

# Deepak Kapa

deepak\_k1@ph.iitr.ac.in | deepak-kapa.github.io | linkedin.com/in/deepak-kapa-iitr26

May 2026 IITR graduate with a passion for designing robots

## Education

CGPA:  
7.8/10

**BTech in Engineering Physics (Department Rank: 9/76)**, Indian Institute of Technology, Roorkee | India

2022–26

### Relevant Coursework:

MATH & PHYSICS: Mathematics I–II, Optimization Techniques, Numerical Analysis, Mechanics & Relativity, Thermal Physics

CS & ELECTRICAL: Analog & Digital Electronics, Microprocessors, DSA, Electrical Science, Signals & Systems

ROBOTICS & DESIGN: Introduction to Robotics, Kinematics of Mechanisms, Engineering Analysis, Mechanical Engineering Drawing

## Experience

**Robotics Engineer (Mechanical)** | Cenizas Labs | (Hybrid) Chennai, India

Aug 2025 – Present

- Designing and fabricating **workspace-assistive robots** for office and industrial applications.
- Developed a **differential-drive office bot** equipped with multiple actuated shelves for indoor navigation and task handling.
- Designed an **8-DOF carbon fiber robotic arm** powered by **3D-printed cycloidal drives**, achieving an **800 mm reach** and **1.8 kg payload capacity**.

**Research Intern** | CREATE Lab, EPFL | (Remote) Lausanne, Switzerland

March 2025 – Aug 2025

- Designed and modeled a **soft origami-based pipe inspection robot** for autonomous underground duct maintenance.
- Developed a **modular CAD design** featuring compliant arms actuated by three Kresling tubes enclosed within a Yoshimura origami shell, all driven by a **single-motor planetary gear system** enabling navigation in 150 mm pipelines. [Onshape Link]
- Leveraged **embodied intelligence** principles to achieve passive obstacle adaptation and navigation without complex sensing.

**Research Intern** | Plecnik Group, University of Notre Dame | (Remote) Notre Dame, USA

Feb 2025 – Present

- Designed and simulated an **asymmetric 5-bar quadruped mechanism** aimed at improving **power efficiency** during locomotion.
- Developed a detailed **CAD model of an 8-DOF quadruped** and performed **dynamic gait simulations** in **MuJoCo** under position control to evaluate motor power consumption and total cost of transport against traditional 2R configurations.
- Developing an **RL controller** for a 7-bar mechanism quadruped featuring mode switching in **Isaac Sim** under Prof. Mark Plecnik.

**Research Intern** | Stochastic Lab, Indian Institute of Science (IISc) | Bangalore, India

June 2024 – Present

- Working on **optimal gearbox design for QDD actuators** and design co-optimization under Prof. Shishir Kolathaya.
- Developed an **automated actuator and gearbox design framework** in SolidWorks using Python, incorporating efficiency and gear-strength analytics to **optimise actuator selection** for desired torque–velocity. [Framework Repo] [Video]
- Fabricating and characterising optimal metal actuators selected by our theoretical framework.
- Developed a **detailed actuator and link mass model** and integrated it with MuJoCo to build a **three-stage co-design optimisation framework** for a monoped robot using CMA-ES.
- Achieved a **50% reduction in mechanical energy** for a **0.8 m jump**, demonstrating the value of simulation-driven mechanical optimisation. [Video Presentation]

**Research Intern** | Tata Institute of Fundamental Research (NIUS) | Mumbai, India

July 2023 & Dec 2023

- Worked under Prof. Shouvik Chatterjee on **single-crystalline membrane fabrication**.
- Developed methods for crack-free, clean, wrinkle-less **transfer of CVD monolayer graphene**.

**Product Design Intern** | EDNAM Solutions | TIDES, Roorkee, India

Oct 2023 – Feb 2024

- Designed a custom mold for **low-pressure overmolding** of a PCB circuit for EDNAM's wearable product line. [Website]
- Collaborated with industrial manufacturers to produce the mold and initiated small-scale production.

## Publications

**Comparison between External and Internal Single Stage Planetary Gearbox Actuators for Legged Robots** — Aman Singh, Deepak Kapa, Prasham Chedda, Shishir N.Y. Kolathaya, *Advances in Robotics* 2025 (AIR).

**A Co-Design Framework for Energy-Aware Monoped Jumping with Detailed Actuator Modeling** — Aman Singh\*, Aasta Mishra\*, Deepak Kapa, Suryank Joshi, Shishir N.Y. Kolathaya, *IEEE-RAS 24th Int. Conf. on Humanoid Robots*, 2025.

**Pancake 3K Planetary Actuator: A Lightweight, Compact, and Low-Backlash Actuator** — Deepak Kapa, Aman Singh, Shishir N.Y. Kolathaya, *IEEE-RAS 24th Int. Conf. on Humanoid Robots (LBR)*, 2025.

**COMPAct: Computational Optimization and Automated Modular Design of Planetary Actuators** — Deepak Kapa\*, Aman Singh\*, Suryank Joshi, Shishir N.Y. Kolathaya, *Under Review – IEEE Int. Conf. on Robotics and Automation (ICRA)* 2026.

