

# PATHANVESHAN - GRAHGAAMI

Rover Competiton 2024

## TABLE OF CONTENTS

Preamble	3
General Information	3
1. Introduction To Rover Competition 2024	3
2. Problem Statement	3
3. Objectives Of The Challenge	4
4. Outcome Of Student Community	4
5. Schedule Of The Events	4
6. Venue	5
7. Contact Information	5
8. Awards And Recognitions	5
Participating Teams	6
1. Registration	6
2. Team Members	6
3. Team Lead Responsibilities	6
4. Selection Process	6
Phase-I Requirements	7
1. Phase I Task Requirements	7
2. Arena	7
3. Navigation Task	7
4. Sample Picking Task	8
5. Task Duration	9
6. Rover And Manipulator Requirements	9
7. Proposal Report Submission	10
8. Proposal Presentation	11
General Rules And Regulations	11

## **PREAMBLE**

Welcome to the **PATHANVESHAN**, a Rover competition organized by Chandigarh University Astronomy Club. This event is designed to challenge and inspire the brightest minds in computational logic and algorithm development. **PATHANVESHAN** offers a unique platform for students to apply their theoretical knowledge to practical, real-world problems in Boolean satisfiability. Participants will have the opportunity to develop innovative solutions, enhance their problem-solving skills, and engage in interdisciplinary collaboration.

## **GENERAL INFORMATION**

### **1. INTRODUCTION TO ROVER COMPETITION 2024**

The **PATHANVESHAN** 2024, organized by the Chandigarh University Astronomy Club, presents a unique challenge focused on the development of ROVERS for planetary exploration. Participants, primarily Indian students, are tasked with designing rovers capable of withstanding Martian terrain conditions and conducting meteorological observations. This competition aims to foster innovation, interdisciplinary collaboration, and practical application of engineering and computational skills in a simulated extra-terrestrial setting. Through rigorous selection and evaluation processes, teams compete to demonstrate their ROVERS' functionality, robustness, and ability to meet stringent mission requirements, enhancing their understanding of aerospace engineering and positioning themselves for future career opportunities in space exploration.

### **2. PROBLEM STATEMENT**

Design, build, and program an autonomous rover to navigate a Mars-like course, perform scientific tasks, and overcome obstacles. Judged on technical performance, innovation, scientific accuracy, autonomy, and presentation. Teams must follow specific rules, document their process, and present their findings. The competition spans the design, development, and final evaluation phases.

### 3. OBJECTIVES OF THE CHALLENGE

- To provide a standardized platform for exploring the area of space robotics.
- To develop a deeper understanding of space robotics and its applications among the student community.

### 4. OUTCOME OF STUDENT COMMUNITY

- Apply the concepts of science, engineering, and mathematics to identify, formulate, and resolve difficult engineering issues.
- Utilize engineering design to create solutions that satisfy predetermined requirements.

### 5. SCHEDULE OF THE EVENTS

This challenge is a breakthrough event with continuous evaluation till the completion of the field event. This section provides the list of milestones the participating teams will approach during the **GrahGaami 2024**. The timeline with important dates is as follows:

#	Description	Date
1.	Launch of the Event	1st June 2024
2.	Last date of team registration and Document Submission (Phase-I) Online	31st August 2024
3.	Last date of proposal draft (Phase-I) Ideathon online	31st August 2024
4.	Results of (Phase-I) announcement (A maximum of 30 teams will be selected)	4th September 2024
5.	Submission of Design report by selected teams	10th September 2024
6.	Selection of Final teams based on design report	12th September 2024
7.	Final Field Round (Phase-II) Offline	4th & 5th October

**NOTE 1:** Organizers reserve the right to change the dates depending on the exigency of the situation.

**NOTE 2:** All deadlines are at 11:30 PM (IST) on the respective dates.

**NOTE 3:** Organizers reserve the right to refine the task details of the challenge as we progress.

## 6. VENUE

The final onsite competition to perform the required tasks is planned to be conducted in the Chandigarh University Punjab Campus in October 2024. For information about the **GrahGaami** 2024 competition venue, please follow our updates on the website.

