shift industries demonstrate 30% faster problem-solving in complex environments—often because they can "import" solutions others may not see.

Skills once considered non-core— communication, strategic thinking, diplomacy, negotiation, teamwork, empathy, and problem-solving—are now central to employability.

In an increasingly unpredictable business environment, organizations value professionals with varied career paths and broad skill sets. For the new generation of graduates, the message is clear: have the courage to seize opportunities, build transferable skills, and remain open to change.

Careers may not always be straight, but they can be woven into a beautiful tapestry that defines who you are. Each pivot, each role, and even each dead end offers tools you did not know you would need.

They teach humility, gratitude, and clarity about what truly matters.

*Every new beginning can be a classroom, and every change, a new language worth learning.*


5 GENDER EQUALITY

***SDG GOAL #5:*** *"Achieve gender equality and empower all women and girls"*

# Telecom to Techco:
## *India's Roadmap from 5G to 6G*

**We recently had the opportunity to interview *Mr. Lakheswar Basumatary*, *Deputy General Manager at Reliance Industries Limited (Jio) and an alumnus of the B.E. 2000-2004 batch*, to gain deeper insights into the ongoing and upcoming developments in the Indian Telecommunications sector. The discussion covered topics ranging from the 5G rollout to future technologies like 6G, the Bharat 6G Mission, the role of IoT, and emerging career opportunities for professionals and students alike.**

***Interviewer:***

*We have observed that the 5G rollout is underway across India. What do you see as the next major development in the Indian telecom sector?*

***Expert's Answer:***

India today stands as the world's second-largest telecom market and one of the fastest countries in terms of deploying 5G. Leading operators, such as Reliance Jio and Bharti Airtel, have invested substantial capital expenditure (CAPEX) to build nationwide 5G infrastructure.

The Indian telecom industry is now entering a transformative phase commonly referred to as "Telco-to-Techco". Operators are moving beyond traditional services limited to voice and data. Instead, they are establishing themselves as technology-driven organizations, offering a broad portfolio that includes digital platforms, cloud services, cybersecurity solutions, IoT, edge computing, and enterprise applications.

A key focus area in this next phase is Fixed Wireless Access (FWA). Currently, every Indian household needs faster data connectivity. However, deploying fiber-to-the-home (FTTH) requires a significant investment by service providers. It is also time-consuming, as creating a fiber network in Indian cities is not easy.

FWA, powered by 5G mid-band and mmWave spectrum, enables operators to deliver fiber-like speeds and low latency over wireless last-mile connectivity. FWA offers lower deployment complexity and strong monetization potential. As data consumption continues to grow exponentially, FWA is expected to play a crucial role in connecting households via wireless media. It will help service providers generate revenue beyond the traditional business of connecting only mobile handsets.

***Interviewer:***

*When do we expect the 6G rollout in India? How is 6G different from 5G?*

***Expert's Answer:***

India is targeting a 6G rollout around 2030, in line with global timelines. Extensive R&D is already underway under the Bharat 6G Mission. Major organizations like IITs, NITs, and dedicated research labs are working on next-generation radio technologies, AI-native network and new spectrum bands.

6G is not just a faster version of 5G; it is a fundamental shift. While 5G delivers gigabit speeds with millisecond latency, 6G is expected to be 50 to 100 times faster, with peak speeds reaching up to 1 terabit per second and microsecond-level latency.

Another key difference is intelligence. In 5G, AI is used mainly to optimize the network. In 6G, AI is built directly into the air interface, making networks inherently intelligent and self-optimizing. Perhaps the most transformative feature is Integrated Sensing and Communication (ISAC). Unlike 5G, which only transmits data, 6G networks can also sense their environment using radio signals. This enables applications such as traffic monitoring, environmental sensing, and industrial safety without cameras or additional sensors. In short, 5G connects devices, while 6G connects intelligence, shaping the foundation of a truly smart and inclusive digital future.

***Interviewer:***

*Could you explain what the Bharat 6G Mission is, and how it will benefit India?*

***Expert's Answer:***

India has been a technology importer until 4G, and to a large extent, even in 5G. Most of the equipment is manufactured and developed by other countries. The Bharat 6G Mission marks a decisive shift from this model. It is a national strategic initiative by the Government of India to position the country as a global leader in 6G technology development. A key objective of the Bharat 6G Vision is for India to secure around 10% of global 6G patents, ensuring meaningful influence in shaping international 6G standards. India is trying to reduce dependence on foreign vendors and gain long-term economic and strategic benefits. Bharat 6G is about ensuring that India helps define the future of global telecom.

***Interviewer:***

*How do you see IoT playing a role in the near future?*

***Expert's Answer:***

Very soon, IoT is going to become the digital nervous system of our future economy. Powered by 5G and the upcoming 6G, we are moving into a world where day-to-day needs will be controlled by IoT. Factories will become autonomous, using real-time data to predict machinery failures before they happen. Our cities will become smarter with AI-controlled traffic systems that communicate directly with cars. Farms will be able to automatically manage water usage without human intervention. By combining this constant flow of data with AI, decisions will happen instantly on the device itself rather than waiting for cloud servers or manual intervention.

***Interviewer:***

*How is the evolving telecommunications landscape expected to drive job creation and new career pathways for both experienced professionals and current engineering students?*

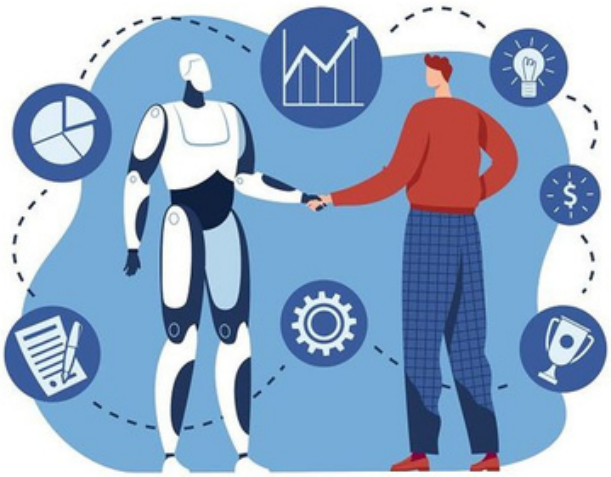
***Expert's Answer:***

As I mentioned earlier, India is the fastest in terms of 5G rollout and far ahead of many Asian and African countries. Consequently, Indian telecom professionals have a very good chance of getting jobs abroad.

The telecom industry will create significant job opportunities for both experienced professionals and today's engineering students. For telecom professionals, new roles are emerging in network automation, AI-driven operations, cybersecurity, enterprise solutions, IoT deployment, and private 5G networks for industries such as manufacturing, ports, airports, and smart cities.

The industry's transition from "Telco to Techco" is also creating opportunities in cloud services, digital platforms, and system integration.

For college students, the opportunity will be like never before. Core telecom skills combined with software, data analytics, and cloud technologies will be highly valued. Students can build careers not only with operators and Equipment Manufacturing Companies but also with semiconductor companies, startups, R&D labs, and global standards bodies working on 6G. Additionally, national initiatives such as the Bharat 6G Mission, Make in India, and Atmanirbhar Bharat are accelerating domestic R&D, manufacturing, and product development.




***SDG GOAL #6:*** *"Ensure availability and sustainable management of water and sanitation for all"*

# Chatbots in the Classroom

*– Dinesh Shankar Pegu , Associate Professor, ETE*

Recently I was in a conversation with an alumnus from the 2011 batch of the *Electronics & Telecommunication Engineering Department*. It was casual but there was one question that stuck on me.

"*Sir, now that AI Chatbots like ChatGPT, Claude, Gemini, Perplexity, and Grok are everywhere, what difference do you see in students compared to those from the pre-AI era?*". This is a question that should concern all educators.

I had to tell the obvious – that *chatbots* have become like calculators in the classroom. Chatbots help students write faster, debug code instantly, and find explanations easily. However, the deeper impacts will perhaps be clear only in few a years from now.

What's important is not *what students can produce, but what students can independently think through.*

Real education can be at risk if we use or encourage using AI as tools for cognitive outsourcing. This could lead to a shift from *thinking first to prompting first* whenever something comes up. When answers are instant and so well organized, the intermediate steps of learning - confusion, struggle, revision, and synthesis are easily bypassed. Over time this will create fluency without understanding. The cost of cognitive outsourcing is not plagiarism or misuse. It's the atrophy of native cognitive capabilities - skills that learners must acquire irrespective of any tools they use.


No matter how powerful AI becomes, students must be trained in native cognitive capabilities – the ability to think *natively, organically,* and *independently*. These are not optional; they are the foundation of higher education, professional judgment, and ethical decision-making. Native cognitive capabilities hinge on abilities to break complex problems into meaningful parts, relate ideas from different subjects, experiences, and contexts, combine ideas into coherent logic, synthesize inputs from multiple sources into original insight, apply knowledge learned in one setting to a new context, and predict outcomes with reasoning.

There's a difference between augmentation and replacement. Used wisely, AI can be a powerful tool – a comprehension multiplier in the classroom. But unwisely used, it can be a cognitive replacement.

Remember calculators didn't kill math or GPS didn't kill navigation skills. They changed our focus. Educators should design learning environments that change the focus to thinking. We must rethink how learning is to be measured. Traditional take-home assignments are no longer reliable. This is the signal to evolve. We must shift toward oral examinations and in-class measurement of comprehension. Assessment must encourage *thinking over typing*.

Students should keep in mind that AI is a privilege, not a substitute. If an idea cannot be explained without AI, it means that idea is yet to be understood. If a problem cannot be solved without AI, it means the skills are yet to be mastered.

The real measure of education has never been in the ability to access answers; it's in the ability to think when answers are unclear. Without the ability to reason independently education is incomplete. Technology will always advance. For human cognition to endure, native thinking must remain non-negotiable.


***SDG GOAL #7:*** *"Ensure access to affordable, reliable, sustainable and modern energy for all"*

# From Classroom to Community: *the Sanchar Mitra* Initiative

*– Swapna Bharali , Assistant Professor, ETE & Nodal Officer at AEC, Sanchar Mitra Scheme*

The rapid expansion of telecommunications and digital services has fundamentally reshaped modern society, enabling seamless information exchange, digital governance, and technology-driven economic growth. Alongside these advancements, however, new challenges have emerged in the form of cyber fraud, misuse of telecom services, digital illiteracy, and limited public awareness of regulatory safeguards and citizen-centric initiatives. Addressing these challenges requires more than technological innovation alone; it calls for sustained awareness, responsible usage practices, and meaningful engagement with society. In this context, the Sanchar Mitra Scheme, launched by the Department of Telecommunications (DoT), Government of India, represents a structured national initiative aimed at strengthening the interface between the telecom ecosystem and citizens through academic participation.

Initially introduced as a pilot programme and subsequently scaled up nationwide in 2025, the Sanchar Mitra Scheme is designed to harness the technical competence and social commitment of students from engineering and technology institutions. Under this initiative, nominated students are designated as *Sanchar Mitra*s trained outreach volunteers who act as intermediaries between telecom authorities and end users. Their role is to facilitate awareness on telecom services, digital safety, and regulatory provisions, while translating complex technical concepts into accessible and practical guidance for the public. The scope of the scheme includes cyber fraud prevention, mobile security, reporting mechanisms for spam and unsolicited communications, EMF radiation awareness, and promotion of citizen-centric digital platforms such as Sanchar Saathi.

As part of this national effort, Assam Engineering College collaborated with the Department of Telecommunications (DoT), Assam Licensed Service Area (LSA) under the Sanchar Mitra Scheme, nominating students from the Department of Electronics and Telecommunication Engineering (ETE) as Sanchar Mitras.

The Department of ETE with its strong academic foundation in communication systems, wireless technologies, and network security, provides an appropriate environment for effective participation in such outreach-oriented initiatives. The scheme enables students to translate classroom learning into practical, socially relevant engagement, reinforcing the broader purpose of engineering education.

From an implementation standpoint, the scheme follows a clearly defined operational framework. Structured orientation and training programmes are conducted by DoT and the National Communications Academy–Technology (NCA-T), covering telecom policies, cyber fraud typologies, EMF exposure standards, national telecom initiatives, and emerging technologies. These training modules ensure technical accuracy, regulatory compliance, and uniformity in outreach messaging. Awareness materials and standardized resources provided by DoT further support effective dissemination of information.

Following training, Sanchar Mitras are encouraged to conduct awareness drives in educational institutions and local communities, focusing on responsible telecom usage, prevention of digital fraud, mobile security, and promotion of digital literacy. A major emphasis of the programme is on educating citizens about suspected fraud communications delivered through voice calls, SMS, instant messaging platforms, and social media. Fraudsters often exploit urgency, fear, or incentives such as lottery winnings, job offers, KYC updates, or service disconnection warnings. The scheme highlights the importance of distinguishing between Unsolicited Commercial Communication (spam) and malicious scams, while familiarizing citizens with common fraud typologies such as financial scams, OTP and APK-based frauds, impersonation scams, fake customer care operations, and malicious links.

Students from the Department of ETE actively support society by acting as informed facilitators between technical platforms and the general public.

Their outreach strategy focuses on simplifying telecom and cybersecurity concepts into easily understandable guidelines. Planned activities include awareness sessions on identifying different types of frauds, live demonstrations of Sanchar Saathi portal and mobile application features, guidance on reporting suspected fraud through the CHAKSHU facility, and dissemination of best practices for safe mobile and internet usage, with special emphasis on vulnerable groups such as senior citizens and first-time smartphone users.

Participation in the Sanchar Mitra Scheme has emerged as a significant extension activity for Assam Engineering College, strengthening industry–academia collaboration while promoting social responsibility among students. The initiative underscores the role of academic institutions in addressing contemporary technological challenges and in preparing future engineers who are not only technically competent but also socially responsible contributors to a secure and digitally empowered society.



