Vatsal Melwani | **22B0396**
Electrical Engineering | **B.Tech.**
Indian Institute of Technology Bombay | **Gender: Male**
DOB: 28/11/2004

Examination	University	Institute	Year	CPI / %
Graduation	IIT Bombay	IIT Bombay	2026	
Intermediate	CBSE	Medi-Caps International School	2022	95.80%
Matriculation	CBSE	New Digamber Public School	2020	96.60%

Pursuing a minor degree in **Artificial Intelligence and Data Science** from C-MInDS, IIT Bombay

Scholastic Achievements

- Currently holding **Department Rank 5** out of **100+** UG students in the Electrical Engineering department *(2024)*
- Secured a perfect **SPI** of **10/10** in the **3rd and 4th** semesters and received **20+** AA grade over 4 semesters *(2024)*
- Received **3 AP** grades: Power Engineering II(**top 0.91%**), Quantum Physics, Material and Energy Balances *(2024)*
- Awarded the **Change of Branch** among **15 students** due to exemplary academic performance in first year *(2023)*
- Secured a percentile of **99.78** in JEE Mains with **100** percentile in Physics among **1 million** candidates *(2022)*
- Secured an **All India Rank** of **1999** in IIT-JEE Advanced exam among **0.15 million** appeared candidates *(2022)*
- Received **merit** for being among the top **0.1%** of students in **Mathematics** in 10th CBSE Board Exam *(2020)*

Research Internships

Quantum Computing: Constant Adder Circuit *(May 2024-present)*

Guide: Prof. Anupam Chattopadhyay, Project Mentor: Siyi Wang, Nanyang Technological University, Singapore

- Studied single and multi-qubit systems, and quantum operations such as **Hadamard**, **Toffoli**, and Fredkin gates
- Explored **Qiskit** python library by simulating circuits like **GHZ** state generation and **multi-control** NOT gates
- Simulated a basic **constant adder** circuit by cascading **N-bit increment** circuits using borrowable **ancilla** bits
- Employed calculations for **toffoli depth**, count and qubit count parameters and currently finding ways to optimize

Analog Circuits *(Dec 2023)*

Guide: Prof. Maryam S. Baghini, Project Mentor: Mohin Shaikh, Embedded Systems Lab, IIT Bombay

- Collaborated in a team of **6** and studied about circuits like, **trans-impedance amplifier** and **peak-valley** detector
- Researched about some op amp **non-idealities**, employed them in circuits and **selected** corresponding op amps
- Simulated and **tested** the circuits using **Analog Discovery AFG** and **DSO** device and the **Waveforms** software

Course Projects

Pipelined RISC Processor Design | *Microprocessors (EE309)* *(May 2024)*

Guide: Prof. Virendra Singh, Dept. of Electrical Engineering, IIT Bombay

- Formed a team of 4 to design a **26** instructions executable, **16-bit**, **6-staged** pipeline **RISC** CPU having **8** registers
- Designed the **5 pipeline** registers, condition code registers, and **instruction decoder** to generate **control** signals
- Detected data dependency and branching **hazards** and employed data **forwarding** and **stalling** to mitigate them
- Implemented the CPU and **Testbench** in **VHDL** and comprehensively tested by analyzing **waveforms** in **Quartus**

8051 Microcontroller Programming | *Microprocessors Lab (EE337)* *(Jan 2024-Apr 2024)*

Guide: Prof. Nikhil Karamchandani, Dept. of Electrical Engineering, IIT Bombay

- Used **Keil** μ**Vision** to write and debug programs in **assembly** language and executed them on **8051** microcontroller
- Applied **keyboard** interfacing to make **tone generator** using **timers** and **interrupts**, displaying output on LCD
- Simulated the behaviour of an **ATM** utilizing serial transmission of 8051 through **UART** and **Realterm** software

Multi-Cycle Processor Design | *Digital Systems (EE224)* *(Nov 2023)*

Guide: Prof. Virendra Singh, Dept. of Electrical Engineering, IIT Bombay

- Collaborated in a **team of 4** to design a **16-bit** computing system capable of executing a total of **14** instructions
- Employed state **equivalence** to create a **Moore** type finite state machine and with a total of **22** executable states
- Ideated and created the circuit of **datapath** for each instruction and identified the **control signals** for each state
- Simulated the CPU in **VHDL** with **64 B** memory, 8 **16-bit** registers and a **testbench** for testing each instruction

