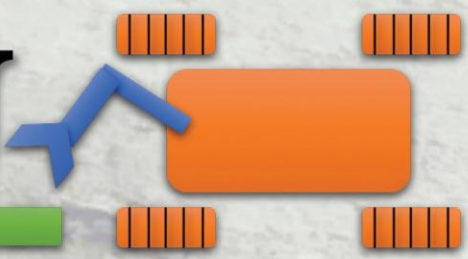


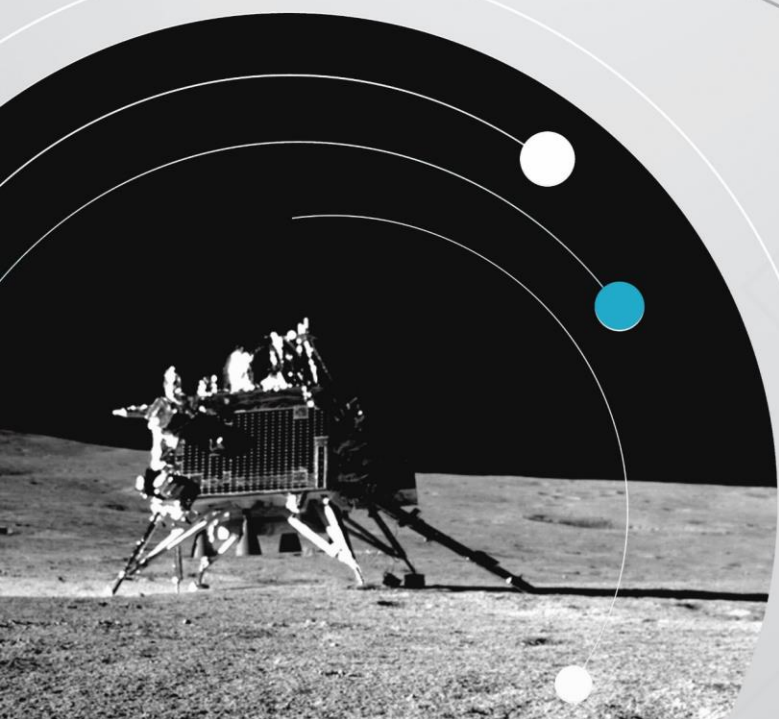
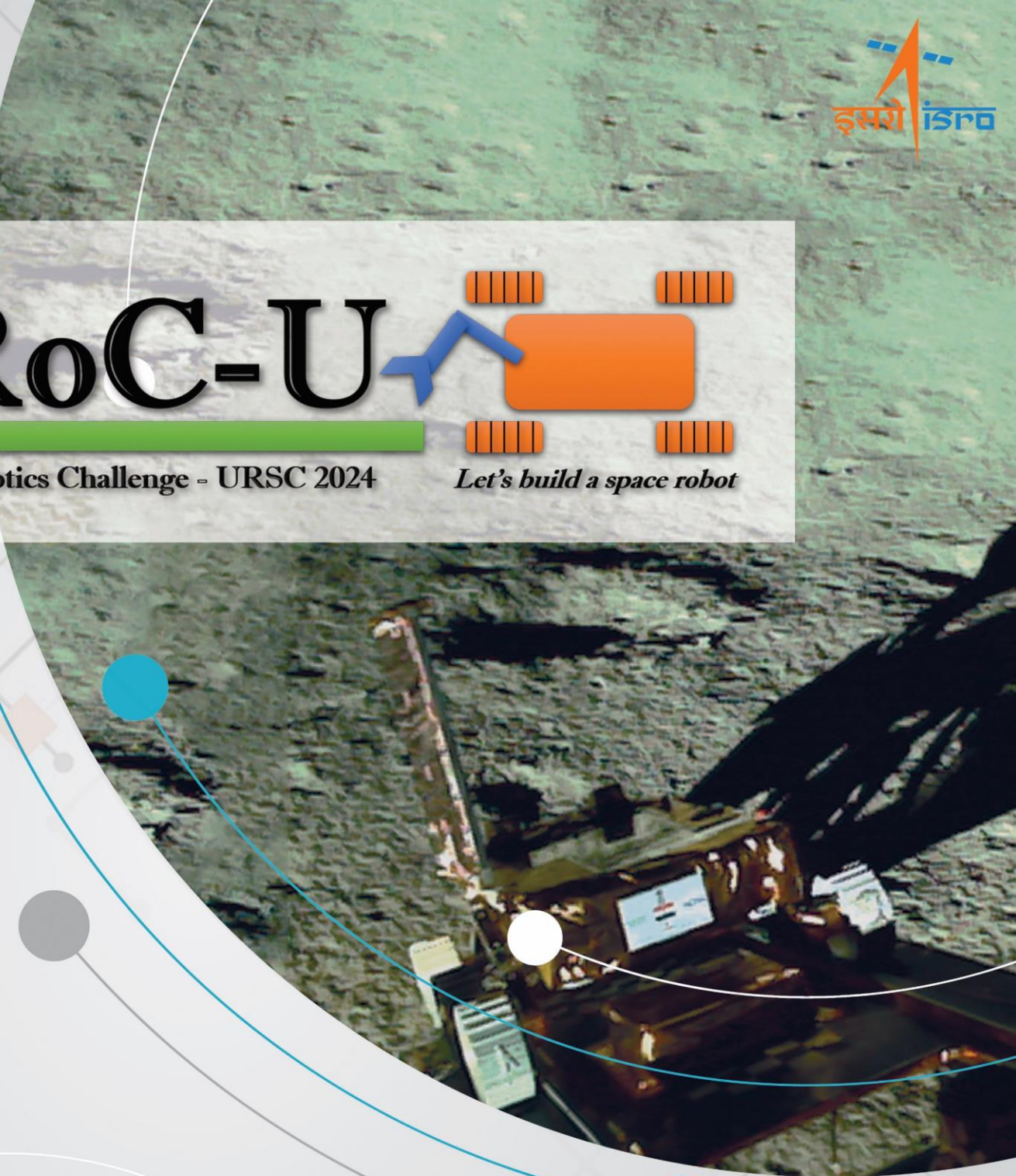