***SDG GOAL #8:*** *"Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all"*

# Touching the Invisible: *Automation in Assamese Gestural Languages and Challenges*

*– Dr. Ananya Choudhury , Assistant Professor, ETE*

Gestural air-writing is redefining the way humans interact with machines. Gestural air-writing—also referred to as in-air handwriting (IAH) allows users to write characters, words, or complete sentences in free space using hand or finger movements, without any physical writing surface [1]. This modality enables intuitive and natural communication between humans and machines and has found applications in smart devices, virtual and augmented reality environments, gaming interfaces, assistive technologies, and intelligent control systems.

By enabling users to write freely in space using hand movements, this technology offers a natural, touchless, and inclusive interaction paradigm. This article explores the automation of Assamese gestural languages through air-writing recognition, highlighting challenges, recent advances, and key research contributions.


*Figure 1: Conceptual illustration of gestural airwriting*

## Why Assamese Gestural Automation Matters

For linguistically rich and culturally distinct regions such as Assam, automation of gestural interaction in the native Assamese script holds particular importance. While air-writing recognition (AWR) systems have been extensively explored for scripts such as Latin, Devanagari, Arabic, and Chinese, the absence of a dedicated framework for Assamese gestural language significantly limits inclusive technological access for native speakers, especially people with special needs. Thus, automating gestural interaction in Assamese is essential for preserving linguistic inclusivity and enabling people with special needs to interact with technology in their native language.

## Gestural Air-Writing as an Assistive and Interactive Technology

Gestural air-writing systems enable users to interact with digital systems through dynamic hand trajectories captured via vision-based sensors or depth cameras. Unlike conventional pen-based handwriting, in-air handwriting is performed in a single continuous stroke, which introduces additional complexity in the form of unintended connecting motions [2] (ligatures) between characters.

Despite these challenges, AWR systems are increasingly being adopted as assistive aids, enabling individuals with physical impairments to operate electronic devices, communicate textually, and engage with digital environments using natural gestures.

In the Assamese context, automation of gestural interaction is particularly valuable for preserving linguistic identity while ensuring accessibility. An Assamese AWR system allows users to communicate in their native script without the cognitive burden of switching to non-native languages, thereby enhancing usability and inclusivity.

## Challenges in Automating Assamese Gestural Languages

Automation of Assamese gestural air-writing presents several unique challenges [3].

- ***Continuous Unistroke Writing:*** Assamese characters written in air are often produced in a single stroke, resulting in ambiguous ligatures and overlapping trajectories that complicate segmentation and recognition.
- ***High Intra- and Inter-User Variability:*** Writing styles vary significantly across users and even across instances from the same user, influenced by articulation speed, hand orientation, and personal writing habits.

- ***Structural Similarity of Characters:*** Many Assamese characters exhibit similar stroke structures and overall trajectory shapes, making discrimination between classes difficult.
- ***Temporal Dependencies in Words and Text:*** Recognition of long words or sentences requires effective modelling of long-range temporal dependencies across trajectory points.
- ***Trajectory Noise and Jitter:*** Free-space writing introduces inadvertent jitters and distortions due to lack of physical support, necessitating robust normalization techniques.
- ***Lack of Annotated Datasets:*** The absence of large-scale, standardized Assamese air-writing datasets poses an additional challenge for data-driven approaches.

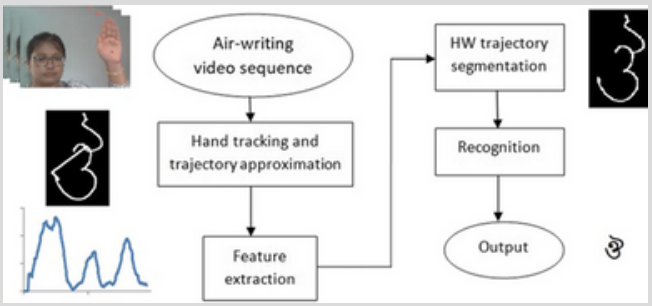



*Figure 2: Basic Assamese AWR framework*

## Research Contributions Toward Automation

To overcome these challenges, my research reported in [4]–[7] introduces a comprehensive vision-based air-writing recognition framework for the Assamese script, enabling robust recognition at character, word, and text levels.

Spatio-temporal handwriting detection is achieved using feature fusion and probabilistic MRF-based modelling. Recognition leverages CNN–LSTM ensembles for characters and an attention-driven 1D Convolutional Recurrent framework for words, enabling robust handling of Assamese script variability.

The proposed framework aligns with state-of-the-art trends by incorporating deep ensemble learning, attention mechanisms, and probabilistic modelling, while remaining computationally efficient.

## In-Air Handwriting Detection

Two complementary approaches are proposed for detecting valid handwriting segments from continuous air-writing trajectories:

- ***Feature Fusion-Based Detection:*** This approach integrates local motion-based features with global shape-based trajectory descriptors to distinguish meaningful handwriting segments from irrelevant interconnecting motions [4].
- ***Statistical Modelling-Based Detection:*** A Markov Random Field (MRF) model combined with Mahalanobis Distance (MD)-based multivariate analysis is employed to model spatio-temporal dynamics and probabilistically identify valid handwriting segments [5].

## Character Recognition Using Deep Ensemble Models

For in-air handwritten character recognition (IAHCR), a CNN–LSTM ensemble architecture is developed [5]. The CNN component captures the overall spatial appearance of the trajectory, while the LSTM network models temporal dependencies across trajectory points. This collaborative learning framework effectively handles ambiguous and structurally complex Assamese character patterns.

## Word Recognition with Attention Mechanisms

To address the challenges of long-range word recognition, a one-dimensional Convolutional Recurrent Attention Framework (1D-CRAF) is proposed [6]. The hybrid encoder learns sequential representations and high-level features, while an attention-aided decoder selectively focuses on salient trajectory segments during prediction. This architecture proves effective in managing trajectory length variations and contextual dependencies.

## Text Segmentation and Recognition

An in-air handwritten text (IAHT) recognition paradigm is introduced using a three-phase heuristic segmentation strategy to extract characters and words from continuous text lines [7]. MRF modelling and Kullback-Leibler (KL) divergence metric is first employed for spotting the meaningful air-writing components, and then separation of characters and words is done using a Convex Hull-based gap estimation criteria.

These segmented units are then simultaneously recognized using the classifier combination networks such as CNN-LSTM ensemble model and 1D-CRAF model, enabling end-to-end automation of Assamese gestural text.

## Recent Trends and State-of-the-Art Approaches

Recent advances in AWR and gestural language automation have increasingly leveraged deep learning and sequence modelling techniques. Transformer-based architectures, self-attention mechanisms, and graph neural networks (GNNs) are being explored to model complex spatial–temporal relationships in air-writing trajectories. Multimodal fusion approaches combining vision, inertial, radar, and acoustic sensor data have also shown promise in improving robustness [8] [9]. Additionally, data augmentation, synthetic trajectory generation, and transfer learning are emerging as effective strategies to mitigate data scarcity in low-resource scripts such as Assamese.

## Conclusion and Future Directions

Automation in Assamese gestural languages through air-writing recognition represents a significant step toward inclusive and natural HCI. It holds immense promise for assistive technologies and intelligent interfaces. The presented research offers a comprehensive solution addressing detection, normalization, segmentation, and recognition challenges using a combination of statistical and deep learning techniques. Future research directions include the development of large-scale Assamese air-writing dataset, exploration of transformer-based sequence models, real-time deployment on edge devices, and integration with multimodal assistive systems. Such advancements will further strengthen the role of gestural automation in preserving linguistic diversity while enhancing accessibility and technological empowerment.

## References


[1] Abir, F. A., Siam, M. A., Sayeed, A., Hasan, M. A. M., & Shin, J. (2021). Deep learning based air-writing recognition with the choice of proper interpolation technique. Sensors, 21(24), 8407.

[2] Alam, M. S., Kwon, K. C., Alam, M. A., Abbass, M. Y., Imtiaz, S. M., & Kim, N. (2020). Trajectory-based air-writing recognition using deep neural network and depth sensor. Sensors, 20(2), 376.

[3] Handique, B. B., & Das, P. (2024, February). A Review in Assamese Handwritten Character Recognition. In NIELIT's International Conference on Communication, Electronics and Digital Technologies (pp. 527-549). Singapore: Springer Nature Singapore.

[4] Choudhury, A., & Sarma, K. K. (2019, November). A two stage framework for detection and segmentation of writing events in air-written assamese characters. In International Conference on Pattern Recognition and Machine Intelligence (pp. 575-586). Cham: Springer International Publishing.

[5] Choudhury, A., & Sarma, K. K. (2021). A CNN-LSTM based ensemble framework for in-air handwritten Assamese character recognition. Multimedia Tools and Applications, 80(28), 35649-35684.

[6] Choudhury, A., & Sarma, K. K. (2023). Trajectory-based recognition of in-air handwritten Assamese words using a hybrid classifier network. International Journal on Document Analysis and Recognition (IJDAR), 26(4), 375-400.

[7] Choudhury, A., & Sarma, K. K. (2022). A Framework for Segmentation of Characters and Words from In-Air Handwritten Assamese Text. In Advances in Intelligent Computing and Communication: Proceedings of ICAC 2021 (pp. 235-246). Singapore: Springer Nature Singapore.

[8] Arsalan, M., Santra, A., & Issakov, V. (2020, December). Radar trajectory-based air-writing recognition using temporal convolutional network. In 2020 19th IEEE international conference on machine learning and applications (ICMLA) (pp. 1454-1459). IEEE.

[9] Tonape, Y. L., Haral, A., Sudarshan, P., Rohit, P., & Sandesh, P. (2024). Machine Learning-Based Air Writing: A Literature Review on Techniques, Progress, and Challenges. ITSI Transactions on Electrical and Electronics Engineering, 13(2), 20-28.


***SDG GOAL #9:*** *"Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation"*

# *Ideas, Iteration* and *Innovation*

*– Devraj Kashyap, Purvanchal Engineering Systems | Alumnus, B.Tech. 2020-24*

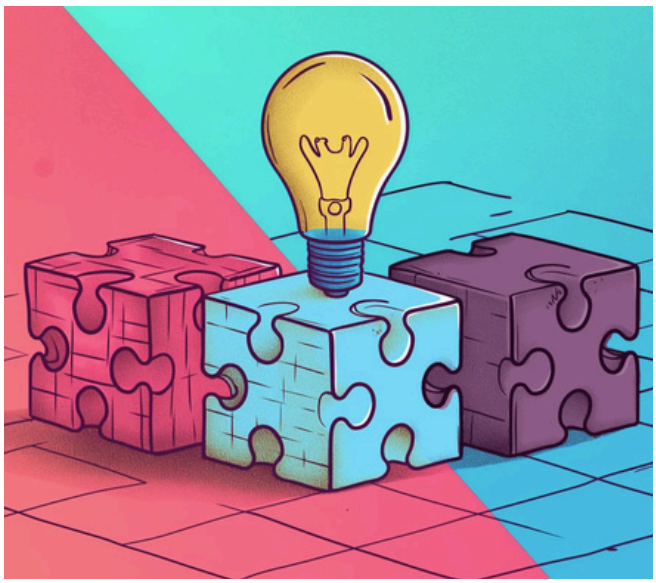
I am asked at times how I ended up on the entrepreneurial path. Given my academic learnings, it seemed too odd a choice. However, to me it was simply an opportunity to apply my learned skills alongside a few friends to real-world problems. What began as a few friends tinkering with hobby electronics slowly turned into something bigger.

We started the way many makers do experimenting, breaking things, and learning by trial and error. As we got deeper into the hobby robotics competitions, we noticed a stark difference. All the cheap products were flimsy or prone to damage while the top-of-the-line products were priced out of reach of newcomers. The markets saw only the people with money to burn as worth retaining, making it prohibitive for students.

Our first attempt at entrepreneurship was thus well received by the hobby market. Our ESCs proved extremely durable in rough use, benefitting students and certain industrial niches. However, we did face roadblocks when attempting to expand to newer markets.

What surprised us, however, was that the hardest part was not innovation or engineering. The real challenge lay in navigating the startup ecosystem itself. Accessing the right kind of support whether from investors, mentors, or startup *"sherpas"* often proved more difficult than building the technology. Many conversations focused on scale and projections long before there was room to discuss learning, iteration, or ground realities. This forced us to become pragmatic.

We learned to recognise when persistence was valuable and when rigidity was counterproductive. Instead of holding too tightly to our original dreams of a fully indigenous drone system, we decided to make a pivot.



We focused on understanding what the market was actually asking for.

Networking played a crucial role in this transition. Conversations within startup circles, and especially guidance from alumni who had navigated similar paths, helped us see the bigger picture. Their experience was instrumental in our pivot from a purely electronics-focused venture to working on IoT hardware coupled with a platform-as-a-service model.

It wasn't a departure from our roots, but an evolution to a form that could thrive bereft of the venture capital and *"incubation"* centres.

Looking back, the journey reinforced a simple idea: entrepreneurship is as much about adaptability as it is about innovation. Following your own heart matters, but so does knowing when to listen, learn, and pivot.

Being open-minded, willing to unlearn, and not overly set in one's ways often makes the difference between an idea that stays a hobby and one that grows into something meaningful.

10 REDUCED INEQUALITIES

***SDG GOAL #10:*** *"Reduce inequality within and among countries"*

# The Global Semiconductor Revolution: *India, Assam & Emerging Talent*

*– Sambhab Roy, B.Tech 6th Semester | 2023-2027*

Semiconductors form the backbone of modern electronics and communication systems.

Every smartphone, 5G base station, satellite, electric vehicle, and defense platform depends on semiconductor devices such as transistors, integrated circuits, and processors. Though physically small, semiconductor chips now influence technological leadership, economic resilience, and national security. For us Electronics and Telecommunication Engineering (ETE) students, semiconductors represent the intersection of core engineering knowledge, geopolitics, and future career opportunities.

