# Curriculum Vitae

**Dhairya Kotecha**

## Personal Data


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## About Me

I am a third-year undergraduate student studying Engineering Physics at the Indian Institute of Technology Roorkee, with a strong interest in astrophysics. Through academic coursework and projects, I have built a foundation in astronomy, data analysis, and physical modeling, and gained experience working with both theoretical concepts and real observational data. I am really eager to learn more and deepen my understanding through new opportunities.

## Academic Background

Aug 2023 – May 2027 **B.Tech in Engineering Physics**, Indian Institute of Technology Roorkee
CGPA: 7.162 / 10
Relevant Courses: Computer Programming, Mechanics and Relativity, Thermal & Statistical Physics, Mathematical Methods, Data Science, Quantum Mechanics - I, Mathematical Physics, Applied Optics, Advanced Engineering Mathematics, Fundamentals of AI/ML, Signals and Systems, Nuclear Instrumentation.

## Astrophysics Projects

Aug 2025 – present
**Big Bang Nucleosynthesis and the Lithium Problem**
Supervisor: Prof. Rajdeep Chatterjee, IIT Roorkee
Studied the physical conditions of the early Universe and the nuclear reaction networks governing light-element formation during Big Bang nucleosynthesis. Examined how primordial abundances depend on reaction rates, cross-sections, temperature evolution, and statistical assumptions. Reviewed literature on non-extensive (Tsallis) statistics and their possible role in addressing the primordial lithium discrepancy, gaining insight into the link between nuclear physics and cosmological observations.

Dec 2025 – Jan 2026
**Galaxy Distance Determination Using TRGB Method**
Mentor: Tanishk Mohan & Aryan Kumar (Krittika Club) IIT Bombay
Determined galaxy distances using the Tip of the Red Giant Branch (TRGB) method, employing red giant stars as standard candles at the helium flash. Extracted and processed FITS data from the GROWTH-India Telescope using PSF photometry, identified the TRGB cutoff for the Draco Dwarf Galaxy using an edge-detection technique, studied red giant stellar evolution, and estimated the distance measurements to gain familiarity with extragalactic distance indicators.

Dec 2025
**Galactic H I Observations and Analysis**
Supervisor: Jameer Manur, IUCAA
Studied Galactic neutral hydrogen emission using the 21 cm hyperfine transition. Analyzed power spectra for multiple antenna pointings along the Galactic plane and performed calibration. Analyzed frequency data in brightness temperature with line-of-sight velocity profiles using multi-Gaussian fitting to identify Galactic spiral arms, and derived the Galactic rotation curve, providing evidence for the presence of dark matter.

Sep–Oct 2025
**Period Determination in Multi-Eclipsing Stellar Systems using Lomb–Scargle Method**
Supervisor: Prof. Kaushalya Jhuria, IIT Roorkee
Performed time-series analysis of triple hierarchical multi-eclipsing stellar systems using simulated and real photometric light-curve data. Applied the Lomb–Scargle periodogram to extract orbital periods from irregularly sampled data and examined eclipse properties to infer system parameters from ambiguous results through physical reasoning.

May–Aug 2024
**Analysis of Eclipsing Binaries**
Mentor: Bhavesh Rajpoot, MPIA
Explored the dynamics and classification of binary star systems while learning foundational astronomy concepts such as celestial coordinates, magnitudes, and orbital motion. Used the PHOEBE, Python library to simulate and analyze eclipsing binary light curves, modeling key system parameters and contributed to a collaborative project report under Krittika: The Astronomy Club of IIT Bombay.

## Lab & Instrumentation Experience

2025
**Radio Receiver Characterization (RAWS 2025)**: Measured cable losses and standing-wave patterns, analyzed LNA gain linearity and compression, and estimated system noise temperature using radiometric calibration.

2025
**Superheterodyne Receiver Analysis (RAWS 2025)**: Traced signal flow through a two-stage superheterodyne receiver and verified RF-to-IF-to-baseband frequency conversion, gain, and conversion losses.

2025
**Radio Telescope Beam Characterization (RAWS 2025)**: Determined beam width (FWHM) and pointing offsets of a 4-m single-dish radio telescope using solar cross-scans and Gaussian beam fitting.

## Engineering Projects

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| May–Jun 2024 | Design of Worm Gearbox in SolidWorks: Designed and assembled a worm gearbox using SolidWorks, enhancing 3D CAD proficiency. |
| Mar–May 2024 | 5-DOF Robot Arm with Stereovision: Developed and implemented a robotic arm with Mecanum wheels, fully controlled in MATLAB using stereovision for real-time manipulation. |
| Mar–May 2024 | Design, Manufacturing, and Testing of Cycloidal Gearbox: Designed and fabricated a high-reduction cycloidal gearbox, combining CAD modeling, prototyping, and testing for robotic applications. |
| Aug–Nov 2023 | Obstacle Avoidance Robot: Built a two-wheeled autonomous robot with Arduino control and ultrasonic sensors for obstacle detection and navigation. |

## Skills

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| Programming | Python – Intermediate (NumPy, SciPy, Pandas, Matplotlib, Photutils, scikit-learn, TensorFlow, Qiskit); LaTeX – Intermediate |
| Astronomical Software & Tools | SExtractor, Astropy, PHOEBE, Astroquery |
| Software | MATLAB; SolidWorks |
| Languages | English, Hindi, Marathi, Indian Sign Language |

## Achievements

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| Dec 2025 | First Place (Group), based on Quiz & Presentation performance, RAWS, IUCAA–NCRA. |
| Oct 2025 | Astrophotograph featured in Trinity News article "Behind the Blood Moon". |
| Nov 2023 | Silver Medal, Qiskit Fall Fest: Dead & Alive Hackathon (Fresher's Prompt Track). |

## Workshops, Schools & Training

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| Dec 2025 | **Radio Astronomy Winter School — IUCAA and NCRA-TIFR**<br>Website: https://raws.iucaa.in/RAWS2025/welcome.jsp<br>Ten-day winter school on radio astronomy covering radio telescopes, interferometry, Galactic HI, pulsars, cosmology, and multiwavelength astronomy through lectures, tutorials, and hands-on laboratory sessions, followed by discussions, participant presentations, and a Quiz. The program also included an on-site visit to the Giant Metrewave Radio Telescope (GMRT), providing first-hand exposure to the facility, its large-scale interferometric operations, and cutting-edge radio astronomy instrumentation in active use. |

## Extracurricular Activities

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| Apr 2024–Present | **Joint Secretary — Physics and Astronomy Club - IIT Roorkee**: Led astronomy and astrophotography workshops and night observation sessions for 100+ participants. Coordinated campus events promoting astronomy, physics, and mathematics, along with administrative responsibilities as Joint Secretary. |
| Apr–Aug 2024 | **Member — Robocon - IIT Roorkee**: Contributed to mechanical subsystem design for Mars rover prototypes, gaining hands-on experience in CAD design, prototyping, and testing. |

## References

Prof. Rajdeep Chatterjee, Department of Physics, IIT Roorkee
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