## 7. CONTACT INFORMATION

Website Address: <https://cuac.in/>

Email Address for teams Communication: [cuacindia@gmail.com](mailto:cuacindia@gmail.com)

## 8. AWARDS AND RECOGNITIONS

The jury's assessment and the teams' fair play attitude will determine which of the first three teams receives awards. Two consolation awards are also scheduled to be awarded. The following are the proposed cash and institute trophy awards:

1st Place - 1,00,00/-

2nd Place - 75,000/-

3rd Place - 50,000/-

## PARTICIPATING TEAMS

### 1. REGISTRATION

All teams must complete the registration process on the website. The registration procedure includes:

1. Team login account creation.
2. Fill out the team details and download the auto-generated registration form.
3. Upload duly signed auto-generated form.
4. Upload proposal file in .pdf format (Max. pages:20 and Max. file size: 10 MB) and presentation (Max. slides:15 and Max. file size: 5 MB).

**NOTE:** Registration shall be deemed to be completed only after uploading as per steps 3 and 4.

## **2. TEAM MEMBERS**

1. The competition is open to students of Indian origin studying in educational institutions located in India.
2. Multiple teams shall participate in the event from an Institute.
3. The team consists of students pursuing diploma/graduation/research.
4. The team must consist of 6 students from the same Institute.
5. The maximum age of any student member shall be 25 years.
6. The team must be mentored by a faculty from the same Institute.
7. The team may have an additional mentor from the Industry.

## **3. TEAM LEAD RESPONSIBILITIES**

1. One person should be designated as the team lead in each group.
2. Only the team lead will receive communications from the organizers, and any questions or requests for clarification should only be made using the team lead's registered email address.
3. Email addresses other than the registered email ID will not receive a response. We'll classify these emails as spam.

## **4. SELECTION PROCESS**

The selection is a two-step process wherein, in Phase I a maximum of 30 teams will be selected from initially registered teams based on the evaluation of proposals. From the Design report, a maximum of 10 teams will be selected for the Phase II Field Round based on the evaluation of the design and demonstration of the prototype. The decision of the organizers in this regard will be final and binding.

## **PHASE-I REQUIREMENTS**

### **1. PHASE I TASK REQUIREMENTS**

The rover and its onboard instruments that support the reconnaissance tasks need to survey the surroundings. Gathering surface soil samples from Luna and bringing them back to Earth for additional examination is another primary objective. These presumptive mission objectives form the basis of the challenge model.

## 2. ARENA

- a) Size of the arena: 5m X 10 m.
- b) Filling material of arena: M-Sand
- c) Sloped terrain: A sloped terrain with an inclination of  $15^\circ$  and inclined length of 2 m filled with M-sand and distributed with obstacles and craters.
- d) Obstacles: Cubes of sides 150 and 300 mm. The obstacles will be made from wood and planted firmly in the Arena. The rover traversal over them will not disturb their position.
- e) Craters: Craters are created by scooping out sand from the arena. These craters will be approximately hemispheres with diameters of 200 and 400 mm.
- f) Boundaries of the arena will be marked distinctly.

## 3. NAVIGATION TASK

The group must create a design that demonstrates how the rover can navigate waypoints in both controlled and autonomous modes. The following questions from the navigation challenge must be the basis for creating the requirements for the rover design:

- a) Using sensors to identify obstacles: The obstacles are 100 mm X 100 mm X 100 mm and 200 mm X 200 mm X 200 mm. The sensors are used to determine the obstacles' dimensions.
- b) Obstacle avoidance/traversal via mobility system: The rover needs to be able to go around obstacles measuring 100 mm X 100 mm X 100 mm while avoiding obstacles measuring 200 mm X 200 mm X 200 mm.
- c) Crater identification with sensors: 120 mm and 220 mm diameters are used to construct spherically shaped craters. The purpose of the sensors is to determine the crater sizes.
- d) Avoidance/traversal of craters by mobility system: The rover should be able to go across 120 mm-sized craters while avoiding those with a 220 mm diameter.

While it is not required for the Prelims and Quals, it is beneficial to have irregular shape detection built into the obstacle and crater recognition algorithms.

## 4. SAMPLE PICKING TASK

The sample pick and place task needs to be accomplished by a manipulator arm mounted on the chassis.

Target identification using visual sensors: The sample target of the following details needs to be identified successfully before picking it up. Details of sample collection tube:

**Mass: ~ 90 gm**

**Shape: Hollow Cylinder with closed ends**

**Size: OD 40 mm, ID 30 mm, L 90 mm (Approx.)**

**Material: 3D Printed ABS**

**Colour: Red**

- Picking and loading on the rover chassis: A gripper must be used to remove the sample tube from the surface. The sample must then be firmly mounted on the rover before the mobility is initiated.
- Identifying the target location: At the target location, there is a cylindrical container with a 100 mm diameter and 100 mm height that needs to be identified.
- Unloading and placement: load the sample into the cylindrical container when the rover approaches the target.
- Last Parking: The rover must be positioned within a 1000 mm-diameter circle from the last site after dropping the sample.