## Semiconductors and Global Geopolitics

In the modern world, semiconductors are as strategically important as energy resources. Advanced chip manufacturing is concentrated in a few regions, primarily the United States, Taiwan, South Korea, Japan, and parts of Europe. Taiwan Semiconductor Manufacturing Company (TSMC) produces a significant portion of the world's most advanced logic chips, making global supply chains highly sensitive to geopolitical instability.

Technology sanctions, export controls, and trade restrictions have turned semiconductors into instruments of geopolitical power. Access to advanced chips determines leadership in artificial intelligence, high-speed communication, cyber systems, defense electronics, and space technology. The ongoing US–China technology rivalry demonstrates how semiconductor control directly impacts economic dominance and military capability.

As a result, nations are investing heavily to localize semiconductor supply chains and ensure strategic autonomy.

## Technical Structure of the Semiconductor Industry

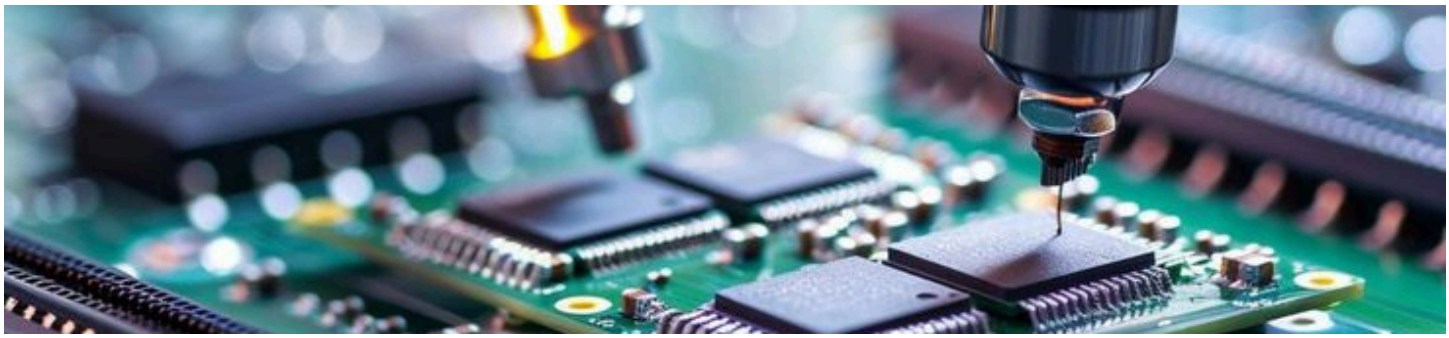
From a technical perspective, the semiconductor industry is divided into several specialized stages including chip design and architecture, fabrication using nanometer-scale processes, assembly, testing, marking and packaging, and system-level integration. Each stage requires expertise in semiconductor physics, material science, analog and digital electronics, RF and microwave engineering, signal processing, and embedded systems.

For ETE students, this industry aligns closely with core subjects such as analog electronics, digital systems, communication engineering, VLSI design, and electromagnetic theory. Modern telecom infrastructure, including 5G and emerging 6G systems, depends on advanced RF, mixed-signal, and high-frequency semiconductor components.

## India's Semiconductor Strategy

India's semiconductor strategy focuses on leveraging its strong engineering talent base while developing domestic manufacturing and packaging capabilities. India already has a global presence in chip design, verification, and embedded systems, with thousands of engineers working in international semiconductor R&D centers.

Government initiatives such as the Semicon India Programme and Production Linked Incentive schemes aim to establish fabrication plants, assembly and testing units, and electronics manufacturing clusters. From a geopolitical viewpoint, this strengthens India's technological sovereignty and reduces dependence on foreign supply chains.



## Role of the Tata Semiconductor Plant in India's Ecosystem

The Tata Group's entry into semiconductor manufacturing marks a defining moment for India's electronics industry. Through Tata Electronics, the group is establishing advanced semiconductor fabrication and packaging facilities, including a major fabrication plant in Dholera, Gujarat, and an assembly, testing, marking, and packaging (ATMP) unit in Assam.
The Tata semiconductor initiatives aim to strengthen India's position across the semiconductor value chain, from manufacturing to supply-chain resilience. These plants are expected to generate large-scale employment, promote technology transfer, and build a reliable domestic ecosystem for critical chips used in telecom, automotive, defence, and power electronics. Strategically, Tata's involvement enhances India's credibility as a global semiconductor partner.

## Assam's role in the semiconductor ecosystem

The establishment of Tata's ATMP facility in Assam positions the state as a critical node in India's semiconductor value chain. Packaging and testing are essential stages that determine chip reliability, performance, and integration into electronic systems.
With the Tata semiconductor facility, Assam can emerge as a hub for high-skill electronics manufacturing, chip testing, telecom hardware, and power electronics.
This development will create employment opportunities, encourage ancillary industries, and significantly reduce the migration of skilled engineers from the region.

## Key Skills for ETE Students

For us ETE students of Assam Engineering College, the semiconductor revolution demands focused skill development. Strong fundamentals in semiconductor devices, analog and digital circuits, communication systems, microprocessors, VLSI, RF engineering, and signal processing are essential.
Alongside theory, we must develop practical skills in hardware description languages, embedded systems programming, RF circuit basics, electronic design automation tools, and hardware-oriented programming using C, C++, and Python. Projects, internships, hackathons, and research initiatives will prepare students to contribute directly to facilities such as the Tata semiconductor plant.

## Role of Assam Engineering College

Assam Engineering College can act as a catalyst by strengthening VLSI and electronics laboratories, introducing semiconductor-focused electives, encouraging applied research, and fostering collaboration with industry partners including Tata Electronics. With its academic legacy, AEC can become a major talent supplier to India's semiconductor ecosystem from the North-East.

## Conclusion

Semiconductors today define technological leadership and geopolitical strength. India's semiconductor mission is a strategic necessity, and the Tata semiconductor plant reinforces this vision by anchoring domestic manufacturing and packaging capabilities. For us ETE students, this is a historic opportunity to build relevant skills and contribute to a nationally significant industry. In a *chip-driven* world, *skilled* engineers define global power.


***SDG GOAL #11:*** *"Make cities and human settlements inclusive, safe, resilient and sustainable"*

# Who Taught The ALGORITHM?
## *On AI bias and the Illusion of Neutrality*

*– Kristina Deka, B.Tech. 6th Semester | 2023-2027*

The first time I heard of ChatGPT, I wasn't online or scrolling through headlines.
I was sitting in an examination hall, writing my Class 12 board exam. Printed clearly on the admit card, alongside the usual prohibitions against mobile phones and smartwatches, was a line banning the use of something called *ChatGPT*. I remember pausing, curious more than concerned, wondering what kind of tool had become important enough to be mentioned in an exam rulebook.

I looked it up later, understood roughly what it was, and then moved on. It would be much later still before I actually used it.
Since then, I don't remember the exact moment AI stopped feeling like a tool. What I do remember is how steadily it began to appear everywhere. Every day, it reaches deeper into our world, showing up in offices and hospitals, classrooms and lecture halls, government institutions and private systems alike. At first, it seemed harmless. Efficient, even. A recommendation here, an automated assessment there; a system designed to make things faster and smoother. But over time, those suggestions hardened into outcomes while AI is marketed as a tool to handle the dull, repetitive tasks no one wants to do, we are increasingly asking it to replace human judgment altogether.

Today, algorithms influence who is considered qualified, credible, risky, or worthy of attention, often before a human ever enters the picture. This shift is rarely framed as a loss of agency. Instead, it is sold as progress: faster decisions, fewer errors, less human bias. Yet, the more responsibility we hand over, the less clear it becomes who is accountable when things go wrong.

We're often told that algorithms are objective, that machines don't judge, and that technology is fairer than people. That promise sounds comforting, especially in societies where human systems have long been unfair.

Most AI systems, however, are trained on historical data. And history, as we know, is not neutral. It carries the weight of who had access, who was excluded, who was seen, and who was ignored. At first glance, algorithms seem impartial. But peel back that veneer, and you'll find biases baked deep into the data they learn from and the problems they are designed to solve. Because these tools operate at a massive scale, even small biases can snowball into major societal impacts.

A striking example comes from hiring. Researchers tested large language models on real resumes where the only difference was the candidate's name. The result? AI systems favored names associated with white applicants 85% of the time over Black-associated names, and male names far more often than female ones.

This isn't just about careers. In healthcare, algorithms trained mostly on light-skinned patients show up to half the accuracy when diagnosing conditions in Black patients, simply because the data rarely includes diverse examples.

Then there's facial recognition. Some systems misidentify darker-skinned women at rates far higher than lighter-skinned men, up to 30–40 times worse in earlier studies, exposing how uneven training data can translate into real-world harm.

Even well-meaning design choices can backfire. When sentencing tools used in criminal justice estimate risk, studies have found that Black defendants are more likely to be labeled "high risk" despite having profiles similar to white defendants, reinforcing existing biases in policing and incarceration.
These dynamics become even more pronounced in the Global South. Many AI systems are trained primarily on Western data, Western faces, accents, languages, and social norms.

Facial recognition tools misidentify darker-skinned individuals far more frequently than lighter-skinned ones. Voice systems struggle with non-Western accents. Translation tools flatten cultural nuance. Entire populations become "edge cases."

What makes algorithmic bias especially dangerous is that it doesn't look like discrimination. There is no hostile intent and no visible gatekeeper. And because machines are trusted, their decisions are rarely questioned. And that's the scary part. A biased human affects dozens. A biased algorithm affects millions, instantly and repeatedly.

If current trends continue, the AI-powered future will be anything but neutral or conducive to human flourishing. Instead, it will automate and amplify flawed thinking, reinforcing the very hierarchies that have long kept some people down while lifting others even higher. But it does not have to be this way.

If we treat algorithms as neutral, we give up accountability. But if we see them for what they are, human systems in digital form, we can demand something better. When we start asking the right questions - who gets to design them, whose data they learn from, and who gets harmed when they fail - the biases, prejudices, and exclusions that have shaped our world for centuries can be written out of the code that increasingly governs it.

All it takes is a collective willingness to recognize these distortions for what they are, and to admit that they serve almost none of us in the long run, no matter how well they are marketed to certain groups.


***SDG GOAL #12:*** *"Ensure sustainable consumption and production patterns"*

# New Frontiers in Electronics: *Redefining the Digital Architecture*

*– Hridayan Nath, B.Tech. 6th Semester | 2023-2027*

Electronics is no longer evolving in incremental steps, it is advancing in tectonic shifts. What once revolved around miniaturizing silicon has expanded into a multi-dimensional frontier of intelligence, efficiency, and quantum-scale adaptability. As we move through 2026, the convergence of new materials and brain-inspired architectures is fundamentally redefining what electronic systems can achieve.

## Beyond Silicon: The Wide-Bandgap & 2D Revolution

As traditional silicon reaches its "Angstrom-era" physical limits, the industry has pivoted toward Wide-Bandgap (WBG) materials.

- *GaN and SiC*: Gallium Nitride (GaN) and Silicon Carbide (SiC) have moved from niche applications to the core of power electronics, enabling the ultra-fast charging and high-efficiency inverters found in the latest electric vehicles and green data centers.
- *2D Nanoelectronics*: Beyond WBG, two-dimensional materials like Molybdenum Disulfide (MoS_2) and Graphene are transitioning from labs to pilot production. These atomic-layer materials allow for transistors with near-zero leakage, promising a future where mobile devices can last weeks on a single charge.

## Neuromorphic Hardware: Circuits that Think

The most significant leap in 2025–2026 is the rise of Neuromorphic Electronics. Moving away from the energy-heavy von Neumann architecture, new chips utilize Memristors—components that "remem-ber" the amount of charge that has flowed through them.

- Spiking Neural Networks (SNNs): By mimicking the human brain's synapses, these chips process information only when "spiked," reducing energy consumption by up to 1,000 times compared to traditional GPUs.
- Edge Intelligence: This efficiency is enabling "Real-time AI" in independent drones and prosthetic limbs that process sensory data locally without needing a cloud connection.

## Bio-Integrated & Stretchable Systems

Electronics is becoming "human-centric" through the development of Electronic Skin (e-skin). These ultra-thin, biodegradable circuits use piezoelectric nanofibers to monitor biometrics such as glucose levels or electrolyte balance directly from sweat.

## The 6G Era and Terahertz Communication

In communication technology, 2026 marks a historic milestone in 6G research. We are moving into the Terahertz (THz) spectrum (100 GHz to 3 THz), targeting data rates of 1 Terabit per second (Tbps).

- *Metamaterials*: Advanced antenna designs now incorporate Reconfigurable Intelligent Surfaces (RIS) that can "steer" signals around obstacles, solving the high-attenuation challenges of THz waves.
- *Impact*: This supports "holographic comm-unication" and massive IoT ecosystems where every object in a smart city is connected with microsecond latency

## Quantum Electronics: From Lab to On-Chip

Quantum electronics has entered the era of Quantum Infrastructure. In 2026, the focus has shifted from just increasing "qubit counts" to solving scalability through:

- On-Chip Cryogenic Control: Recent breakthroughs in cryogenic CMOS allow control electronics to sit directly inside the refrigerator with the quantum processor, eliminating the "wiring bottleneck."
- Quantum-Safe Networking: Photonic Integrated Circuits (PICs) are now being deployed for Quantum Key Distribution (QKD), ensuring that our communication remains secure even against future quantum threats.

## Conclusion

Modern electronics has moved beyond speed to focus on smart, sustainable, and integrated systems. The challenge today lies not in how small chips can be, but in how intelligent and efficient entire systems can become.

# Edge AI: *Intelligence at the Chip Level*

*– Mandisha Shivam, B.Tech. 6th Semester | 2023-2027*

For many years, artificial intelligence was something that lived mostly in powerful computers and massive cloud data centers. Whenever we used AI-based applications such as voice assistants, face recognition, or recommendation systems, most of the processing took place far away from our devices, on servers that consumed a lot of power and had access to large storage and computational resources. However, technology has started to move in a new direction.