Multi-Terrain Line Follower Bot | *Makerspace (MS101)* *(May 2023-Jun 2023)*

Guide: Prof. Dinesh K Sharma, Dept. of Electrical Engineering, IIT Bombay

- Worked in a **team of 6** to develop a **line following** bot with **300 gm** of load **carrying and dumping** capacity
- Formulated electrical circuits using IR sensors, **Arduino UNO**, motor driver, **L293D** shield, and 300rpm motors
- Integrated the design using **Fusion 360** and **LaserCAD** and programmed the Arduino using **AduinoIDE** software

Digital Circuits Simulation | *Digital Circuits Lab (EE214)* *(Aug 2023-Nov 2023)*
Guide: Prof. Siddharth Tallur, Dept. of Electrical Engineering, IIT Bombay

- Developed and **simulated** various digital circuits using **VHDL** in **Quartus** and tested them using a **Testbench**
- Formulated a **universal 8-bit shifter** and a **BCD** adder/subtractor utilizing the **X-coded**(Excess-3 coded) inputs
- Devised a sequence **generator** and a string **detector** as Finite State Machines by **behavioural** modeling structure

Analog Ciruits Design | *Analog Lab (EE230)* *(Jan 2024-April 2024)*
Guide: Prof. Anil Kottantharayil, Dept. of Electrical Engineering, IIT Bombay

- Simulated **op-amp** based amplifiers, rectifiers, **multivibrators**, and filters using **LTspice** and built them hands-on
- Constructed a **square root amplifier** using log and anti-log amplifiers and verified its working through simulation

Technical Projects

FlappeRL | *Seasons of Code* *(May 2023-Aug 2023)*
WnCC, IIT Bombay

- Implemented **value** iteration and **policy** iteration methods to build a **maze solver** as a **Markov** Decision Process
- Developed the well-known game **'Flappy Bird'** using **pygame** as an encoded **environment** for an MDP in Python
- Rewarded with high scores above **200** by curating an **Online** State Action Reward State Action, **SARSA** model

Trapped in Neural Nets | *Winter in Data Science* *(Dec 2022-Jan 2023)*
Analytics Club, IIT Bombay

- Achieved an accuracy of **93.5%** by training a **3-layered image classification NN** model on the **MNIST** dataset
- Acquired knowledge about **linear and logistic regression** and various relevant tools of **matplotlib** and **sklearn**
- Studied the basic structure of a **neural network** and learned about activation functions **ReLU** and **Softmax**

Positions of Responsibility

Technical Team Member | Data Analytics and Visualization Team *(Jun 2023-Apr 2024)*
Undergraduate Academic Council, IIT Bombay

- Selected to be a part of a **10-student** team to provide **data-driven** solutions and **insights** into institute data
- Worked on a **course-recommendation** system by using **40K+** student-course mapped data points using clustering
- Analyzed the average **growth** of various **sectors** using stock data of numerous firms with **yfinance** python library
- Engaged in institute **feedback** analysis projects to extract valuable and actionable patterns from the collected data

Technical Skills

Languages	C++, Python, Assembly(8051 μC), VHDL, Embedded C
Softwares	Quartus, Keil μVision, LT Spice, XCircuit, Realterm, Fusion360

Key Courses

Electrical	Microprocessors, Control Systems, Power Engineering, Electronic Devices and Circuits, Digital Systems, Analog Circuits, Probability and Random Processes, Signal Processing-I, MakerSpace, Communication Systems*, Electromagnetic Waves*
Data Science	Programming for Data Science, Introduction to Machine Learning
Mathematics	Linear Algebra, Differential Equations, Calculus-I and II
Miscellaneous	Introduction to Quantum Physics, Computer Programming and Utilization
Labs	Digital Circuits, Microprocessors, Power Engineering, Analog Circuits, Communications*, Control Systems*, Electronic Devices*, Computer Programming and Utilization

**To be completed by Nov 2024*

Extracurricular Activities

- Achieved a **rank of 196** in the **COMEDK** Undergraduate Entrance Test 2022 among more than **55K** applicants
- **Represented** New Digamber Public School, Indore in the **Green Schools Programme** Audit 2017-18 in Delhi
- Awarded with a **Silver medal** and a Certificate of Participation in **French Olympiad** conducted in 2016
- Selected for and successfully completed a year-long **NSO** programme of Badminton at IIT Bombay in first year
- Held **runner-up** position at summer **badminton** camp 2016 organized by Indore District Badminton Association
- **Graduated** in Abacus & Mental Arithmetic **(UCMAS)** by completing all the eight levels of the course in 2015
- Conferred with **Merit twice** in **9th and 10th State Level** UCMAS Competition in 2014 and 2015 respectively