Pursuing a Minor Degree in **Robotics**

Scholastic Achievements

- Attained **International Rank 58** in the **International Olympiad of Science** among **30,000+** candidates
- Ranked among top **24** teams out of **120+** for line follower project in makerspace and presented it to the Dean
- Achieved **AA (10/10) in 5** courses including **Computer programming & Utilization**(CS101) - CS course based on C++, **Digital Electronics and Microprocessors**(PH222), and **Makerspace**(MS101) - Robotics course

Internship and Research Experience

VP-Propulsion Software Intern | Jaguar Land Rover [May '25 - Jul '25]

- Developed a Python application with a **PyQt5-based GUI** to automate extraction and comparison of multiple **ARXML (AUTOSAR XML) files**, improving reliability of version comparison and structured report generation
- Automated version-to-version comparison, reducing manual verification time by **300%** in ECU model validation
- Engineered a MATLAB application with **MATLAB App Designer** to automate complex model verification workflows, reducing validation time by **80%** and enhancing usability and improving productivity for engineers
- Engineered a Battery Health Platform for **JLR Global Hackathon**, developing **ECM model** in MATLAB and leveraging Machine Learning for precise State-of-Health (SOH) and State-of-Charge (SOC) estimation

Distributed Optimization for Uncertain Rotational Rigid Body Systems | BTP
Guide: Prof(s). Ravi N Banavar [Jan '25 - Present]

- Designed and implemented a **nonlinear torque-based controller** integrating gradient descent, consensus coupling, and integral compensation for orientation alignment of agents with local and relative measurements
- Applied **Lie theory** to formulate the total objective function and ensure convergence on the **SO(3) manifold**
- Simulated system and controller dynamics in **Python** to validate performance of the proposed controller

Technical Experience

Design Engineer | Autonomous Integration and Simulation Development | IITB Racing Driverless
Guide: Prof. Sandeep Anand [Aug '23 - Apr '25]

Part of **Autonomous Integration and Simulation Development** division in a team of **70+** students representing India as the **1st** driverless contingent among **100+** teams to work on a vehicle worth **£100k** at Formula Student AI

- **Published on arXiv**, "IIT Bombay Racing Driverless: Autonomous Driving Stack for Formula Student AI", for research and development of the self driving vehicles in Computer vision, SLAM, Motion Planning and Controls
- Secured overall **4th** place among 25 teams in the 2025 competition acheiving a **7-place** jump over last year
- Built a 1/5th scale prototype of a driverless racecar with **STM32 microncontroller** and **CAN communication**
- Increased obstacle detection and depth prediction accuracy in simulations by more than **90%** by retraining it with around **1000+** image data collected from the simulator, improving the overall efficiency of the autonomous stack
- Implemented the complete tech stack migration from **ROS1** to **ROS2** leading to **25% increase** in performance
- Responsible for the development on a **custom PCB** used on prototype bot, increasing the efficiency by integrating **Arduino-Nano**, **LM-2596** DC-DC converter module, **BTS7960** motor driver and **HC-05** Bluetooth module
- Implemented an efficient development pipeline for the race car using **MRPT, ROS2, PyTorch, TensorFlow, ZED-2i packages** within a **Docker container**, ensuring seamless testing and validation of the autonomous stack
- Implemented **Virtual CAN** interface in **Linux** using test DBC files and **Cantools** with other Python libraries

Electrical Division Trainee | IIT Bombay Racing Team [Dec '22 - Aug '23]

- Utilized **Eagle** software to design a **Printed Circuit Board(PCB)** produced specifically for the current sensor
- Gained expertise in circuit design and simulation, utilizing **LTSpice** to create and validate electronic circuits
- Successfully engineered a non-destructive method of current measurement using a **Hall effect sensor** and building a device capable of measuring currents of up to **50 Amps**, developing knowledge in circuit building