Today, artificial intelligence is gradually shifting from the cloud to the edge — meaning directly onto small devices like smartphones, smartwatches, home appliances, industrial sensors, and even tiny microcontrollers. This trend is known as Edge AI, and it is transforming how we design and use intelligent systems.

## What Is Edge AI and Why Is It Important?

Edge AI refers to the execution of machine learning models directly on local devices instead of sending data to remote servers. In this approach, the device itself processes data, makes decisions, and produces outputs in real time. This is fundamentally different from the earlier cloud-based approach, where data had to be transmitted to the cloud, processed there, and then results were sent back to the device

The importance of Edge AI comes from several key advantages. First, it dramatically reduces delay. Since the computation happens on the device itself, responses are much faster, enabling real-time applications such as instant speech recognition, gesture control, autonomous navigation, and safety monitoring.

Second, it improves privacy and security because sensitive data such as voice recordings, health information, or camera footage does not have to leave the device.

Third, it improves reliability as devices can continue functioning even without internet connectivity. Finally, it significantly reduces bandwidth usage and cloud processing costs, making AI more scalable and affordable.

## The Core Challenge: Limited Power and Resources

Despite its benefits, Edge AI faces a major engineering challenge. Traditional machine learning models are very large and require enormous computational power, memory, and energy. Large neural networks can have millions or even billions of parameters and normally run on GPUs or advanced processors with high power consumption. In contrast, edge devices are extremely constrained. Many edge chips have only a few hundred kilobytes of RAM, limited processing capability, and must operate for long periods on small batteries.

This means we cannot simply take a complex AI model used in data centers and run it unchanged on a smartwatch or sensor. Instead, researchers and engineers must find intelligent ways to shrink, simplify, and optimize machine learning models without significantly reducing their accuracy and performance.

## Techniques Used to Shrink Machine Learning Models

- *Quantization:* Quantization is one of the most widely used techniques. Normally, neural networks use 32-bit floating point numbers to store and process data. Quantization reduces this precision to 16-bit, 8-bit, or even lower. This drastically cuts memory usage and speeds up computation because low-precision operations require less hardware power. Interestingly, in many cases, model accuracy remains almost unchanged even after this compression, making quantization highly practical for edge deployment.

- *Pruning:* In a neural network, not every connection or neuron contributes equally to the final prediction. Many parameters barely impact performance. Pruning techniques identify and remove these unnecessary or weak connections. As a result, the model becomes smaller, faster, and more resource-efficient while still performing close to the original version.

- *Knowledge Distillation:* Knowledge distillation is a training approach in which a large, powerful model (called the teacher model) is first trained with full capability. Then, a smaller, simpler model (called the student model) is trained to replicate the behavior and intelligence of the teacher. This student model becomes compact enough to run on edge devices while retaining much of the teacher model's accuracy.

- *Designing Efficient Architectures:* Rather than only shrinking existing models, researchers also design neural networks specifically meant for low-power devices. These architectures are built with efficiency as a primary goal. Models such as MobileNet, SqueezeNet, and EfficientNet-Lite are examples where the structure itself is optimized to require fewer computations while still delivering strong performance. This allows advanced AI tasks like image classification and speech recognition to run smoothly on portable devices.

- *Specialized Edge Hardware:* Hardware development also plays a crucial role. Modern edge devices are increasingly equipped with specialized AI accelerators and neural processing units (NPUs) designed to handle machine learning tasks more effectively than traditional processors. Examples include Google's Edge TPU, Qualcomm's Snapdragon NPUs, NVIDIA Jetson platforms, ARM Cortex microcontrollers, and dedicated chips like Apple's Neural Engine. These chips enable faster processing, lower latency, and reduced power consumption.

## Real-World Applications of Edge AI

Edge AI is already becoming part of our daily lives. In smart homes, it powers voice-controlled assistants, intelligent lighting, and automated security systems without requiring continuous internet access.

In smartphones and consumer electronics, it enables features such as facial recognition, real-time photo enhancement, and noise cancellation.

In the automotive sector, Edge AI supports driver assistance systems, obstacle detection, and safety monitoring, contributing to safer transportation.

In healthcare, wearable devices can monitor heart rate, detect irregularities, assist patients with hearing impairments, and provide continuous health supervision without cloud dependence.

In industrial environments, Edge AI enables smart sensors for predictive maintenance, machinery monitoring, quality inspection, and agricultural automation.

## Remaining Challenges

Although Edge AI is advancing rapidly, it is not without challenges. Compressed models sometimes lose accuracy compared to large cloud-based systems. Updating thousands of deployed edge devices with new models securely and consistently can be difficult. Hardware diversity creates compatibility issues, and security threats at the device level remain concerns. Balancing performance, cost, and battery life continues to be a complex engineering problem.

## The Future of Edge AI

Looking forward, Edge AI is expected to become increasingly powerful and widespread. Concepts like TinyML aim to bring machine learning to extremely small microcontrollers operating on minimal power. Federated learning will allow devices to collaboratively improve models without sharing raw data, enhancing privacy. Hybrid systems combining both edge and cloud intelligence will provide the best balance between efficiency and capability.

## Conclusion

Edge AI represents a major technological shift from centralized cloud computing to intelligent, self-sufficient devices. By shrinking machine learning models and designing efficient hardware, we are making AI faster, more private, more affordable, and more accessible. As research continues, Edge AI will play a critical role in shaping the next generation of smart technologies in homes, industries, healthcare, transportation, and beyond.

# Satellite Communication in Rural Connectivity: *Bridging the Digital Divide*

*– Ishita Peters, B.Tech. 6th Semester | 2023-2027*

## Bridging the Digital Divide

In an increasingly digital world, access to reliable and high-speed communication networks is not just a luxury — it's a necessity. Yet, despite rapid advances in telecommunication infrastructure globally, rural areas remain persistently underserved, especially in regions with challenging geography, low population density, or limited economic viability for private investment. Here, satellite communication has emerged as a transformative force, offering connectivity where traditional terrestrial networks struggle to reach.

## Why Satellite Connectivity Matters for Rural Areas

Traditional connectivity solutions like optical fiber, microwave backhaul, or cellular towers have shaped urban and peri-urban communications. However, deploying this infrastructure in rural and remote regions often proves logistically difficult and economically prohibitive. Mountainous terrains, dense forests, deserts, scattered villages, and islands make laying cables or erecting towers both costly and time-intensive, discouraging service providers due to limited return on investment.

Satellites overcome these physical barriers by offering coverage that is essentially global in scope. Whether a village is perched high in the Himalayas or tucked away in the Sundarbans, satellite beams can deliver connectivity without the need for extensive ground installations. This makes satellites uniquely positioned to close the rural–urban digital divide that persists in many developing nations, including India.

## How Satellite Networks Deliver Connectivity

Satellite communication works by transmitting signals from ground terminals to orbiting satellites, which then relay data back to other ground stations or user terminals. Modern satellite internet systems fall into several categories:

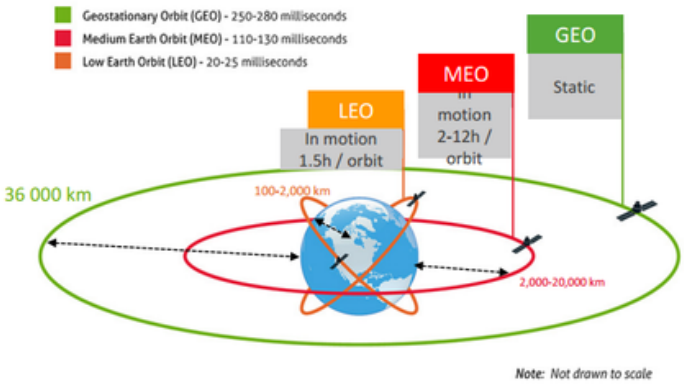
- Geostationary Earth Orbit (GEO) satellites sit about 36,000 km above Earth, providing broad coverage but with higher latency — often unsuitable for real-time applications.
- Low Earth Orbit (LEO) constellations orbit much closer (500–2,000 km), resulting in significantly lower latency and higher throughput, enabling smoother video calls, remote learning, and telemedicine.
- Medium Earth Orbit (MEO) and hybrid networks combine elements of both, aiming to optimize speed and coverage.

Satellite networks can be used directly by individual homes or via a community gateway that redistributes access locally. In many rural deployments, a central hub connects to satellites and then shares internet via Wi-Fi or local fiber, reducing individual hardware costs.

## Key Benefits for Rural Development

Satellite communication extends far beyond merely providing internet access. Its impact ripples across multiple high-impact sectors:

- Education and Digital Learning Connected classrooms can access global educational content, virtual libraries, and interactive learning platforms, helping rural students overcome long waiting distances to physical schools.



This boosts both learning outcomes and future opportunities for young learners.

- Telehealth and Remote Medicine Satellite broadband enables telemedicine services, connecting rural patients with specialists in urban centers. Consultations, diagnostics, and even remote monitoring become feasible, reducing strain on local health facilities and improving timely care.
- Economic Empowerment Small businesses and entrepreneurs in rural communities gain access to e-commerce platforms, digital payments, market prices, and supply chain networks. This fosters economic activity and integration with broader markets, creating new income streams and employment.
- E-Governance and Public Services Online access empowers rural citizens to use government services — from land records to welfare schemes — without traveling long distances. Digital inclusion strengthens civic participation and transparency.
- Disaster Preparedness and Emergency Response Natural disasters often destroy ground infrastructure, leaving communities isolated. Satellite systems, less vulnerable to local damage, provide critical communication links for rescue, coordination, and information dissemination.

## Technological Advances Enhancing Capability

The field of satellite communication is evolving rapidly:

- *LEO Mega-Constellations*: Projects like SpaceX's Starlink, OneWeb, Amazon's Project Kuiper, and Telesat's Lightspeed are launching thousands of satellites to deliver low-latency broadband globally.
- *Hybrid Networks*: Combining terrestrial 5G and satellite links can optimize performance — a smart approach for rural areas where broadband has gaps due to geography or traffic demand.
- *Smaller and Portable Terminals*: Modern Very Small Aperture Terminals (VSATs) and portable satellite modems are easier to deploy and require minimal power, enabling off-grid connectivity for remote schools, health posts, and community centers.

## Challenges and Limitations

Despite immense promise, satellite connectivity faces several obstacles:

- Cost and Affordability High upfront hardware costs and subscription fees remain barriers, especially in low-income rural communities.Without subsidies or public support, many households cannot adopt satellite services.
- Latency and Performance While LEO satellites significantly reduce latency compared to GEO systems, their performance can still lag behind fiber or 5G networks for real-time interactive applications.
- Regulatory Hurdles Satellite operators must navigate complex licensing, spectrum allocation, and data security regulations. These processes can delay deployments and increase costs.
- Space and Environmental Risks Mega-constellations contribute to orbital congestion, raising concerns about space debris and long-term sustainability.

## The Road Ahead: Policies and Partnerships

Realizing the full potential of satellite communication for rural connectivity requires coordinated action:

- *Government Initiatives*: National programs can subsidize rural access, integrate satellite links with national broadband strategies (e.g., BharatNet in India), and streamline regulatory pathways.
- *Public-Private Partnerships*: Collaboration between space agencies like ISRO, telecom operators, and global constellation partners can scale deployments while sharing risks and resources.
- *Localized Models*: Village broadband hubs, shared community access points, or cooperative internet models can make satellite broadband more affordable and sustainable.

## Conclusion

Satellite communication is no longer a futuristic concept — it has become a critical enabler of inclusive digital growth. By overcoming the barriers that impede terrestrial networks, satellites bring connectivity to the farthest corners of the globe. From health and education to agriculture and commerce, the socio-economic benefits are far-reaching. While challenges remain, the momentum of technological innovation and supportive policy frameworks promise a future where no community is left disconnected from the digital world.

# The Master Architect of the Silicon Age:
## *Why ASML is the World's Most Indispensable Tech Company*

*– Riman Sharma, B.Tech. 6th Semester | 2023-2027*

In the quiet Dutch town of Veldhoven, a company operates that most people have never heard of, yet almost no one can live without. ASML does not make smartphones, cars, or AI software. Instead, it builds the machines that make those things possible. Often described as the "architect of Earth's most complex machines," ASML has evolved from a struggling "problem child" into a global monopoly that sits at the very heart of the semiconductor universe.

From Leaky Sheds to Global Dominance ASML's journey began in 1984 as a risky joint venture between the electronics giant Philips and Advanced Semiconductor Materials International (ASMI). In its early days, the company was far from a success story. It operated out of a leaky shed next to a Philips office in Eindhoven, struggling to sell its first system, the PAS 2000. Throughout the 1980s, ASML faced constant financial peril. At one point, the global electronics market took such a sharp downturn that shareholder ASMI withdrew its support, leaving ASML's future hanging by a thread. It was saved only by a final, desperate investment from Philips and a stroke of serendipity involving Morris Chang, the founder of TSMC.

After a fire destroyed TSMC's first order of ASML machines, the insurance payout allowed Chang to reorder the equipment, effectively doubling ASML's revenue at a critical moment. This partnership with TSMC would eventually become the bedrock of the modern chip industry.


*The EUV Breakthrough:* Engineering the Impossible ASML's true importance today lies in its mastery of Extreme Ultraviolet (EUV) lithography. For decades, chipmakers used Deep Ultraviolet (DUV) light to etch circuits onto silicon. But as chips became smaller, DUV became too "blunt"—like trying to write a letter with a snow shovel.

The solution was EUV, a technology so complex that many believed it was physically impossible. To create EUV light, ASML's machines fire a high-power laser at a tiny droplet of molten tin 50,000 times per second, creating a plasma hotter than the surface of the sun. This light is then reflected by the world's flattest mirrors to etch patterns just a few nanometers wide. Developing this took over 30 years and $9 billion in R&D;, but it granted ASML a total monopoly; they are currently the only company on Earth capable of building these systems.

Why the Tech Giants Bow to Veldhoven today, ASML is the ultimate gatekeeper of progress. Tech titans like Apple, Nvidia, and Intel are entirely dependent on ASML's machines to produce their most advanced chips. Without EUV technology, the "*AI Revolution*" would grind to a halt, as the powerful GPUs required for Large Language Models cannot be manufactured without ASML's scanners.

