

# Abhay Saxena

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## RESEARCH INTERESTS

Ultrafast Terahertz Spectroscopy, Spintronics, Topological Materials, *Ab-initio* methods, and Quantum Computation.

## EDUCATION

### •Indian Institute Of Science Education and Research Kolkata

Aug 2021 – June 2026 (expected)

*BS-MS Dual Degree Program: Physical Sciences (Minor Computational and Data Sciences)*

- CGPA: 7.74 (till semester 8)
- **Relevant Courses:** Advanced Quantum Mechanics ([term paper](#)), Condensed Matter Laboratory, Advanced Optics Laboratory, Quantum Information Processing, Hard and Soft Condensed Matter Physics, Quantum Field Theory, Computational Physics, Linear Algebra I, Programming and Data Structures II, Information Retrieval, Electrical Circuits and Electronics, Artificial Intelligence: Search Methods

### •Navyug Convent School Delhi

2021

Senior Secondary (PCM): **Percentage: 92%** (CBSE)

### •Cambridge School Noida

2019

Matriculation: **Percentage: 96.4%** (CBSE)

## PROJECTS AND EXPERIENCE

### •MS Student, Ultrafast Terahertz Spectroscopy (UFTS) Group

Dec 2024 - Present

Mentor: Dr. Kamaraju Natarajan (Department of Physical Sciences, IISER Kolkata)

[Group Page](#) • [Presentation](#)

- Joined the group for MS Thesis and Research Project (RP-II) Course.
- Experience in ultrafast dynamics of condensed matter systems using femtosecond pump-probe spectroscopy and THz spectroscopy.
- **Recreated** and simulated cyclotron resonance in a high mobility 2DEG with Circular Dichroism using characteristic matrix methods in MATLAB (based on David J. Hilton's work).
- Analysis of multiple reflections in thin films and successfully **improved spectrum resolution** by implementing Transfer Matrix Method.

### •Research Intern – Spintronics & FMR, Quantum NanoDevice Lab

May - Jul 2025

Mentor: Dr. Kuntal Roy (EECS Department, IISER Bhopal)

- Independently designed and **assembled an FMR setup**, integrating CPWs, nanovoltmeter, lock-in amplifier, picoammeter, Schottky diode, spectrum analyzer, and a custom power supply-driven Helmholtz coil and Hall probe system.
- Developed LabVIEW control and acquisition systems for absorption measurements and integrated lab equipment.
- Investigated FMR in CoFeB thin film using lock-in amplifier, direct nanovoltmeter + bias-tee readout, and spectrum analyzer.
- Gained in-depth understanding of spintronic phenomena (GMR, AMR, TMR, SOT, spin pumping, Hall effects and LLG with ST like terms).
- Collaborated closely with Dr. Roy, troubleshooting experimental challenges and learning through iterative trial, error, and documentation.
- Built theoretical understanding of **ST-FMR**.

### •Study of Topological insulators and DFT

May - Jul 2024

Supervisor: Dr. Kuntal Roy (EECS Department, IISER Bhopal)

- Demonstrated deep understanding through rigorous discussions with advisor for the study of topological materials, emphasizing Hall effects, SSH, Kane-Mele model, Majorana Fermion, and graphene properties. Used *Kwant* for analyzing graphene nanoribbons and Quantum ESPRESSO for *ab-initio* calculations of topological insulators.

### •Quantum Computing - Quantum Algorithms in Qiskit

May - Jul 2023 (Remote)

Supervisor: Dr. Kuntal Roy (EECS Department, IISER Bhopal)

[GitHub](#) • [Presentation](#) • [Report](#)

- Title: Efficiency Comparison and implementation of VQE, VQD and p-VQD Algorithms in Qiskit
- Studied in detail about various types of Eigensolvers, Time Evolver (p-VQD) Algorithms and other optimizer and amplifiers and customized implementation of VQE, VQD and p-VQD in *ibmq\_quito*.

### •Coding Project in Django, Nextjs and Javascript

May - Jul 2023

Supervisor: Dr. Dwaipayan Roy (CDS Department, IISER Kolkata)

[Report](#) • [Certificate](#)

- Title: Exploring and Implementing a Robust Crediting Module in Canteen Management System
- Integrating Cashfree and MobiKwik payment gateway system in Students mess credit system using Python and Javascript

## TECHNICAL SKILLS

- **Proficient Programming Languages:** Python, C, MATLAB, JavaScript, Kotlin
- **Tools and Frameworks:** LabVIEW, Quantum Espresso, VESTA, Qiskit, Kwant, SymPy,  $\LaTeX$ , Git, Tensorflow, flutter, Android Studio, Arduino, Blender, Django, React/NextJs, html/css/js

## STUDENT INTERESTS

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- **Academic**
  - **2025:** Workshop on Future of Sensing (OPTICA Student Chapter IISER Kolkata, TCS Research)
  - **Completed Machine learning Foundational Crash Course by Google AI** and implemented Fundamental Quantum support vector machines using kernel tricks in Qiskit
  - **2023:** Volunteered Regular Classroom Teaching for summer vacation at [ek pehel](#)
- **Coding:**
  - **2023:** Completely coded and designed my Personal Website ([link](#)) from scratch
  - **2022:** Kotlin Based YouTube client on android that allows modification to website functionality and background action using GeckoView ([GitHub](#))
  - **2016:** Exercise App for spaced repeated timers and statistics, based on Cordova and updated to Webview([GitHub](#))
  - Arduino Projects: Nokia 5110 display, HC-05 and esp8266 based iot experiments
  - IIT Delhi Rendezvous IOT Workshop for esp WiFi Module
  - Secured top positions in multiple inter-school web design and mathematics competitions.

## ACHIEVEMENTS

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- **Programming and Data Structures Course** Group Project : C Library System - Outstanding Group Assignment Honourable Mention Certificate: Prof. Kripabandhu Ghosh, CDS IISER Kolkata (Nov 2023) - [Certificate](#)
- Qualified **JEE Advanced** 2022 - top 2%
- Zonal topper for SOF **National Cyber Olympiad** Class 9, international rank 57 Class 7