

EDUCATION

Indian Institute Of Technology Bombay

Electrical Engineering(Dual degree - B.Tech + Mtech) specializing in Microelectronics




Mumbai, India

5th year UG(2018-2023)

Examination	University	Institute	Year	CPI(/10) / %
On-roll	IIT Bombay	IIT Bombay	2023 (Expected)	8.85
Intermediate/+2	WBCHSE	Ramakrishna Mission Vidyalaya, Narendrapur	2018	95.60
Matriculation	WBBSE	Ramakrishna Mission Vidyalaya, Narendrapur	2016	93.57

Completed **Minor** in Management under **Shailesh J. Mehta School of Management, IIT Bombay** (CPI: 8.8/10)

PREPRINTS AND PUBLICATIONS

- **Steady-State Tunable Entanglement Thermal Machine Using Quantum Dots**  QST, iopscience
Anuranan Das, Adil Anwar Khan, S.D. Mishra, P. Solanki, Bitan De, B. Muralidharan, Sai Vinjanampathy
Accepted
- **Steady-State Tunable Entanglement Switch with Quantum Dots**  APS March Meetings
Sai Vinjanampathy, Parvinder Solanki, Bhaskaran Muralidharan, Bitan De, Adil Khan, Anuranan Das
March'22
- **Euler-Rodrigues Parameters: A Quantum Circuit to Calculate Rigid-Body Rotations**  arXiv:2203.12943
Emilio Pelaez, Anuranan Das, Parmeet Singh Chani, Daniel Sierra-Sosa
March'22

INTERNSHIPS AND RESEARCH EXPERIENCE

Few layer MoS_2 based NEMS for sensor applications

Prof. M. Adachi, ENSC (SFU, BC)


Mitacs Globalink Research Intern(Canada)

May'22 - Jul'22

- Performed electrical characterization of suspended MoS_2 NEMS to find resonant frequency and current-voltage characteristics using a combined setup of **Lock-in amplifier, vacuum chamber, optical microscope, and Keithley 2400 sourcemeter**.
- Formulated a **COMSOL Multiphysics model** to simulate the eigenfrequency of the device and thereby match with experiments.
- Visualized possible extensions of the device as a photocurrent-based pressure sensor dependent on the tensile stress subjected.

Steady-State Tunable Entanglement Switch with Quantum Dots

Guide: Prof. B. Muralidharan, EE (IITB)

UG researcher, Computational Nanoelectronics & Quantum Transport Group 

Dec'20 - Dec'21

- Developed and analyzed an entanglement generating thermal machine model with the help of ancilla impurities and Transport Master equations. Envisaged an amalgamation of quantum computing and quantum transport concepts.
- Analyzed the variation of quantum entanglement measure in the model with **thermal bias**. Documented results were submitted for publication in the form of a research article. Published at **Quantum Science and Technology, IOPScience**.

Reliability of CMOS devices and circuits

Guide: Prof. Souvik Mahapatra, EE (IITB)

Undergraduate Researcher(SURP)

May'21 - Dec'21

- Investigated challenges in **CMOS technology scaling** in the semiconductor industry and the evolution of **FinFETs**.
- Explored possibilities of reducing power consumption in data centers by increasing efficiency of transistors at **low** temperatures.

Interaction Coupling and Qubit from 2-D materials

Guide: Prof. R. Rahman, Physics (UNSW, Australia)

Remote Junior Researcher

Aug'20 - Jan'21

- Conducted extensive literature review on **coherent spin exchange via a quantum mediator** and effect of nuclear spins.
- Analysed the possibilities of creating qubits from 2-D materials on the basis of various intrinsic properties of the materials.

SCHOLASTIC ACHIEVEMENTS

- Selected along with **34** students all over India for the **Chanakya UG/PG Fellowship** for research in Quantum Technologies (2022)
- Earned 1st position in **IBM Quantum Challenge 2021**, a worldwide Hackathon held for quantum computing community (2021)
- Awarded **Intermediate and Advanced** achievement badges, respectively, for completing the IBMQ challenge. (2020, 2021)
- Achieved 99.83 percentile among **10,74,319** candidates in **JEE MAIN 2018** (2018)
- Secured a rank in the top **3.06** percent among **231024** candidates in **JEE ADVANCED 2018** (2018)
- **GRE General Test** ::: Quantitative : 168/170 , Verbal : 161/170 , AWS : 4 | **TOEFL iBT** ::: 108/120 (2022)

KEY PROJECTS

Pauli Blockade in Graphene Double Quantum Dots and CNNs

Guide: Prof. Bhaskaran Muralidharan

Supervised Research Exposition and Master's Thesis

Jul'21 - Dec'21, Jul'22 - Present

- Identified the regimes of **valley blockade** and **spin blockade** achieved experimentally in Bilayer Graphene Quantum dots.
- Refurbished a model to explain experimental findings of Pauli Blockade in these systems using **fermi's golden rule** approach.
- Introduced **Photon relaxation** effects and **Spin-Orbit Coupling** into the system to get a match of experimental characteristics.
- Developing a **CNN-based model** to determine blockade states from experimental **charge stability** diagrams and **bias triangles**.