Each EUV machine is roughly the size of a bus, costs upwards of $200 million, and requires three to seven Boeing 747s just to transport. Because these machines are the only way to shrink transistors further, ASML effectively dictates the roadmap for the entire tech industry. In a world increasingly defined by silicon, ASML isn't just a supplier—*it is the architect of the future.*

13 CLIMATE ACTION

***SDG GOAL #13:*** *"Take urgent action to combat climate change and its impacts"*

# VLSI Design: *How Tiny Chips Power the Digital World*

*– Tushar Kanti Sahariah, B.Tech. 6th Semester | 2023-2027*

In today's technology driven world, almost every electronic device we use – smartphones, laptops, communication systems, and even household appliances depends on a tiny silicon chip. These chips may appear insignificant in size, yet they contain immense computational power. The technology that enables such high functionality in a compact form is known as VLSI (Very Large Scale Integration) design. VLSI has become the foundation of the modern digital era, enabling faster, smarter, and more efficient electronic systems.

## Understanding VLSI Design

VLSI design is the process of integrating millions or even billions of transistors onto a single integrated circuit. In the early days of electronics, systems were built using discrete components that occupied large spaces and consumed significant power. As technology advanced, engineers learned how to fabricate multiple components on a single silicon chip, drastically reducing size and cost while improving performance. VLSI design represents the peak of this integration, allowing complex systems to function on a chip no bigger than a fingernail.

In simple terms:

*"**More transistors** + **smaller area** = **more intelligence** on **one** chip"*

## Evolution of Integrated Circuits

The journey toward VLSI has been gradual yet revolutionary. Electronics first progressed from small-scale integration, where only a few logic gates could be placed on a chip, to medium and large scale integration with hundreds and thousands of gates.

Eventually, advancements in semiconductor fabrication made it possible to pack millions of transistors onto a single chip, giving rise to VLSI. This continuous increase in transistor density, often described by Moore's Law, has driven exponential growth in computing power over the decades.

Electronics has evolved through different stages:

- **SSI (Small Scale Integration)**
- **MSI (Medium Scale Integration)**
- **LSI (Large Scale Integration)**
- **VLSI (Very Large Scale Integration)**

## What Lies Inside a VLSI Chip ?

At the heart of every VLSI chip are CMOS transistors arranged in intricate patterns. These transistors form logic gates, memory blocks, and processing units that work together to execute instructions. Multiple layers of metal inter-connections link these components, enabling fast communication within the chip. Designing such a system requires careful consideration of speed, power consumption, and reliability, as even minor inefficiencies can impact overall performance.

## The VLSI Design Process

Designing a VLSI chip is a systematic and highly precise process. It begins with defining the functionality of the chip, followed by creating an architecture that outlines how data will flow through the system. Engineers then describe the hardware using specialized languages such as Verilog or VHDL and simulate the design to verify correctness. Once validated, the design is synthesized into logic gates and physically laid out on silicon through placement and routing. The final step involves fabrication and testing, ensuring that the chip performs as intended in real-world conditions.

VLSI design is not just about hardware it is a structured engineering process:

- **Specification:** Define what the chip should do.
- **Architecture Design:** Decide data paths and control logic.
- **RTL Design:** Write hardware description using Verilog or VHDL.
- **Simulation & Verification:** Ensure correct functionality.
- **Synthesis:** Convert code into gate-level design.

- **Physical Design:** Placement and routing of components.
- **Fabrication & Testing:** Manufacture and test the chip.

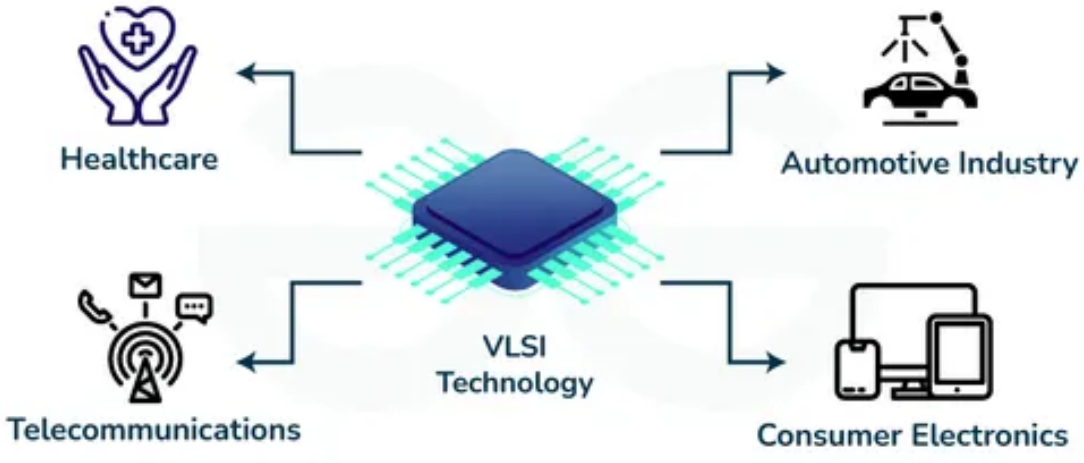
Each step demands precision because even a tiny error can cost millions.

## Role of VLSI in Everyday Life

VLSI technology is deeply embedded in everyday life. The processors in smartphones and computers, the control units in automobiles, the routers that manage internet traffic, and the electronics used in medical devices all rely on VLSI chips. Without this technology, modern communication, automation, and digital entertainment would not be possible. VLSI has transformed electronics from bulky machines into compact, portable, and highly intelligent systems.

## Future of VLSI Technology

The future of VLSI design is both exciting and demanding. Emerging applications such as artificial intelligence, machine learning, and high-speed communication require specialized chips capable of handling massive data efficiently. Technologies like system on-chip designs, three-dimensional integration, and nano-scale transistors are shaping the next generation of electronics. As devices become smarter and more connected, the importance of VLSI will only continue to grow.




***SDG GOAL #14:*** *"Conserve and sustainably use the oceans, seas and marine resources for sustainable development"*

# Learning at the Core of Standards: *My BIS Internship Experience*

*– Kangkana Bora, B.Tech. 8th Semester | 2022-2026*

Stepping into the headquarters of the *Bureau of Indian Standards(BIS)*, *New Delhi*, on *9th June* marked the beginning of a journey filled with both anticipation and apprehension. It was our first time working with a national standards body, and the scale of responsibility was immediately apparent. Alongside excitement, there was *nervousness*—the quiet awareness that this experience would demand *professionalism, precision,* and a *willingness* to learn from the very start.

I undertook this two-month-long internship with *Sudin Pran Saikia* and *Abdul Matin*, and together we entered a structured and highly professional environment that balanced technical rigor with real-world relevance. From the first day, the atmosphere at BIS Headquarters reflected *discipline, accountability*, and a *deep commitment* to public welfare —values that form the foundation of standardization in India.

The initial phase of the internship involved careful observation and adaptation. Understanding how a national body functions, how decisions are documented, and how standards are shaped was both challenging and enlightening. What eased this transition significantly was the support of the mentors assigned to each of us. Their approachability and guidance transformed our initial hesitation into confidence.


They encouraged questions, clarified doubts patiently, and ensured that learning remained a continuous and engaging process.

One of the most impactful aspects of the internship was exposure to the *pre-standardization process*, where standards are not merely implemented but critically analyzed, compared, and refined.

I worked on technical and analytical tasks involving safety standards, including comparative studies of existing frameworks. This experience deepened my understanding of how national and international standards evolve to keep pace with advancing technology and emerging safety requirements.

The internship encouraged thinking beyond textbooks. Concepts that once seemed theoretical: such as *regulatory compliance, risk-based safety assessment*, and *harmonization of standards* became tangible through document analysis, structured reporting, and guided discussions. Over time, I developed stronger research abilities, improved technical documentation skills, and a more disciplined analytical approach.

Equally valuable was the collaborative environment. Working closely with fellow interns fostered teamwork, critical dialogue, and collective problem-solving. Interactions with experienced officials at BIS offered meaningful insight into how engineering knowledge translates into policy formulation and national-level quality assurance.

Beyond professional exposure, spending two months in New Delhi added another dimension to the experience. Exploring the city, sharing *moments* outside work, and creating *memories together* helped balance the intensity of the internship. These experiences strengthened our camaraderie and made the journey personally enriching as well.

In retrospect, my two-month internship at BIS Headquarters was far more than an academic requirement. It was a defining professional experience that strengthened my interest in standards, safety, and research-oriented work, while instilling a lasting respect for the systems that quietly uphold quality, reliability, and public trust across the nation.

# Learning Beyond Borders: *A Student in Moscow*

*– Sohini Bhattacharjee, B.Tech. 8th Semester | 2022-2026*

On a train journey from Guwahati to Haridwar , a WhatsApp notification popped on my mobile.

Myself Sohini Bhattacharjee, and I am a 22 year old engineering students from Assam Engineering College.

The notification was of an overseas internship in Russia, Moscow on the topic artificial intelligence and space Science. Since I have never been to abroad before, but always dreamt about it so in no time I filled the form then and there without much of a thought and resumed by journey to the KedarNath which in itself a different story for later.

Now my tickets are booked and visa is done after a hasty trip to Kolkata, I am on my first international Flight from Delhi to Abu Dhabi then Moscow in Etihad Airways. We were a group of six people from Assam who were selected by our university for pursuing the internship. We arrived in SVO Airport Moscow where I met my first ever Russian friend, Kareena who picked us up and drove to our institution. It was who her showed us the beauty of the Kremlin Red Square, the eternal flame and introduced us how to access their Metro, which is one of the largest and busiest metro systems in the world with over 300 stations.

The University RUDN, also known as the People's Friendship University with its eco-friendly campuses and lush greenery gave me a feeling of Déjà vu as if I once painted this place on the canvas of my imagination. We were kept in dormitories and I shared a room with my friend which had a beautiful window overlooking a gorgeous sunset, an emerald-colored church and the busy streets of Moscow.

It was Autumn and Maple leaves decorated my dormitory zone Red. I remember I woke up early before my internship started to roam around my Dormitory and ate berries hanging from the Tree hoping I don't poison myself.

My mentors were Sir Alexander, Elizaveta Ma'am they imparted knowledge upon us on the topics of space satellites and the use of Artificial Intelligent on it. It was indeed a great honour to learn from them and their teachings would be helping me in my future course of career.

There were trips arranged by the RUDN university themselves, we were taken to the famous Moscow State University where our professor themselves sang tales of their time there, we were shown the famous Bolshoi Theatre, The Kremlin, The Arbat Street, Museum of Cosmonautics, Pushkin State Museum of Fine Arts and treated with pizzas and rice paneer bowl.

The main fun and learning however came from our very own individual ventures to the Moscow state by ourselves. With a phonic translator and few Russian language picked up, we 6 set out to explore this beautiful old historic place by ourselves. From touristy attractions to cheapest market, we went to the nook and corner of Moscow with a metro card in pockets. But mainly, it wasn't about the places we went, it was the experience we gained, the courage we showed and the decisions we took.

I experienced Moscow with curiousness of a student and joy of a tourist. The day of leaving was poetically the coldest day of all and we six made a promised to come back again and revisit everything.


***SDG GOAL #15:*** *"Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss"*

# SIH '25: *Six people. Five days. One goal.*

*– Bibek Bharadwaj, B.Tech. 4th Semester | 2024-2028*


Some journeys don't begin with confidence. Ours began with uncertainty, doubt and a quiet question we never said out loud: "*Are we really ready for this?*"
When we received the message that our team, **Out of De Box**, had been *selected* for the Smart India Hackathon 2025 (Hardware Edition) finals, it felt unreal. Excitement rushed in first, the kind that hits before you can even process it.

Bibek and Manas actually jumped out of their chairs, yelling, laughing, completely losing it for a moment. It was loud, chaotic, unreal. And then, almost instantly, it settled. The noise faded, the smiles lingered and the pressure took its place quietly.
***This wasn't just another event anymore.***

Expectations came from *everywhere*: *mentors, peers* and *ourselves*. This was the national stage. Every decision would be questioned. Every flaw exposed. Every mistake would cost us time we didn't have. Six people. One problem statement. Only a few days to prove ourselves, justify the faith placed in us and turn belief into something real.

We reached Forge Innovations, Coimbatore, on 7th December, a day before everything officially began. Registrations were done and accommodations allotted. Girls at a hotel behind the campus, elsewhere, boys at a villa nearby. That night was strangely quiet. Everyone was physically present but mentally we were already racing through circuits, mechanisms, code and failure scenarios.

The inauguration on Day 1 set a serious and demanding tone for the event. With the evaluation structure clearly outlined—20% on Day 1, 30% on Day 3 and a decisive 50% on Day 5—it was evident that performance was being assessed continuously.

There was no scope to compensate for lost time or defer progress, making every hour critical and every decision consequential from the very beginning.

Each team was allotted a dedicated workspace, which gradually became the center of all activity without us even realizing it. One key rule required that *at least two team members* be present in the workspace at all times. While this initially seemed manageable, its impact became evident as hours extended and days blended into one another. Continuous presence demanded constant alertness—there was always someone awake, engaged and problem-solving. Rest was no longer uninterrupted; it became brief, strategic breaks taken whenever possible.

Exhaustion did not arrive suddenly; it built up gradually, reflecting in every conversation, every decision and every small mistake. This marked the real beginning of our journey—not just as a *team*, but as six *individuals* supporting one another to stay resilient.
Responsibilities blurred and roles evolved continuously, with leadership shifting naturally as members alternated between planning, building, debugging and simply keeping the team going.

Decisions were made under fatigue, refined under pressure and upheld with unwavering commitment.

The first evaluation round proved particularly demanding. The idea we had worked on and believed in for weeks was subjected to intense scrutiny, exposing flaws and challenging long-held assumptions. For a moment, it felt as though everything we had built was slipping away. Frustration set in, patience wore thin and doubts emerged, with the stress becoming almost physical. However, that moment of breakdown ultimately became our turning point, pushing us to rethink, realign and move forward with renewed clarity and determination.

