Soumik Sahoo

B. Tech in Engineering Physics
Indian Institute of Technology, Bombay

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Degree/Examination	University	Institute	Year	CPI/%
B. Tech in **Engineering Physics**	IIT Bombay	IIT Bombay	2023-2027	8.72
Higher Secondary **+2**	CHSE, Odisha	Saraswati Vidya Mandir,Neelakanthanagar	2022	89.66%
Secondary **10th**	BSE, Odisha	Saraswati Vidya Mandir,Singhpur	2020	93.5%

- Pursuing an **Honors** degree in the **Department of Physics, IIT Bombay**
- Pursuing a **Minor** degree in **Centre for Machine Intelligence and Data Science, IIT Bombay**

Scholastic Achievements

- Secured a place in the top 1% out of 0.2 million candidates in Joint Entrance Examination Advanced. *(2023)*
- Achieved 99.87 percentile out of 1.2 million candidates in Joint Entrance Examination Mains. *(2023)*

Key Projects

- **Free Fermions in Disguise** *(Aug '25 - Now)*
  Supervisor: Prof. Sumiran Pujari | Department of Physics, IIT Bombay
  - Studied emergent free-fermion behavior in interacting spin chains using Fendley's Free Fermions in Disguise framework and derived mappings between spin and Majorana representations in 1D quantum models.
  - Investigated algebraic structures and symmetries underlying fermionization, connecting Clifford algebras and non-local operators to the emergence of solvable quantum phases.
  - Implemented numerical simulations and algebraic derivations to validate the free-fermion correspondence, visualizing energy spectra, degeneracies, and topological phases arising from non-trivial fermionization schemes.
- **Electronic Transport and Scattering in Conductors** *(Jan '25 - April'25)*
  Supervisor: Prof. Soumya Bera | Department of Physics, IIT Bombay
  - Analyzed scattering effects in conductors by Boltzmann transport equation and relaxation time approximation.
  - Explored electron-phonon and electron-electron interactions, deriving temperature-dependent resistivity.
  - Formulated the momentum relaxation via impurity and Umklapp scattering processes.
- **Non-Equilibrium Green's Function Formalism** | *Computational Physics Project* | *Krittika IITB* *(Dec '24 - Jan '25)*
  - Implemented NEGF formalism to model coherent electron transport in nanoscale systems, achieving accurate I-V predictions, capturing conductance quantization effects, and enhancing quantum device simulations.
  - Integrated Self-Consistent Field, bandstructure analysis, and subband modeling, visualizing key quantum phenomena such as density of states, local density of states, potential profiles, and transmission functions.
  - Formulated matrix-based quantum transport equations for Hamiltonian, solving complex eigenvalue problems using basis function expansions, and iteratively computing electron density and electrostatic potentials.
- **Cosmology and Darkmatter** | *Summer of Science* | *Krittika IITB* *(April '24 - August '24)*
  - Studied the Special Theory of Relativity, covered basics of General Relativity which has essential concepts such as metric tensors, Christoffel symbols, the Riemann curvature tensor, and Einstein's field equations.
  - Analyzed the transition from early cosmic epochs through inflation, the matter-dominated phase, and dark energy-driven expansion, along with the critical factors and key processes influencing this evolutionary timeline.
- **Eclipsing Binaries** | *Krittika Summer Project* | *Krittika IITB* *(April '24 - August '24)*
  - Used the PHOEBE package extensively to determine the DI-Her eclipsing binary system's stellar masses, radii, orbital parameters, and overall system dynamics, while also analyzing light curves and improving data accuracy.
  - Focused intently on stellar temperatures, orbital inclination, eccentricity, and other parameters through iterative fitting and advanced optimization techniques for highly accurate system modeling, predictions, and analysis.
  - Simulated light curve variations and processed extensive data, providing valuable insights into the unique orbital dynamics, physical interactions, and overall stellar evolution of the components in the DI-Her binary system.

Technical Skills

- **Programming & Scripting Languages:** C++, Java, Javascript, Python, HTML, CSS, Blender, Photoshop
- **Libraries:** Scikit-Learn, Matplotlib, Pandas, Numpy, Scipy, Seaborn, Plotly, Tensorflow, Keras, XGBoost, Altair, Pytorch, MATLAB, LaTeX, ReactJS, Phoebe, Bootstrap, Django, LTSpice, Figma
- **Tools:** Arduino, 3-D printing, Lathe, Digital Storage Oscilloscope, Arbitrary Function Generator, DC Power Supply.