Quantum Key Distribution Protocol

Two Day long Hackathon

QuTech Challenges @ MIT iQuHACK 2022

Jan'22

- Constructed a QKD system exploiting the **MQTT protocol** for remote devices with low code footprint & Network Bandwidth.
- Visualized the possibilities of transforming the two-user system into a multi-user one using multiple Quantum keys.

Computing Rigid Body Rotations with Qiskit

Qiskit Advocate Mentorship Program, IBMQ

Daniel Sierra-Sosa, QAMP'21

Aug'21 - Dec'21

- Developed an algorithm to use Superconducting qubit hardware to find a method to compute rigid body rotations.
- Wrote a programming blog on **Implementing A Hybrid Quantum Classical Neural Network With Qiskit** on blogging site **Medium**.

Variational Quantum Eigensolver to Find the bond length of LiH molecule

Final project, Qiskit Global Summer School

IBM Quantum

Aug'20

- Successfully tested various combinations of parameters like **Variational Ansatz**, **optimizers**, **initial state**, **noise simulators**.
- Analyzed the performance of various optimizers for **UCCSD variational form** with **Jordan wigner** qubit mapping.

COURSE PROJECTS

Analysis of Josephson Effects

Quantum Transport In Nanoscale Devices, Spring'21

- Reviewed the interpretation of **Bogoliubov-deGennes formalism** using both NEGF and Scattering Matrix Based approaches.
- Reproduced sinusoidal **DC current-phase** ($I - \phi$) relationship for Josephson Junction in s-wave superconductors using MATLAB.

Clap detector for toy and appliance control

Electronic Design Lab, Spring'20

- Designed a circuit with **envelope detector**, **Comparator** and **Current amplifiers** that can detect the occurrence of a clap .
- Devised **control** codes to provide visual feedback to the user, depending on the interval of two successive claps.

FPGA based Traffic Light Controller System

VLSI Design Lab, Spring'21

- Designed a Traffic Light Control System to manage the road traffic in **Verilog** and operated on **Intel DE2-115** board.
- Supplanted the design with **Intelligent peak timing** method based on sensors, more efficient than **fixed time method**.




Pipelined RISC Microprocessor

Processor Design, Spring'21

- Devised IITB-RISC, an **8-register**, **16-bit** system with standard **6 stage** pipelines capable of executing **15** instructions.
- Programmed the design in **Verilog** and equipped the design with control flow, data forwarding & hazard mitigation.

Numerical Modeling of MOS Capacitors and FETs

Physics of Transistors, Spring'20

- Modelled numerical Poisson solver in **MATLAB** to produce Band-diagrams in MOS capacitors and effect of interface traps. 
- Implemented **Pao-Sah**, **Brews**, and **piece-wise** models for MOSFET current and compared speed and accuracy trade-offs. 
- Developed mobility vs. effective electric field model using data generated from Split-CV simulations done in TCAD. 

Strain Engineering for CMOS Scaling

CMOS Logic and Flash Memory Devices, Autumn'21

- Reviewed the Industry grade procedures used for strain engineering and participated in a seminar to deliver a presentation on the same. Simulated tunneling leakage characteristics of gate stack using **Wentzel-Kramers-Brillouin (WKB)** method.

Alzheimer's Disease Detection by EEG Signal Processing

DSP, Autumn'20

- Implemented feature extraction process using **Fast Fourier Transforms** from Alzheimer's patients' database availed online
- Initiated and trained **classifiers** based on logistic regression, SVMs, Decision Trees(Binary), Random Forest and Adaboost

Liquid State Machine for Digits Classification

Neuromorphic Engineering, Autumn'21

- Created a speech classification model using **reservoir computing** and **bio-inspired neuron** learning.
- Proposed a graph visualization-based method to analyze the extent of **delayed coincidence** affecting learning in the reservoir.

Excitons in semiconductors

Physics Of Nanoelectronic Devices, Autumn'20

- Studied and analyzed methodology to determine the exciton binding energy and wave functions for two-dimensional systems.
- Simulated the dependence of binding energy as per various parameters using the **Potential Morphing Method** in Python.

Digital Filter Design under given specifications

Digital Signal Processing, Autumn'20

- Designed Infinite Impulse response **Bandpass(Butterworth)** and **Bandstop(Chebyshev)** filters under certain specifications.
- Used MATLAB to verify the stability of the filter and applied **Kaiser filter approximations** to simulate finite responses.