We went back, rethought everything, and allowed ourselves to accept something difficult, that our first idea wasn't perfect, and that was okay.
What followed was chaos and we could feel it in our heads and our hands. Ideas kept coming faster than we could settle on them. Whiteboards filled up, got erased and filled up again. We pulled models apart even when it hurt to do so, knowing there wasn't time to get attached.

We kept running back and forth between the workspace, the 3D printing lab, and the D-Fab lab, drilling and cutting with tired hands and thoughts still lingering over our heads,

"*will it work*?".
No.

We have to make it work. Every mistake added to the stress, but stopping wasn't an option. We learned while breaking things, fixed them on the go and kept pushing because there was no other way forward.

Days blurred into nights.
Coffee replaced sleep.

Meals were eaten without noticing the taste. The cultural night felt like a breath of air after being underwater, a reminder that we were still human. But there wasn't any time to spare.

With each evaluation, we grew tougher. More grounded. More honest.

By the final round, the model we presented looked nothing like what we had imagined on day 1. But it was stronger, smarter and truly ours.

When the winners were announced on the last day, we stood there together- tired, anxious, hopeful. We didn't hear our name. And for a brief second, everything went quiet inside.

Later, our coordinator, Guna sir, told us something that changed how we saw everything.
We had just missed the winning spot by just, three points. Three. That's when it hit us. We hadn't failed. We had. Fought. Till the very LAST edge!

Looking back, the real win was never the trophy.
It was learning how ideas break and rebuild.

It was understanding that flexibility matters more than ego. It was realizing that solutions often appear only after you're pushed to exhaustion.

Most importantly, it was knowing that *six people, under stress, doubt* and *pressure*. Chose to fight together.

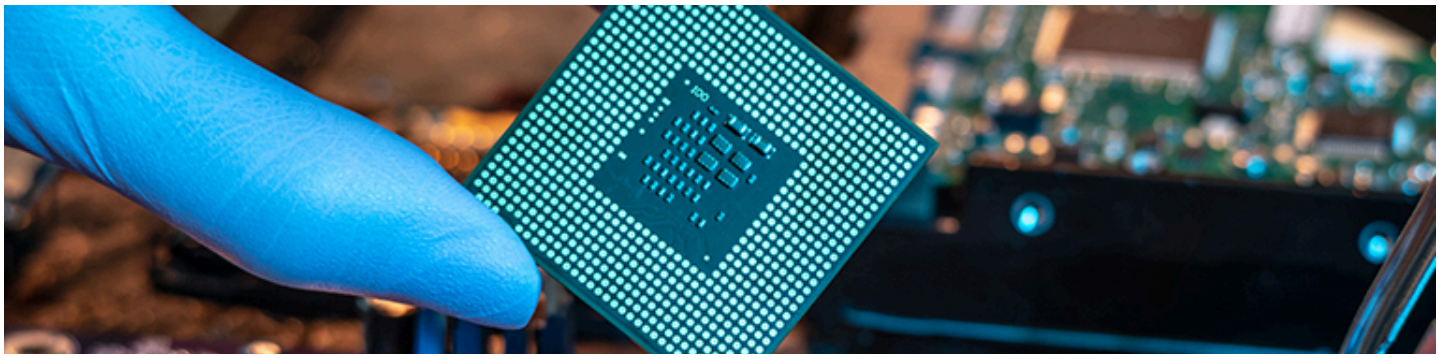
The centre welcomed us warmly, the faculties supported us endlessly and every interaction taught us something new. But this journey will always belong to the six of us - *Bibek, Manas, Gaurav, Jit, Niharika* and *Hema*. Each bringing something different when it mattered most, stepping up when another slowed down, carrying the load together when it became too heavy for one person alone.

It belongs to the sleepless nights, the disagreements, the comebacks, and the quiet moments of trust that kept us going when doubt crept in. We held on to the belief that we could do better, even when it felt impossible. We may not have won the title, but we walked away changed—and that itself was a victory.


***SDG GOAL #16:*** *"Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels"*

# The Future of Telecom and Electronics: *A Technical Insight for ETE Students of Assam Engineering College*

*– Subhashish Paul , B.Tech, 6th Semester | 2023-2027*



## Introduction

Electronics and Telecommunication Engineering (ETE) stands at the core of today's digital revolution. Every modern technology around us —whether it is high-speed internet, smartphones, satellites, defense communication, smart cities, autonomous systems, or artificial intelligence—relies on strong foundations of electronics and communication engineering.

## Global Technology Landscape

Technologies such as 5G, 6G, IoT, satellite communication, radar, and semiconductor chip design are transforming industries worldwide. These define the future infrastructure of communication, automation, and national security. India's Rise in Semiconductor & Telecom Sector With initiatives like *Semicon India Programme, Make in India, Digital India*, and the involvement of major companies like *Tata and Micron*, India is emerging as a global semiconductor and telecom hub, opening huge opportunities for engineers. Assam's Emergence in Semiconductor Ecosystem Tata's ATMP semiconductor facility in Assam is expected to drive employment, industrial growth, innovation and research collaborations. This marks Assam's entry into the global technology ecosystem.

## Skills Required for ETE Students

Students must strengthen electronics fundamentals, communication systems, VLSI, embedded systems, PCB design, IoT, software programming, RF engineering, and soft skills. Practical exposure through projects and internships is essential.

## The Role of Assam Engineering College (AEC)

AEC can support students by upgrading labs, encouraging research, fostering industry collaborations, and training students in advanced telecom and semiconductor technologies.

## Conclusion

Assam's growing participation in India's semiconductor and communication revolution is opening up tremendous opportunities for ETE students. With the right technical skills and practical exposure, students can explore emerging fields such as VLSI design, embedded systems, IoT, wireless communication, and advanced electronics. This progress not only creates strong career prospects but also encourages innovation and research at the regional level. By building expertise in these domains, ETE students can play an important role in driving technological development and actively contribute to shaping India's future in next-generation electronics and communication.

17 PARTNERSHIPS FOR THE GOALS

***SDG GOAL #17:*** *"Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development"*

# MUKHAA : Evolving Drama in AEC

*-Pragyanbrat Kalita , B.Tech, 6th Semester | 2023-2027*

I stepped into AEC for the first time with a heart full of dreams and expectations.

My heart was always drawn more toward the cultural world than the classroom. Drama and music felt like home to me. On my very first day, while walking past the Students' Common Room, I heard voices rehearsing. Curious, I looked inside and saw a group of seniors practicing a street play. When I asked if I could watch, they welcomed me warmly. That moment marked my first encounter with Mukha—and I knew I had found my place.

Although drama has always been a part of AEC's culture, Mukha – The Dramatics Society was formally established in 2018. Since then, it has become a space where passion meets expression. Every year, new students join with stories to tell and voices to be heard. From street plays addressing social issues to stage productions in the college auditorium, Mukha continues to grow as a creative platform. During Pyrokinesis, our college's biggest festival, Mukha proudly hosts its signature event, Era Baator Xur, celebrating theatre and storytelling.

Today, I feel honoured to serve as the Secretary of Mukha. With this role comes responsibility—not only to lead, but to nurture every aspiring actor who hesitates behind the curtains. We believe talent often hides behind fear, and overcoming stage fright is one of our biggest challenges. Creating an environment where students feel safe to perform is our first step forward.

There are, of course, challenges. Limited infrastructure, an auditorium not fully suited for theatre, and financial constraints often test our efforts. Yet, these obstacles have never dampened our spirit. This year, Mukha takes a new step by organising a traditional Assamese *Bhaona* for the first time—an initiative close to our cultural roots.

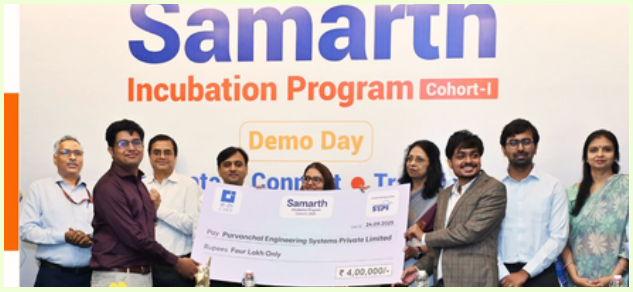
However, there are several areas that certainly require our attention:
*Overcoming Hesitation:* First, we must tackle the shyness hidden within us. Many talented students are afraid to step onto the stage due to stage fright. To become a good actor, we must shed this hesitation; only then can we discover the hidden gems of talent within our college.

*Infrastructure:* Second, our current auditorium stage is not very conducive to high-quality theatrical productions. Although a new auditorium is under construction, we have raised our concerns with the authorities, and they have assured us of a solution.

*Financial Constraints:* Third, the issue of finances. Pursuing theater requires funds. While we receive some assistance from the authorities, it is often insufficient for the entire year. A stronger financial foundation would allow us to achieve much more in the future.

Nevertheless, "Mukha" is moving forward with fresh perspectives this year. For the very first time, under the initiative of Mukha, we are preparing to organize a "Bhaona" (traditional Assamese theater). My only wish is for "Mukha" to continue thriving and advancing on the path of progress in the years to come.

# Students' Achievements




Winner of the Samarth Cohort-1 challenge by C-DOT & STPI, *Ashique Anowar and Ritav Kashyap* (B.Tech, 2021-24 batch). Their *Start-up, Purvanchal Engineering Systems* is one of five startups who received the Stage II grant for the IoTCertManager solution earning a cash grant of Rs. 4 Lakhs with integration discussions. (September, 2025)

*Aman Ahmed, Baijeet Samdani, Bandip Barman, Rekibbudin Ansani, and Sambhab Roy* (B.Tech 6th Semester), as Team Zodiac, secured 1st position in Robo Rush 2025 and 3rd position in Robo Soccer 2025 at JEC, showcasing excellence in robotics design, control, and team coordination.

*Tanmay Gogoi* (B.Tech 6th Semester) secured the Gold Medal in the *60 kg* weight category at the 5th National Mixed Boxing Championship, 2025, showcasing exceptional skill, discipline, and competitive excellence at the national level.

*Caleb Varte, Riman Sarma, and Archit Aryaman* (B.Tech 6th Semester), as Team Psychotron, secured 3rd position at Techniche 2025, IIT Guwahati, and 3rd position in Robo Soccer at Euphuism 2025, GCU, showcasing strong technical and teamwork skills in competitive robotics events.

*Caleb Varnunthar Varte* (B.Tech. 6th Sem.) from Team ISTE AEC secured the Runners-Up position in AEROKRAFT (the RC plane maneuvering competition) held during the technical fest TECHNOVUS at Jorhat Engineering College on 30 April 2025, showcasing skill in aeromodelling and flight control.

*Chinmoy Koch* (B.Tech 8th Semester) along with two others, secured the Runners-Up position in the Cosmic Code Hackathon 2025 held at Dhemaji Engineering College, demonstrating strong problem-solving and coding skills.

# Students' Achievements


*Bedanta Sarma* (B.Tech 6th Semester), along with four others, as Team Rhino Botz, secured 1st position in Robo Soccer at Don Bosco University, 1st position in Robo Rush at Euphuism 2025, GCU, 2nd position in Robo Sumo at Techxetra & Don Bosco, and 1st Runners-Up in the Gear Ball League (Robo Soccer) 2025 at GCU.

*Prithviraj Das and Anubhab Borgohain* (B.Tech 4th Semester), as Team Phantom Battalion, secured 3rd Prize in the Robo Race Competition 2025 at ADBU. Additionally, they achieved 1st and 2nd Prizes in the Robo Soccer Competition 2025 at ADTU by competing with two self-built robots in the same event (Prize Pool: ₹25,000).


*Siddharth Paul* (B.Tech 4th Semester), along with others, as Team Roborace, secured 2nd Prize in the RoboRace Competition at Prajyuktam 2025, held at Assam Don Bosco University, demonstrating strong technical skills and competitive performance in robotic racing.


*Sohini Bhattacharjee* (B.Tech 8th Semester) attended a two-week Summer Camp at RUDN University (People's Friendship University of Russia), Moscow during September, 2025. The Summer Camp focused on Artificial Intelligence and Space Science.

*Bibek Bharadwaj (Team Leader), Gaurav Choraria, and Niharika Choudhury* (B.Tech 4th Semester), as Team Out of the Box, were selected for the National Grand Finals of Smart India Hackathon 2025, emerging as the only team from Assam Engineering College (AEC) to qualify for this prestigious national level competition.


*Ashique Anowar and Proyash Paban Sarma Borah* (B.Tech, 2021-24 batch) was selected for Stage II of the AICTE Yukti Innovation Challenge and presently incubated under the AICTE. This innovation aims to manage IoT platforms efficiently using custom Networking ICs with homegrown technologies for high security deployments to reduce risks of penetration. (November, 2025)

# Department Events

*Beyond Syllabus Activities | 2025*

## Promoting Startup Support Initiatives

*26 March, 2025 | In association with Assam Downtown University*


A session on startup support initiatives under NIDHI–iTBI introduced students to early-stage innovation funding and entrepreneurship opportunities. The talk highlighted government-backed ignition grants for transforming ideas into prototypes, while providing insights into the startup ecosystem, innovation-driven research, and pathways for commercialising technology-based solutions.

## Industrial Visit

*24 April, 2025 | Bureau of Indian Standards*

Students participated in an industrial visit to the Bureau of Indian Standards (BIS) to gain practical exposure to standardization and quality assurance in electronics. Accompanied by *Mr. Niranjan Jyoti Borah*, Assistant Professor, ETE Department, the visit enhanced understanding of national standards, certification procedures, and compliance requirements in industrial and manufacturing settings.