Course Projects

- **Orbital Hall Effect (PH 557)** *(Aug'25-Nov'25)*
  Prof. Sayantika Bhowal | Department of Physics, IIT Bombay
  - Investigated the theoretical frameworks of Hall effects **Quantum, Spin, Orbital**, analyzing their underlying topological properties, associated band structures, and the illustrative wheel analogy and current experiments.
  - Delivered a presentation to peers on this fascinating and fundamental topic in the field of modern Spintronics.
- **Orbital behaviour of similar and disimilar objects.:** *(PH 222)* *(Jan'25-April'25)*
  Prof. Pradeep Sarin | Department of Physics, IIT Bombay
  - Designed an interactive physics simulation Ul on TFT LCD using Arduino Mega, and other electrical components.
  - Enabled user-controlled simulations of binary star systems and satellite-planet trajectories by adjusting key parameters like mass ratio, distance, eccentricity, angle, velocity, etc. via intuitive button-based navigation UI.
  - Predicted the path, energy, time period, etc. both analytically and numerically, and got an error of up to 0.02%.
- **Nonlinear Dynamics: Chaotic duffing oscillator:** *(PH 567)* *(Aug'24-Dec'24)*
  Prof. Punit Paramananda | Department of Physics, IIT Bombay
  - Studied papers about Duffing Oscillator and used numerical methods and simulations to explore its behavior from simple harmonic motion to complex chaotic states, which is done just by triggering the initial conditions.
  - Done stability analysis of the Duffing Oscillator's fixed points by linearizing equations and examining eigenvalues.
  - Visualized chaotic behavior using time series, phase diagrams, and Poincaré sections and analyzed similar analogous potential by creating an electrical analog circuit using basic electronics devices.
- **Quantum System Analysis:** *(PH 227)* *(Aug'24-Dec'24)*
  Prof. Alok Shukla and Prof. Sadhana Dash | Department of Physics, IIT Bombay
  - Implemented ML models to predict quantum mechanical properties implementing real physics laws as parameters, achieving MSE of 0.00077 with PINNs compared to RF (0.01295) and XGB (0.03213).
  - Designed Physics-Induced Neural Networks incorporating Schrödinger equation constraints in the loss function, enabling accurate wavefunction predictions that closely matched analytical solutions for quantum SHO.
  - Generated synthetic datasets by numerical solution of Schrödinger equation, developed comparative analysis across multiple models, and demonstrated superior performance of PINN for quantum property prediction.
- **Voice and Song Recognition:** *(DS 203)* *(Aug'24-Dec'24)*
  Prof. Vinay Kulkarni | CMINDS, IIT Bombay
  - Developed a singer and song recognition system by analyzing over 100 MFCC feature files of vocal snippets.
  - Designed and fine-tuned classification models including Support Vector Machines (SVM), K-Nearest Neighbors (KNN), and Random Forest to accurately identify singer names, song titles, and categorize musical styles.

Mentorship and Position of Responsibility

- **Teaching Assistant In Electronics Lab** *(Aug'25 - Now)*
  - I have hands-on experience assisting over 60 Masters students in their foundational Electronics lab.
- **Introduction to Quantum Computing** *(May'25 - july'25)*
  - I have mentored 13 students during SOC on Quantum Informations and Computing for 6 weeks.
- **Activity Associate at NSS IITB** *(jan'24 - April'25)*
  - Designed intuitive UI/UX for NSS website's Flare event, enhancing engagement for 10k+ users, while creating Instagram posters to boost social media presence and audience interaction throughout the year.

Key Courses Undertaken

- **Physics**:Classical Mechanics, Analog and Digital Electronics, Non-Linear Dynamics, Quantum Mechanics I & II, Statistical Mechanics, Electromagnetic Theory, Quantum Information and Computing*, Condensed Matter physics* .
- **Mathematics**: Calculus, Linear Algebra, Differential Equation, Complex Analysis, and Integral transforms.
- **Miscellaneous**: Introduction to Psychology, Introduction to Management, Economics, Computer Utilization and Programming, AI and Data Science, Makerspace, Design thinking and Innovation.

Extracurricular activities

Science Exhibition	– Secured top honors in district-level Vedic math competitions twice.	*(2017-18)*
Social	– Devoted 80+ hours to NSS Green Campus by lots of planting activities in the campus.	*(2023-24)*