Department of Electrical Engineering
Indian Institute of Technology Bombay
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Abhineet Agarwal

Research/Professional Interests:

Broadly interested in nanofabrication and solid-state devices, having experience in modeling, fabrication and tool-making. I also have strong interests in biomedical engineering, EDA software design, lab-to-fab translation and commercialization, besides building and leading technical or R&D teams.

Education

2026-27 **M.Tech in Electrical Engineering**, *Indian Institute of Technology Bombay*, Mumbai.
Specialization: Solid State Devices
Advisors: Prof. Swaroop Ganguly, Prof. Dipankar Saha

2022-26 **B.Tech in Electrical Engineering**, *Indian Institute of Technology Bombay*, Mumbai.
Grade: 9.12/10 | **Minor:** Physics
Advisors: Prof. Veeresh Deshpande, Prof. Swaroop Ganguly, Prof. Anil Kottantharayil

2020-22 **Senior School Certificate Examination (AISSCE)**, *Maa Bharti Sr Secondary School*, Kota.
Grade: 99.4% | **Stream:** Science

Research Experience

Quantum Biomimetic Electronic Nose *(May 2024 - Present)*

Guide: Prof. Swaroop Ganguly | Collaborators: TCS Research

- Used the NEGF method for 3D quantum transport calculations exploiting RTDs for room-temperature IETS.
- Proposed a novel mode-based approach to determine relevant inleastic transport channels in a 3D RTD.
- Investigating different heterostructures such as GaAs–AlAs and IGZO–SiO_2 for the fabrication of the RTDs.
- Designing a nanoampere front-end and a novel sub-threshold PDFET based low-noise IETS readout method.

Fabrication of ReRAM Devices | B.Tech Project - 1 *(Aug 2025 - Present)*

Guide: Prof. Veeresh Deshpande | Collaborators: Yale University, Applied Materials

- Undergoing cleanroom training in photolithography, thin-film deposition (sputtering/ALD), annealing etc.
- Fabricating a W/WO_x/HfO_2/Pt stack, performing DC and pulse programming over $100+$ cycles to study SET/RESET behavior, endurance and retention, and later validating results using GENESTRA simulations.

AlN BAW Filters for Space Applications *(Sep 2024 - Feb 2025)*

Guide: Prof. Apurba Laha | Collaborators: ISRO

- Designed a 3.6 GHz AlN BAW SMR achieving Q-factor of 6650 and 25.15% coupling coefficient in COMSOL.
- Implemented BVD and Mason equivalent circuit models for bandpass filters achieving 99.1 MHz bandwidth.
- Investigated the incorporation of a ferroelectric layer for a three-electrode structure to make f-tunable filters.

Honors and Awards

- Awarded the **Undergraduate Research Award** (URA-01) by IITB for exceptional research work. *(2025)*
- Received the **Atomic Fellowship** from GradCapital to start HackerFab IITB. *(2025)*
- Won the **Micron Hackathon** at IIT Bombay for the lithography problem statement. *(2025)*
- Best Project Award for BTBT optimization in Global Foundries 32nm and 22nm SOI nodes in EE 724. *(2024)*
- 2nd among 100+ freshman teams for summer project building an assistive device for the blind. *(2023)*
- Achieved an **All India Rank 158** in the JEE Advanced examination among 1.58 lakh candidates. *(2022)*
- Secured an **All India Rank 81** in JEE Main among 1 million candidates, scoring **290/300** overall. *(2022)*
- Among the National Top 1% of candidates in the National Standard Examination in Chemistry. *(2022)*
- Offered the prestigious **KVPY Fellowship** by the Dept. of Science and Technology, Govt of India. *(2020)*
- Among the National Top 1% of candidates in the National Standard Examination in Junior Science. *(2019)*

Technical Experience

HackerFab IITB | Founder *(Aug 2025 - Present)*

Advisor: Prof. Anil Kottantharayil | Supported by: GradCapital, Mercatus Centre, SemiX IITB

- Co-founded IITB chapter of the HackerFab initiative to build India's first bottom–up, student-led chip fab.
- Developing a maskless DMD-based lithography system capable of achieving 2 µm linewidths and a spin-coater.
- Raised Rs 45 lakh and built a team of ten, presenting our work at the 3rd SemiX Summit, IIT Bombay in a panel alongside top semiconductor executives, govt representatives and academicians.

Automation of Cancer Detection using Olfaction | Summer Intern *(May - Jul 2025)*

Dognosis India Pvt Ltd

- Designed a 16-channel EEG amplifier using dual ADS1299 AFEs with BMS, battery gauge, and nrf52840 BLE.
- Implemented a CAN-based STM32F automation system with serial servo motors, steppers, sensors and pumps.
- Designed optodes for mapping cranial bloodflow using fNIRS and studied quartz tuning fork based e-noses.

iKshana: A Complete Navigational Solution for the Visually Impaired | Team Lead *(May - Aug 2023)*

Institute Technical Summer Project | Institute Technical Council, IIT Bombay

- Led a team of four students to develop a successful proof-of-concept. Was adjudged 2nd among 100+ teams.
- Designed and fabricated wearable foot harnesses with haptic feedback for real-time directional guidance.
- Developed an Android app and used OpenStreetMap to create an intersection database for campus navigation.