## World Intellectual Property Day

*06 May, 2025 | Department of ETE, AEC*


World Intellectual Property Day, initiated by WIPO in 2000 and observed on April 26, celebrates creativity and innovation worldwide. The session highlighted the importance of intellectual property rights in protecting inventions, copyrights, trademarks, and creative works, emphasizing their vital role in fostering innovation and safeguarding ideas in today's knowledge-driven world.

## BIS Standards for Electronics

*06 May, 2025 | Department of ETE, AEC*

The session on BIS Standards for Electronics introduced students to key standards, certification schemes, and compliance requirements for electronic products. It explained the importance of standards, the BIS certification process, and the role of the Compulsory Registration Scheme (CRS) in ensuring product safety, quality, and reliability.

# Department Events

*Beyond Syllabus Activities | 2025*

## Summer Internship I

*June - July, 2025 | Department of ETE, AEC*


During June and July 2025, the Department of ETE at Assam Engineering College became a hub of innovation through a Summer Internship on Robotics and Embedded Design. Guided by faculty members, students engaged in hands-on hardware programming, robotic assembly, and intelligent system development, gaining strong technical foundations to thrive in the rapidly advancing field of automation and robotics.

## Summer Internship II

*June - July, 2025 | Department of ETE, AEC*

In tandem with the robotics initiative, the department organized a Summer Internship on Semiconductor and TCAD Tools. Addressing the global push for indigenous chip design, the programme introduced students to industry-standard TCAD software. Guided by expert faculty, participants explored semiconductor physics and device modeling, gaining essential skills for careers in VLSI and microelectronics.


## Induction Program 2025

*11-12 August, 2025 | Department of ETE, AEC*


On August 11–12, 2025, the Department of Electronics & Telecommunication Engineering welcomed first-year students through an Induction Programme. The orientation provided a comprehensive departmental tour, introducing future engineers to the academic curriculum, faculty mentors, and state-of-the-art laboratory facilities that will support their learning journey over the next four years.

## Workshop

*14 August, 2025 | Department of ETE, AEC*

Building on orientation and moving toward advanced application, the department hosted a One-Day Workshop on the Internet of Things (IoT) on August 14, 2025. Led by industry expert Mr. Fitasarkar of Fitas Technology Pvt. Ltd., the session offered practical insights into connected technologies and real-world IoT deployments, blending industry expertise with academic learning.

# Department Events

*Beyond Syllabus Activities | 2025*

## World Entrepreneurship Day

*21 August, 2025 | In association with Mechanical Engineering Department, AEC*

A career guidance and awareness session was organized on World Entrepreneurship Day under the INTERACT initiative. Led by founding members of Sonata Software, Bangalore, the programme inspired ETE students to explore entrepreneurship, innovation, startup culture, emerging career paths, and interdisciplinary collaboration for sustainable technology-driven ventures.

## India's Super Brain

*15 September – 02 November, 2025 | In association with Society for Data Science and Alien Brains*

India's Super Brain, an initiative by the Society for Data Science and Alien Brains, introduced students to competitive problem-solving and data-driven thinking. The programme featured India's first hiring auction for technology students, promoting skill-based assessments, enhancing analytical abilities, and preparing participants for industry-oriented challenges in the evolving tech ecosystem.

## Vishwakarma Puja

*17 September, 2025*

Vishwakarma Puja was celebrated on 17th September with devotion and enthusiasm in the department. Faculty, staff, and students honored Lord Vishwakarma, seeking blessings for knowledge, innovation, and excellence, while fostering unity, cultural awareness, and respect for tools, technology, and engineering craftsmanship.

## Technical Talk

*09 October, 2025 | In association with EncodersPro*

A technical talk titled "Cyber 0×02: Security in the Shadows of the Internet" was delivered by Mr. Sandeep Verma, CEO of EncodersPro. The session explored modern cyber threats, ethical hacking, and digital security, creating awareness of real-world challenges, safe internet practices, and career opportunities in the field of cybersecurity.

## Sanchar Mitra Orientation Programme

*14 October, 2025 | In association with BSNL & MeitY*

The Sanchar Mitra Orientation Programme 2.0 was organized to introduce students to the goals of the Sanchar Mitra initiative. Faculty from the ETE Department guided participants on telecom awareness, digital connectivity, and public outreach, encouraging them to serve as ambassadors of telecom literacy and promote digital communication awareness in society.

# Department Events

*Beyond Syllabus Activities | 2025*

## Interaction at Jagiroad Semiconductor Plant

*07 November, 2025 | Supported by Government of Assam*

An interaction programme organized by the Government of Assam on 07 November 2025 at Jagiroad featured Union Finance Minister Smt. Nirmala Sitharaman and Chief Minister Dr. Himanta Biswa Sarma. The programme encouraged entrepreneurship, strengthened startup ecosystems, and inspired innovation-driven growth among students and young professionals across Assam.


## Training Programme

*18 November, 2025*

The ISEA Training Programme was conducted on *18 November, 2025* at Assam Engineering College by the Department of ETE, AEC, under the *Information Security Education and Awareness* (ISEA) initiative of *MeitY, Government of India*. The programme aimed at grooming students in cybersecurity fundamentals, information security practices, and creating awareness on cyber hygiene and cyber security challenges.

## Faculty Development Program

*08 December - 20 December, 2025*

A *Faculty Development Programme* was conducted from *08 December, 2025 to 20 December, 2025* at the Department of Electronics and Telecommunication Engineering, Assam Engineering College. Resource persons from *Cadence, Synopsys,* and *Mentor Graphics* delivered hands-on training on Electronic Design Automation (EDA) tools, focusing on the design, simulation, and verification of complex integrated circuits (ICs) and electronic systems. The programme aimed at strengthening faculty expertise and aligning academic practices with current semiconductor industry requirements.

## Best Project Awards in memory of Late (Dr.) Anup Gogoi, Ex-Professor, ETE

The *Late (Dr.) Anup Gogoi Memorial Award* honors outstanding B.Tech projects every year, recognizing innovation, technical excellence, and meaningful contributions to the society.





**1st position**: "*Cloud-based Water Quality Surveillance System for Hybrid Predictive Analysis of Water Bodies*", Nitish Gogoi, Arnall Saikia, Abhijit Das and Rajarshi Dutta (Guided by: Dinesh S. Pegu, ETE)

**2nd position**: "*Development of a Semiconductor based Nanosensor using Zinc Oxide (ZnO) Nanomaterials for the Detection of Melamine Adulterant in Milk*", Rhitwija Goswami, Sneha Borah, Asha Priya Bairagi and Chandrima Paul (Guided by: Dr. Rashi Borgohain, ETE)

**3rd position**: "*Design and Simulation of Broken Gate TFATE and its RF Application*", Swrang Brahma, Kh. Alisha Singha, Aditya Singha and Karapallav Chutia (Guided by: Dr. Bijoy Goswami, ETE)

"*Detection of Myopia and Hypermetropia using Image Processing*", Shruti Paul, Saptaparna Bhattacharjee and Kristi Kayum Kuli (Guided by: Dr. Navajit Saikia, ETE and Nelson R. Varte, CA)

# ASSAM ENGINEERING COLLEGE
# ROBOTICS CLUB

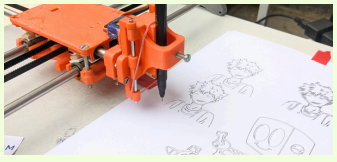
## ROBO 101- *Introductory Session of 'Freshers'*

The **Robotics Club** of Assam Engineering College successfully organized **Day 1** of **ROBO-101**, an *introductory session*, on ***28th August***, for the academic year 2025, with the objective of familiarizing first-year students with an ice-breaker session which would help them find the right *motive* of this club.
The session successfully demystified the multidisciplinary field of robotics through interactive showcases of key technologies like m*icrocontroller programming, 3D printing*, and *FPV* drones.

## Escalade 14.0 *Zonals*

On ***1st August 2025***, **Escalade 14.0 Zonals - Guwahati** witnessed an enthusiastic participation of teams from various prestigious institutes, showcasing their robotics prowess. The event served as a *zonal qualifier* for the grand finale of **Techniche IITG's Escalade 14.0**.
The **Escalade 14.0 Zonals'** event in Guwahati was a resounding success, marked by high levels of *innovation, teamwork,* and *competitive spirit*. The qualified teams proceeded to represent the Guwahati Zonal at the national-level finals under Techniche, IIT Guwahati.


## Robotics Exhibitions *at Gauhati University*



On ***7th March, 2025***, the Robotics Club successfully conducted a ***robotics exhibition*** at **Gauhati University**, led by core members *Suksham Upamanyu, Bhabartha Prakash Gogoi,* and *Satyajit Lahan* (8th Semester, Electronics & Telecommunication Engineering). The event was organized on the occasion of the *71st Foundation Day* celebration of the **Department of Physics, Gauhati University**, making it a significant platform to represent AEC's technical culture and innovation-driven approach in front of students, faculty members, and visitors.

The exhibition featured engaging, real-time demonstrations of *three* key robotic projects: a *Drawing Robot*, a *Race Bot*, and a *Robo Soccer Bot*. Each model highlighted different aspects of robotics—ranging from precision control and mechanism design to speed, stability, and competitive performance. Through these demonstrations, the team showcased not only their hands-on engineering skills and practical implementation capabilities, but also their ability to communicate technical concepts effectively and inspire curiosity among the audience. Overall, the exhibition reflected the club's commitment to building impactful projects and promoting robotics learning through interactive and experience-based showcases.

# R-AEC 7.0

## ROBO SOCCER


As part of R-AEC, Robotics Club successfully conducted Robo Soccer on **27th February 2025**, with participation from around 12 talented teams. The event provided a thrilling platform for students to demonstrate their robotics and automation capabilities through strategic game play and technical coordination.

Robo Soccer was not only about building robots, but also about ensuring accurate movement, control mechanisms, and quick responsiveness during matches. Teams showcased impressive performance in areas such as wireless control, agility, speed balancing, and teamwork-based strategy, making each match highly competitive and engaging for the audience.

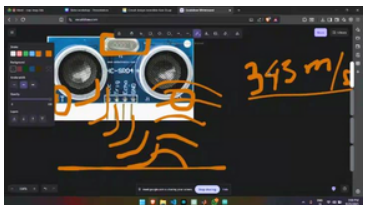
## ROBO RACE




Robotics Club successfully organized Robo Race under the flagship event R-AEC on **28th February 2025**. The event witnessed enthusiastic participation from 12 competing teams, each showcasing their technical skills, creativity, and engineering excellence through their custom-built robots.

Robo Race was designed to test the speed, stability, control, and precision of the robots on a challenging track filled with turns and obstacles. The competition encouraged students to apply practical knowledge of mechanical design, motor control, electronics, and real-time handling, making it a complete test of both innovation and execution.

# Online Robotics Workshop


Robotics Club successfully organized an Online Robotics Workshop focused on the basics of Arduino, aiming to introduce students to the fundamentals of electronics and robotics. The workshop was designed to help beginners build a strong foundation in embedded systems and understand how Arduino can be used as a powerful tool for developing real-world robotic applications.

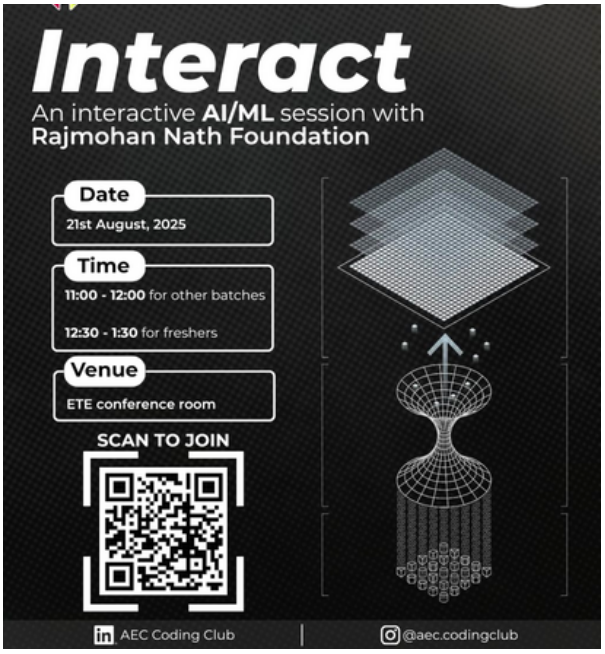
During the session, participants were introduced to the Arduino platform, including its components, working principles, and practical uses in robotics. The workshop covered essential topics such as Arduino IDE setup, basic programming concepts, understanding digital and analog pins, and how to interface simple electronic components like LEDs, sensors, and motors. The session also emphasized the importance of logic building and coding structure, helping students gain confidence in writing and executing Arduino programs.

The workshop provided an interactive learning experience, allowing participants to clarify doubts and understand concepts through simple examples and demonstrations. Overall, the event served as a valuable learning opportunity for students who were interested in robotics, automation, and electronics, encouraging them to explore further projects and innovations using Arduino.

# ASSAM ENGINEERING COLLEGE
# CODING CLUB

## Interact- *An interactive AI/ ML session with Rajmohan Nath Foundation*

On **21st August 2025**, the **AEC Coding Club** in collaboration with the **Institution's Innovation Council (IIC)** and the **Rajmohan Nath Foundation**, organized an interactive session focused on *AI, ML, and Startups*. This session was specifically structured to help students transform their innovative ideas into scalable and impactful ventures by providing direct insights from industry-aligned organizations. The program covered essential entrepreneurial milestones, including details on securing seed funding ranging from *₹10–50 lakhs*, navigating incubation programs, achieving market validation, and establishing investor connections. The event was strategically scheduled in two sessions to accommodate different academic levels: a morning session for 3rd, 5th, and 7th-semester students, followed by an afternoon session specifically for 1st-semester freshers. This comprehensive approach ensured that students across all years gained the necessary tools.




## Coding 101- *An Introduction to Programming*

On ***27th August 2025***, the **Coding Club** kicked off the year with a massive response to its first event, **Coding 101**.

The workshop saw an extraordinary turnout, with the venue packed with students eager to dive into programming. From the ***first line of code to collaborative problem-solving***, the high-energy session transformed complex concepts into "aha!" moments.