32-bit Brent Kung Adder (Course Project)

VLSI Design, Autumn'21

- Described a **32-bit Brent Kung** adder using **carry-generate** and **carry-propagate** logic in **VHDL** with delay timing of 100ps.
- Tested the final model by generating test cases through **Python** and feeding them through **VHDL** model to check validity.

Other Projects

Course

- Created circuitry to display any LED pattern on an 8x8 LED matrix using digital logic.
- Audited **Amul Brand** and explored the **marketing strategies** for its products.
- Programmed 8051 micro-controller in **embedded C** to simulate the behavior of an ATM.
- Reproduced Gate leakage Characteristics of a MOSCAP based on WKB tunneling approach.

Introduction to Electronics('19)

Marketing Management('19)

Microprocessors Lab('20)

Physics Of Transistors('20)

- Designed an Arithmetic Logic Unit(ALU) using VHDL(Altera Quartus).

Digital Design Lab('20)

- Reviewed financial crisis of 2008 from John Cassidy's 'How Markets Fail'.

Capitalism:Theory,History and Varieties('20)

POSITION OF RESPONSIBILITY AND OTHER EXPERIENCES

Qiskit Advocate

Quantum Computing Advocate

Qiskit

Aug'21 - present

- Succeeded in **IBMQ Developer certification test** and contributed to Qiskit SDK as an active community member.
- Acting as a volunteer for various programs organized by the Qiskit community for inculcating Quantum education.

Qiskit Global Summer School ('20, '21)

Virtual School Attendee

IBM Quantum

July'20, July'21

- Joined Global Summer school to get familiar with cutting-edge Quantum hardware('20) and Quantum Machine Learning('21).
- Successfully completed lab assignments and final project with the help of IBM mentors and peers.

Teaching Assistant | VLSI Design(EE671)

Jul'22 - Present

- Upskilled the performance of enrolled students by collaborating with the instructor and helping conduct weekly lectures

Hostel Sports Secretary

Sports council of Hostel 2 in IIT Bombay

Hostel 2 council, IIT Bombay

Aug '19 - Jul' 20

- Acted as the first point of contact in sports-related queries and strived to make Hostel 2 a pioneer in sports
- Managed the teams representing Hostel 2 in General championships, won the **Runners up** position among 15 hostels

Educational Content Development

Work From Home Internship

Embibe

April'20 - June'20

- Worked on end-to-end creation, editing of solutions, and correction of different questions of Intermediate level Physics for an online platform under **Reliance Industries Limited** which serves **7 million users across India**
- Collaborated with project coordinators to get the content developed as per company vision and daily targets

Summer Of Sciences, 2020

Mentor

Maths and Physics Club, IITB

Apr'20 - June'20

- Mentored three freshmen in their endeavor to explore the basics of nanotechnology and its applications for their project.
- Monitored their plan of action and resolved their doubts, and verified their final study reports

TECHNICAL SKILLS

Programming Languages	Python 3, Verilog, Embedded C, C++, R, Scilab, MATLAB, VHDL, Octave, Assembly
Electronics	EAGLE, Altera Quartus Prime, Keil uVision, Proteus, NgSpice, GNU Radio, Sentaurus TCAD
Frameworks and libraries	Qiskit, QuTip, Tkinter, Numpy, Pandas, Tensorflow, Keras, Scipy, Mpmath, Sympy, Dplyr(R)
Softwares	COMSOL Multiphysics, AutoCAD, MS Office, Git, SolidWorks, InkScape, Anaconda, LaTeX
Web(Basics)	HTML, CSS, Javascript, Flask, Django, Jinja 2, Bootstrap 4, MySQL

KEY COURSES

- Electronics:** Physics of MOS Transistors, Nanoelectronics, Advanced CMOS Logic, Flash Memory Devices, Microprocessors, VLSI Technology, Processor Design, VLSI Design, Testing and Verification of VLSI Circuits, Quantum Information and Computing.
- Programming :** Computer Programming and Utilization, Algorithms Specialization (Coursera), Deep Learning (Coursera)
- Statistics:** First Course in Optimization, Data Analysis and Interpretation, Probability and Random Processes
- Mathematics :** Calculus, Ordinary Differential Equations, Linear Algebra, Partial Differential Equations, Complex Analysis

EXTRACURRICULAR ACTIVITIES AND AWARDS

- Received **Hostel Sports Color** award in **2019-20** for invaluable contribution to the Hostel sports culture (2020)
- Part of the 5-player Hostel Table Tennis team to win the Institute-wide **Table Tennis General Championships** (2020)
- Led the team to **Runners up** position in **Institute Table Tennis League** (2019)
- Finished **3rd** position in Table Tennis and Badminton in **Freshiesta**, an alias for the Institute Freshman open (2018)

REFERENCES

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