Selected Academic Projects

X-ray Mask Fabrication and XRL | ME6110 *(Oct - Nov 2025)*

Nanomanufacturing Processes | Instructor: Prof. Rakesh Mote

- Fabricating high-precision tantalum X-ray masks for satellite imaging applications in collaboration with ISRO.
- Evaluated laser micromachining, EDM, and etching techniques to achieve sub-10 µm pattern accuracy.
- Concurrently, exploring commercialization potential of X-ray lithography for CMOS fabrication.

Heterogeneous Integration of 2D and 3D materials | EE784 *(Mar - Apr 2025)*

2D Materials and Electronics | Instructor: Prof. Saurabh Lodha

- Modeled and simulated MoS_2/SiC Esaki diodes using NEGF formalism, reproducing experimental NDR peaks.
- Developed models for MoS_2 BioFETs to study surface charge effects, predicting V_{th} shifts and SS trends.
- Proposed a novel SiC/SiO_2/MoS_2/SiO_2/SiC RTD and its fabrication process flow for room-temperature IETS.

Dual-Junction LDD/HDD MOSFET Scaling | EE620 *(Mar – Apr 2025)*

Physics of Transistors |Instructor: Prof. Souvik Mohapatra

- Scaled transistor from 1μm to 0.18μm gate length with halo implants for short-channel effect control.
- Achieved V_{th} reductionfrom 1V to 0.85V and 100$\times I_{ON}$ improvement, optimizing through TCAD simulations.
- Used Hurkx BTBT tunneling and mobility degradation models to demonstrate DIBL control at 118 mV/V.

16-bit Pipelined IITB CPU | EE309 *(Apr – May 2024)*

Microprocessors | Instructor: Prof. Virendra Singh

- Designed a 16-bit Turing-complete RISC processor with a 6-stage pipeline and a 26 instruction ISA.
- Implemented the design, consisting of ALUs, Register File, 5 pipeline registers, control & hazard on VHDL.
- Wrote a testbench to verify the design using RTL and gate-level simulation and checked for synthesisability.

BTBT in FDX 22nm SOI MOSFET | EE724 *(Feb - Apr 2024)*

Nanoelectronics | Instructor: Prof. Udayan Ganguly

- Investigated band-to-band tunneling current optimization in 32nm PDSOI and 22nm FDSOI MOSFETs.
- Achieved optimal BTBT performance at $L_{OV} = 1.4\,\mathrm{nm}$ and $N_{CH} = 1 \times 10^{17}\ \mathrm{cm}^{-3}$ for FD-SOI inverters.
- Analyzed temperature effects and gate scaling using Synopsys Sentaurus TCAD. Won a best project award.

Teaching and Mentorship

Teaching Assistant | 28nm CMOS Device & Process Tech Course *(Oct - Nov 2025)*

SemiX IIT Bombay | Instructor: Prof. Udayan Ganguly (supported by Synposys)

- Only undergradute in an 11-member team offering an upskilling course for semiconductor professionals.
- Conducted the tutorial sessions and quizzes for the short-channel effects and stress-engineering sections.

Team Mentor | Institute Technical Summer Projects *(May - Aug 2025)*

Institute Technical Council

- Mentored two freshmen teams developing an autonomous micromouse maze-solver with FPGA-based pathfinding algorithms and a tactile glove using IMUs for real-time finger tracking and gesture control.
- Guided students through the hardware development lifecycle including PCB design, firmware and sensors.

Teaching Assistant | EE207 (Electronic Devices and Circuits) *(Jan - Apr 2025)*

Instructor: Prof. Swaroop Ganguly

- Conducted tutorial sessions covering p-n junction physics, MOSFET operation, and device fundamentals.
- Taught fundamentals of TCAD simulation tools and guided hands-on analysis of devices using nanoHUB tools.

Technical Skills

- **Fabrication and Characterization:** Photolithography - DSA and direct-write, Atomic Layer Deposition, RF/DC magnetron Sputter, Annealing Furnace, Plasma Asher, CV and IV measurement (Agilent B1500), Four probe sheet resistance and Hall measurement, Scanning Electron Microscopy, Ellipsometer
- **Programming Languages:** Python, C, VHDL, 8051 Assembly, Verilog
- **Softwares and Tools:** Sentaurus, KiCAD, ATK, Virtuoso, Quartus, Genus, Innovus, Altium

Selected Coursework

- **Microelectronics:** Electronic Devices†, Nanoelectronics, Compound Semiconductors, 2D Materials, VLSI Design, VLSI Technology, Neuromorphic Engineering, Quantum Transport, Nanomanufacturing Processes, Physics of Transistors, Microelectronics Lab†
- **Other Electrical Engineering:** Microprocessors†, Power Engineering†, Signal Processing-I, Control Systems†, Communication Systems†, Electronics Design Lab†
- **Others:** Quantum Mechanics-I, Classical Mechanics, Statistical Physics, Condensed Matter Physics, Machine Learning, Probability, Linear Algebra, Differential Equations, Design Thinking†, Makerspace†

†*had a lab component*

Extracurricular activities

- Played for the Hostel 5 field hockey team and won the inter-hostel General Championship. *(2025)*
- Member of the IIT Bombay Quiz contingent placed third overall at the Annual Inter-IIT Cultural Meet. *(2023)*
- Served as **Editor**, **Department Editorial Board**, catering to 1500+ students, faculty and alumni. *(2023)*
- **State Runners-up** in The Frank Anthony Memorial All-India English Debate, held in Cuttack. *(2019)*
- Trained Hindustani vocalist and keyboard player of 6+ years and was a member of the St. Paul's School Choir.
- Avid hiker having trekked multiple trails in the Himalayas, the Garhjat hills and the Western Ghats.

References

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