**A Novel Energy Efficient Quadruped with Direct-Drive Five-Bar Leg Architecture** — Deepak Kapa, Aman Singh, Shashank Ramesh, Mark Plecnik, Shishir N.Y. Kolathaya, *Under Review – IEEE Int. Conf. on Robotics and Automation (ICRA)* 2026.

## Selected Projects

**Pancake Planetary Actuator**

Aug 2025 – Present

Bachelor Thesis Project, IIT Roorkee & IISc

- Proposed a **novel configuration** for **Wolfrom and compound planetary actuators** to reduce the **mass and axial width** of the second stage by nearly **50%** with same load capacity and efficiency.
- Validated the design through **steady-state torque analysis** and **kinematic modeling**, and currently **working on patenting it**.
- Engaged in **fabrication and experimental characterization** of the optimized actuator prototypes.

## Lunar Exploration Rover

Nov 2024 - Dec 2024

International Rover Design Challenge, Team Robocon

- Designed a CAD model of a **lunar rover** to investigate the **Shiv Shakti Point**, accompanied by a **tri-leg hopping daughter rover**.
- Incorporated a **zip chain actuator** for **soil collection** at depths of up to **10 feet**, ensuring efficient sample retrieval.
- Implemented a **Hybrid Legged Wheel Drive system** for **extreme terrain traversal**, powered by a **Radioisotope Thermoelectric Generator** and supplemented with a **folding origami solar panel system**.

## Mobile Pipe-Inspection Robot

March 2024 – Oct 2024

Robotics and Control Lab, IIT Roorkee

- Designed and modelled a **mobile pipe-inspection robot** under Prof. P. M. Pathak, capable of motion through bends up to 75°.
- Developed a **four-arm expanding mechanism** driven by a single Maxon motor and bevel-gear transmission, enabling wireless traversal through **300 mm diameter pipes**.
- Conducted **simulations and analytical validation** to verify performance; fabrication via SLS 3D printing and machining.

## Portable Telescopic Agitator

Dec 2023

Mechanical Design Challenge — Solinas, Inter IIT Tech Meet 12.0

- Designed a **CAD model** for a portable telescopic agitator capable of extending from **1 m to 5 m** for mixing solid waste with water to generate pumpable slurry.
- Developed a **lead-screw driven telescopic mechanism**, actuated via a **cycloidal drive** for high torque and compact packaging.
- Engineered a **symmetrically distributed clutching mechanism** with radially expanding arms, **powered by a single high-torque motor**, enabling automatic centering inside the tank.

## Mars Rover Chassis and 5-DOF Robotic Arm

June 2023 – Nov 2023

Robocon, IIT Roorkee

- Designed and manufactured a **height-adjustable Mars rover prototype** using V-extrusions, integrated with a **front differential bar** for consistent four-wheel contact and stability on **slopes up to 40°**.
- Added a **science box** for soil sample analysis (Bradford Test) and integrated a **robotic manipulator** for field testing.
- Developed a **5-DOF robotic arm** made of **carbon fiber**, with **7 kg lifting capacity** and a **semi-differential wrist end-effector**.
- Integrated the arm into the rover and **automated package sorting mechanism** for Flipkart Grid 5.0.

## Skills

**Programming :** Python, Java, Arduino, Matlab, LaTeX, HTML, Quiskit (Quantum Computing)

**Hardware :** 3D printing, VMC, LMC, Carvey

**CAD and CAE :** Solidworks, Fusion 360, Adams, GD&T

## Achievements

- 2025 **HoD's Letter of Appreciation for academic session 2024-25**, IITR
- 2025 **International Rover Challenge 2025 - 10th place**, Space Robotics Society
- 2025 **International Rover Design Challenge 2025 - 4th place**, Space Robotics Society
- 2025 **Hyundai Hope Scholar**, Hyundai Motor India Limited
- 2024 **International Rover Challenge 2024 - 13th place**, Space Robotics Society
- 2023 **Gold Medal, Solinas - Mechanical Product Design Challenge**, Inter IIT Tech 12.0
- 2023 **Flipkart Gridshot 5.0 Robotics PS National Finalists (over 24,000 participants)**, Flipkart Gridshot
- 2023 **NIUS 20 Scholar - One among 40 students across India**, Homi Bhabha Centre for Science Education, TIFR, GOI
- 2023 **Class Topper in First Semester, Upgraded branch from BS-MS Physics to Engineering Physics**, IITR
- 2023 **INSPIRE Scholar**, Inspire Scholarship for Higher Education, Government of India

## Positions of Responsibility

### Mechanical Lead, Team Robocon IITR

May 2024 – July 2025

Led and mentored a team of 50+ students in space robotics competitions, focusing on the design and fabrication of robots and Mars Rover prototypes.

### Teaching Assistant

Fall 2024, Fall 2025

Served as a UGTA for PHC-101 (Introduction to Computational Physics) and TMI-101 (Tinkering and Mentoring); guided students through course material, created tutorial questions, and evaluated submissions.

## References

### Shishir N.Y. Kolathaya

Assistant Professor, RBCCPS & CSA  
Indian Institute of Science (IISc)  
Email: shishirk@iisc.ac.in

### Mayank Goswami

Associate Professor, Physics  
Indian Institute of Technology Roorkee  
Email: mayank.goswami@ph.iitr.ac.in

### Mark Plecnik

Assistant Professor, ME  
University of Notre Dame  
Email: plecnikmark@nd.edu