The sheer volume of participants and their enthusiasm proved that the campus coding culture is stronger than ever, setting a powerful foundation for the months ahead.

## Beyond 101- *Web and Problem solving*

Building on that momentum, the club returned on ***6th September 2025,*** with **Beyond 101**.

This session focused on two critical pillars: *Web Basics* and *Problem Solving*.

Students spent the first hour mastering **HTML** and **CSS** to build web foundations, while the second hour was dedicated to the core logic required for Competitive Programming.

By balancing creative design with algorithmic thinking, the event equipped members with a versatile toolkit for their next steps in tech.

## Cyber Security 0x02- *In the Shadows of the Internet*

On ***11th September 2025***, the Coding Club collaborated with MSSC to host **"Cyber Security 0x02: In the Shadows of the Internet."**
The workshop featured guest speaker **Mr. Sandeep Verma**, Director & CEO of *EncodersPro*, who guided students through the intricate world of digital security. Participants gained expert insights into navigating the complexities of the web, turning the "*shadows*" of the internet into a clear landscape of professional knowledge and safety.. To support the students' professional development, participants were awarded ISO certified participation certificates.

## Crack the code- *Basics of Problem Solving*

The momentum continued on ***12th October 2025,*** with **Crack The Code**, a session where *curiosity met logic*.

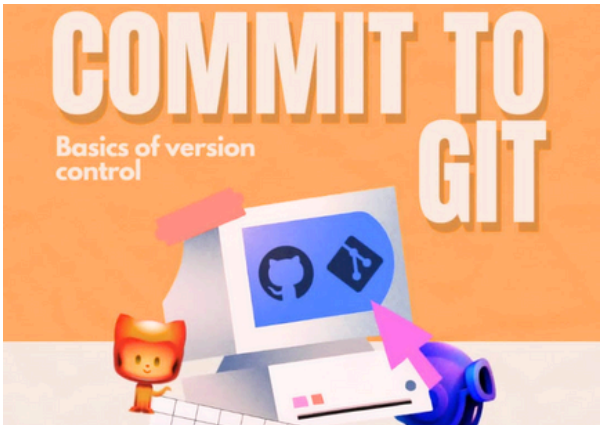
This workshop focused on the core of programming: **breaking down problems** and **building structured, logical steps** to turn thought into code. By simplifying complex algorithmic concepts, the event demonstrated how *problem-solving* forms the bedrock of Competitive Programming. It was a day of high engagement that made deep technical thinking feel both accessible and fun. The club aimed to demystify programming for the general student body and encourage new interest in technical problem-solving.

## Behind the code- *An interactive online session with Anshaj Sharma in collaboration with Coding Panda*


On ***14th October 2025***, the Coding Club hosted an insightful *online session* titled **"Behind the Code"** featuring **Anshaj Sharma**, an **SDE-2** at **Amazon**.
This power packed one hour session provided students with industry backed insights into building a successful career in software engineering. The speaker shared a comprehensive roadmap for mastering Data Structures and Algorithms (DSA) and Web Development, while offering strategic advice on when and how to learn emerging technologies. Concluding with a live Q&A, that offered students rare industry-backed guidance.

## Commit to Git- *Basics of Version Control*

On ***30th October 2025***, the Coding Club conducted **"Commit to Git"**, a beginner-friendly online session introducing students to the fundamentals of Git and GitHub.
Designed for participants with little or no prior coding experience, the workshop explained version control in simple terms, highlighting its role in teamwork, project organization, and safe progress tracking. Students learned essential collaborative workflows and core concepts such as *commit* and *push*, with real-world examples showing how version control is used across technical and creative fields.



# RESEARCH PUBLICATIONS

*Highlighting the Department's scholarly contributions across journals, conferences, and books.*

## Journals

1. *Lakhyadeep Konwar, Navajit Saikia, Subhash Chandra Rajbongshi*, "Revisiting human activity recognition using smaller DNN", Springer CCF Transactions on Pervasive Computing and Interaction, 7, pp. 458-473, June, 2025. (ESCI)
2. *Aparajita Das, Kandarpa Kumar Sarma, Navajit Saikia, Subhash Chandra Rajbongshi*, "A Deep Multi-Phase Attention Model for Compulsive Action Detection in Surveillance Applications", IntechOpen Journal of AI, Computer Science and Robotics Technology, 4, pp. 1-27, November 2025. (Scopus)
3. *Nelson R Varte, Kaustubh Bhattacharyya, Navajit Saikia*, "Advancing environmental monitoring: YOLO algorithm for real-time detection of greater one-horned rhinos", Elsevier International Journal of Environmental Sciences, 11(11s), pp. 995-1007, June 2025. (SCI)
4. *Nelson R Varte, Kaustubh Bhattacharyya, Navajit Saikia*, "Advancing Greater One-Horned Rhino Conservation: A YOLO Instance Segmentation Framework with Morphological and Semantic False Positive Suppression", Journal of Environmental Protection and Ecology, 26(6), pp. 2427–2438, November 2025. (Scopus)
5. *Nelson R Varte, Kaustubh Bhattacharyya, Navajit Saikia*, "Continual Yolo-Based Detection for Long-Term Monitoring of the Greater One-Horned Rhino", EPH - International Journal of Science and Engineering, 11(2), pp. 65–69, November 2025. (Scopus)

## Book Chapters

1. *Gunajit Kalita, Navajit Saikia, Amit Sravan Bora,* "A Design Approach for Reversible SR and D Flip Flop", Proc. of International Conference on Advances in Sustainable Development, Innovation and Green Technology (ICASDIGT-2024), Nova Science Publishers (June, 2025), pp. 193-198.
2. *Arif Ahmed Laskar, Bedatrayee Dey, Arif Ahmed, Avinash Gupta, Ankur Jyoti Sarmah,Navajit Saikia*, "A Machine Learning –Based Syatem to Predict Flood", Proc. of International Conference on Advances in Sustainable Development, Innovation and Green Technology (ICASDIGT-2024), Nova Science Publishers (June, 2025), pp. 325-330.
3. *Aparajita Das, Navajit Saikia, Kandarpa Kumar Sarma and Subhash Ch. Rajbongshi*, "Human Action Recognition: A Review of Evolving Techniques and Applications", Proc. of International Conference on Advances in Sustainable Development, Innovation and Green Technology (ICASDIGT-2024), Nova Science Publishers (June, 2025), pp. 445-454.
4. *Lakhyadeep Konwar, Navajit Saikia, Subhash Chandra Rajbongshi,* "HGR: Handcrafted to Deep Learning Techniques", Proc. of International Conference on Advances in Sustainable Development, Innovation and Green Technology (ICASDIGT-2024), Nova Science Publishers (June, 2025), pp. 463-472.
5. *Sangeet Baruah, Srimanjyoti Dutta, Akash Chetia, Manash Pratim Das, Simantika Choudhury, Navajit Saikia*, Nelson R. Varte, "Helmet and Number Plate Detection Using Different YOLO Algorithms", Proc. of International Conference on Advances in Sustainable Development, Innovation and Green Technology (ICASDIGT-2024), Nova Science Publishers (June, 2025), pp. 473-480.
6. *Anupal Deuri Bharali, Bhupali Sarma, Ritul Paul, Tushar Nath, Riju Kalita,, Debashis Dev Misra and Bijoy Goswami* "Dual Source SOI TFET for Inverter Applications" Nova Science publications Green Research, Developments, and Programs, https://doi.org/10.52305/SCZK7425

# RESEARCH PUBLICATIONS

*Highlighting the department's scholarly contributions across journals, conferences, and books.*

7. *Hrishikesh Deuri, Pratyush Deep Hazarika,Puja Bhuyan, Sadhvi Mahanta and Rashi Borgohain* "Energy Harvesting Using Nanomaterial" Nova Science publications Green Research, Developments, and Programs, https://doi.org/10.52305/SCZK7425

## International Conference

1. *N. R. Varte, M. Patowary, R. Roy, K. Hazarika, P. Chutia, N. Saikia and K. Bhattacharyya*, "Animal Detection and Alert System for Road Safety", in 2025 IEEE Guwahati Subsection Conference (GCON), Itanagar, India, June, 2025.
2. *Golam Imran Hussain; Rashi Borgohain; Navajit Saikia,* "Green-Synthesized Carbon Dot Electrochemical Sensor for Sensitive Emamectin Benzoate Detection at Room Temperature", 2025 IEEE 20th Nanotechnology Materials and Devices Conference (NMDC), Online Conference, October, 2025
3. *Asha Priya Bairagi;Chadrima Paul, Rhitwija Goswami;Sneha Borah;Rashi Borgohain,* "Design and Development of Silver Nano-material Based Colorimetric Sensor for Detection of Melamine in Milk", 2025 IEEE Guwahati Subsection Conference (GCON),DOI: 10.1109/GCON65540.2025.11173380
4. *Kh. Alisha Singha; Aditya Singha; Swrang Brahma; Karapallav Chutia; Bijoy Goswami*, " Design and Simulation of Broken Gate TFET and its RF Applications" 2025 Joint International Conference on Digital Arts, Media and Technology with ECTI Northern Section Conference on Electrical, Electronics, Computer & Telecommunications Engineering (ECTI DAMT&NCON), Thailand, DOI: 10.1109/ECTIDAMTNCON64748.2025.10962089.
5. *Ayan Bhattacharya; Bijoy Goswami; Nalin B Dev Choudhury*,"A Source-Drain Engineering Di-Electrically Modulated Double Gate TFET Based Label-Free Biosensor" TENCON, Singapore, DOI: 10.1109/TENCON61640.2024.10902813
6. *Susankar Borgohain,Khrishtina Dutta,Rashmi Choudhury,Niranjan Jyoti Borah, Ruchira Mazumdar, Mriganka Gogoi, P K Dutta*, "Design of Temperature Resistant Dual Band VCO with Integrated TFC Circuit for Studying Aging Affect using Machine Learning Framework", 10th IEEE International Nanoelectronics Conference IEEE INEC 2025, 3-6 Jan 2025, Taiwan.
7. *Chanakya Borgohain; Pallavi Barman; Subungsa Boro; Nabajit Chouhan; Niranjan Jyoti Borah; Ananya Choudhury*, "Driver Drowsiness Detection and Adaptive Braking System",2025 IEEE Guwahati Subsection Conference (GCON), DOI: 10.1109/GCON65540.2025.11173295.

## Books

1. "Advances in Sustainable Development, Innovation and Green Technology", *Kandarpa Kumar Sarma, Navajit Saikia, Debashis Dev Misra,* Series: Green Research, Developments, and Programs, Nova Science Publishers, USA. ISBN: 979-8-89530-527-0

# PLACEMENT RECORD FOR THE YEAR 2025

## *Batch 2021- 25*

| SL No. | Name of the Student | Recruiter |
|---|---|---|
| 1 | Shagufta Baruah | Teachnook |
| 2 | Mriganka Patowary | Teachnook |
| 3 | Nabajit Chouhan | ORC Engineering |
| 4 | Susankar Borgohain | ORC Engineering |
| 5 | Mausham Gogoi | ORC Engineering |
| 6 | Subungsa Boro | ORC Engineering |
| 7 | Aditya Singha | ORC Engineering |
| 8 | Ananta Mohan Barman | ORC Engineering |
| 9 | Madhurjya Kumar Bhattacharjya | Johnson Controls India |
| 10 | Sayanee Roy Barman | Johnson Controls India |
| 11 | Pallavi Barman | Siemens, TIME |
| 12 | Saptaparna Bhattacharjee | TIME |
| 13 | Ananta Barman | TIME |
| 14 | Shivam Gogoi | Sony |
| 15 | Asha Priya Bairagi | Drishtee Foundation |
| 16 | Nabajit Chouhan | Drishtee Foundation |
| 17 | Aditya Singha | Drishtee Foundation |
| 18 | Kh Alisha Singha | Drishtee Foundation |
| 19 | Sneha Borah | Drishtee Foundation, TATA Electronics |
| 20 | Shruti Paul | Vikas Group |
| 21 | Chanakya Borgohain | Star Cement |
| 22 | Jiya Noshin | Siemens |
| 23 | Arohan  Gogoi | Oil India Limited |
| 24 | Joydeep Gogoi | Godrej & Boyce |
| 25 | Kristi Hazarika | Little Box |
| 26 | Abinash Kalita | Little Box |
| 27 | Tirthankar Nath | TVS Credit Service |
| 28 | Abinash Kalita | TVS Credit Service |

# Students' In-House Entrepreneurial Ventures

**ASHIQUE ANOWAR**
*Co-founder of Eastern Wings*

**DEVRAJ KASHYAP**
*Co-founder of Eastern Wings*

**ROHAN VERMA**
*Co-founder of Frint*

**ARIF AHMED**
*Founder of CurioversityLearning Pvt. Ltd*

**MRIGANKA PATOWARY**
*Co-founder of OmniSync Technologies and Founder of Robotics Innovation Network of Assam (RINA)*

**PRANDEEP CHUTIA**
*Co-founder of OmniSync Technologies*

**RITAV KASHYAP**
*Co-founder of Frint*

**GYANAM KASHYAP**
*Founder of Vastukalpa Design Studio*

**AMAN AHMED**
*Founder of Radix Robotics*

**PRAGYANBRAT KALITA**
*Founder of Ratka Xetu*

# OUR COLLABORATIONS

1. ASSAM DON BOSCO UNIVERSITY

2. ASSAM DOWN TOWN UNIVERSITY

3. BUREAU OF INDIAN STANDARDS

4. GAUHATI UNIVERSITY

5. INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI

6. NATIONAL INSTITUTE OF ELECTRONICS AND INFORMATION TECHNOLOGY, GUWAHATI

7. VOLVO EICHER COMMERCIAL VEHICLES








Published by the Department of
**ELECTRONICS AND TELECOMMUNICATION ENGINEERING**
**ASSAM ENGINEERING COLLEGE,**
**GUWAHATI 781013, INDIA**