Key Projects

Lead Compensator Design | AE 308 | Control Theory | Course Project [Nov '23]
Guide: Prof(s). Arnab Maity

- Designed a compensator to achieve a phase margin of **46.1°** from **-46.7°** in **MATLAB** for given transfer function
- Achieved a static error constant of **100**, utilizing **2** lead compensators analysed via Bode and Root locus plots

Preserving Noether symmetries | SC 651 | Estimation on Lie Groups | Course Project [Apr '24]
Guide: Prof(s). Ravi N Banavar

- Performed a detailed analysis of the paper **Lie Groups and Quantum Mechanics** by P.G.L. Leach and Nucci
- Examined the use of Lie groups and Jacobi's last multiplier preserving Noether symmetries during quantization

YOLOv1 Implementation | Self Project [Jun '24]

- Implemented and tested an object detection model based on **YOLOv1 paper** trained on **PASCAL VOCDataset**
- Utilized **PyTorch** to build a CNN, achieving an accuracy of **84.3% mAP** at IOU threshold of **50%** during training

Star tracker | ME 604 | Robotics | Course Project [Apr '25]
Guide: Prof. A. Gupta

- Built Arduino-based star tracker with gyroscope, RTC and servo motors for real-time tracking of celestial objects
- Developed a self-leveling platform mechanism for more robust star tracking using magnetometer feedback

Smart Appliance IR Controller | PH 222 | Digital Electronics and Microprocessor | Course Project [Apr '24]
Guide: Prof(s). Maniraj Mahalingam

- Developed the Smart Appliance Infrared-Remote Controller, utilizing **Atmega328p** as the main micro-controller
- Integrated **2 Arduino** via **Serial** Communication protocol, with the ability to store signals for **5+** different devices
- Utilized **HC-05** Bluetooth module, increasing it's functionality by enabling remote control via a Bluetooth device

Obstacle Removing Line Follower robot | MS 101 | Makerspace | Course Project [Feb '23]
Guide: Prof(s). D.K. Sharma and Joseph John

- Designed and developed line follower bot using **Arduino**, finishing any given track **50% faster** than other teams
- Used **Fusion 360** for 3D modeling, **LaserCAD** for developing laser-cutting templates and Fractory to 3D print

Positions of Responsibility

SOC Mentor | F-Society Security Breachers | Seasons of Code 2024 [Jun '24]

- Mentoring **5** undergraduate students in the field of cybersecurity, including Network Security and Cryptography
- Provided mentees with regular assistance and resources to learn, as well as insights on various related topics

Technical Skills

- **Softwares**: Docker-containers, MATLAB, ROS, Git, LTspice, Fusion 360, Eagle, Unity, Linux
- **Languages**: LaTeX, Python(NumPy, Pandas, Matplotlib, OpenCV, Torch), C, C++, Bash

Key Courses

Computer Science and Robotics	• Computer Programming and Utilisation, Makerspace, Artificial Intelligence and Data Science, Control Theory, Robotics, Non-linear Dynamics, Fundamentals of Digital Image Processing, Nanodevices and Applications
Physics and Electronics	• Quantum Physics, Classical Mechanics, Analog Electronics, Digital Electronics & Microprocessors, Statistical Mechanics, Numerical Analysis, Electromagnetic Theory, Introduction to Condensed Matter Physics, Light Matter Interaction
Mathematics	• Calculus, Linear Algebra, Differential Equations, Complex Analysis and Integral Transform, Estimation on Lie Groups, Analytical and Geometric Dynamics

Extracurriculars

Leadership	• Successfully organized an event in collaboration with **Red Bull** as part of the IITB Racing Team, showcasing event management skills
Sports & Cultural	• Proudly represented Hostel-2 in the **Fine Arts GC** and achieved **1st position** • Contributed to Abhyuday's **Versova Beach cleanup** initiated by IIT Bombay • Was a part of National Sports Organization(NSO) - **Piano** for the first year