## 5. TASK DURATION

The total time available to execute both tasks by the rover and manipulator arm is **30 min.**

## 6. ROVER AND MANIPULATOR REQUIREMENTS

- Requirements: Every rover needs to meet the requirements listed in the table below.
- The teams must indicate in the proposal report how well the suggested manipulator and rover adhere to the requirements.
- The rover must be a movable, stand-alone device that can function in non-GPS environments. During operation, the rover should not be linked to external power and data sources.

#	Rover	
1.	Type	Wheeled/Leeged
2.	End-to-End Dimension (Rover Alone)	<0.6 x 0.6 x 0.5
3.	Mass (with manipulator arm)	<15kg
4.	Slope climbing capacity	12 degrees
5.	Power source	Battery operated only
6.	Communication	RF radio mode only
7.	Gravity	Under Earth's gravity
	Manipulator	
1.	Type	Serial/Parallel
2.	Payload Mass	90g



- The battery must have a minimum capacity to ensure that it won't need to be changed or charged in between navigation tasks.
- The rovers that can do the objective in the shortest amount of time and with the least amount of mass, power, and overall size will have an additional advantage during the evaluation process.
- It is strictly forbidden to use prefabricated robotics kits.
- Every rover needs to have a "kill switch" that is always accessible and visible on the outside of the vehicle. In an emergency, this switch has to cut off the rover's movement and remove all battery power.
- Groups must construct their rovers. Using COTS (Commercial-Off-The-Shelf) components is advised for teams.
- The rover's minimum speed must be at least one centimeter per second. The rover's top speed must be less than or equal to 50 cm/s.
- The team should have real-time radio control over the rover. Radio communication with the rover must be set up to operate on frequencies and power levels that are permitted by law. It is anticipated that there will be less than 15 meters as the maximum separation between the rover and the antenna mast.
- The team will specify the kind of manipulator arm and degrees of freedom.
- Care should be taken when handling and gripping the sample tube to prevent damage.
- The rover should be stable during the operation of the rover or manipulator arm. The instability of the rover while operating would lead to negative scoring.
- The rover and manipulator should be built to handle challenging terrain with appropriate dust. The operational temperature range shall be between +20 and +40 °C.

## **7. PROPOSAL REPORT SUBMISSION**

Every enrolled team needs to send in a proposal. The submission should include an introduction to the team and a justification for the team's project being selected for the GrahGaami 2024. To support its selection based on the initial draft of the suggested solution, the team's experience and technical know-how might be demonstrated. It ought to attest to the team's having read, considered, and comprehended the job specifications.

Download the proposal report template and adhere to the instructions in the attached paper. The document must be uploaded to the website (maximum 10 MB).

## 8. PROPOSAL PRESENTATION

Upon finishing the registration process, a presentation describing the idea must be created and posted on the website. The presentation's format is up to the team to decide. A maximum of 15 slides are allowed. There is a 5 MB maximum file size limit.

## GENERAL RULES AND REGULATIONS

- When moving through obstacles, the rover needs to be stable. Should the rover fall or topple, the team will not be allowed to participate in any more parts.
- It is strictly forbidden for any team member to physically interact with the rover after it has begun to move.
- The rover can be instructed to transition between autonomous and controlled modes, or vice versa. Other commands are not permitted.
- Path planning cannot use hard-coded coordinates for the sample drop and final parking locations. The sample should be placed in the container with the proper orientation after Rover has identified which one it is.
- It is not allowed to control the rover with joysticks or a human-in-the-loop.
- It should be mentioned that the rover operation is scheduled to take place throughout

## 9. CONTACT FOR FURTHER QUERIES

If you have any further queries or require clarification regarding the **PATHANVESHAN 2024 @GrahGaami**, please feel free to reach out to the organizers using the following contact information:

Email: - [cuacindia@gmail.com](mailto:cuacindia@gmail.com)

Phone: -9820023642

We encourage you to visit the competition website regularly for updates, frequently asked questions, and any additional information regarding the challenge.