IRoC-U



ISRO Robotics Challenge - URSC 2024

Let's build a space robot



PRELIMS RULE BOOK V1.2

December 2023

U R Rao Satellite Centre

Prelims Rule Book

V 1.2

08.12.2023

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Version Updates

Version	Section	Date
V 1.0	Original Document	08.11.2023
V 1.1	Section 3.2 updated	09.11.2023
V 1.2	Section 2.4 Schedule Section 2.9 IPR New Section 2.10 Section 3.2 Section 3.3 Section 4	08.12.2023

1. PREAMBLE

Indian Space Research Organisation (ISRO) successfully landed Chandrayaan-3 Vikram on lunar surface and Pragyan explored near to the southern pole of Moon. Post this accomplishment, it is time to look at future robotic exploration missions to Moon and other planetary bodies. It has been a constant endeavour at ISRO that, we create unique opportunities for academia & industry to participate in the technology developmental activities commensurate with organisational objectives. In line with these objectives, U R Rao Satellite Centre (URSC) solicits from the youth of India, innovative ideas and designs of robotic rovers for future missions through the conduct of ‘ISRO Robotics Challenge, URSC-2024’. This is an invitation for student community for design and realisation of a ‘Wheeled/Legged Rover’ encompassing the development of complete hardware and software. Details of the same are provided herewith. The objective here is to provide development opportunities in space robotics to the participating entities and to leverage the creative thinking among the youth of our Nation for ISRO interplanetary missions. It is also expected to play an important role in augmenting ISRO’s activities in space exploration.

All interested are encouraged to participate in this challenging competition and join hands with ISRO, towards the advancement of space science & technology in the country.

2. GENERAL INFORMATION

2.1. Introduction to IRoC-U 2024

ISRO is foraying into the development of state-of-the-art Space Robotics, Artificial Intelligence and Machine Learning technologies. The technologies are being developed to meet the futuristic mission needs of ISRO viz., ISRO In-orbit Servicer Mission, Lunar sample return mission, Docking in Space (SPADEX), Mars Lander Mission etc. This is conceived as a natural next step in this direction, when ISRO’s Chandrayaan-3 mission accomplished landing and surface exploration using an indigenous Lander and Rover.

In order to provide a greater opportunity for the students of the country to provide innovative solutions in the area of space robotics, it is planned to organise “ISRO Robotics Challenge-URSC 2024 (IRoC-U 2024)” with a tagline of “Let’s build a space robot”. The solutions provided by the students in IRoC-U 2024 have the greater chances of getting incorporated into ISRO’s future interplanetary robotics missions.

IRoC-U 2024 consists of an engineering project where the Institutional teams build robots to compete on an extra-terrestrial inspired arena, performing tasks based on the real life challenges faced by space robotics. IRoC-U is being planned as a platform for co-development of technologies in the area of space robotics through organising challenges.

2.2. Objectives of the Challenge

- a. To provide a standardised platform for exploring the area of space robotics.
- b. To develop a deeper understanding of space robotics and its applications among student community. It enhances their communication, collaboration, inquiry, problem solving and flexibility skills that will benefit them in their academic and professional lives.

- c. To co-develop (students and ISRO) future technologies needed in the area of space robotics.

2.3. Outcome for Student Community

- a. Identify, formulate, and solve complex engineering problems by applying principles of mathematics, science and engineering.
- b. Apply engineering design to produce solutions that meet specified needs.
- c. Communicate effectively.
- d. Collaborate with a team, provide inclusive leadership, establish goals, plan tasks, and meet objectives.
- e. Formulate and conduct appropriate experiments, analyse and interpret test and analytical data and use engineering judgment to draw conclusions.

2.4. Schedule of the Events

This challenge is a milestone-based 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 IRoC-U 2024. The timeline with important dates are as follows:

#	Description	Date
1.	Announcement of the challenge	08.11.2023
2.	Submission of registration form along with proposal	20.11.2023 to 15.01.2024
3.	Announcement of Selection of teams for Quals (Maximum 50 teams will be selected)	30.01.2024
4.	Submission of Design Report (DR) by selected teams	01.03.2024
5.	Feedback on DR by organisers	15.03.2024
6.	Demo of prototype by selected teams	15.05.2024 to 19.05.2024
7.	Selection of teams for Field Round (Maximum 10 teams will be selected)	25.05.2024
8.	Release of task particulars for Field Round	01.06.2024
9.	Operation Readiness Review and feedback	01.07.2024 to 06.07.2024
10.	Team Preparation Day	04.08.2024
11.	ISRO Robotics Challenge Day	05.08.2024 and 06.08.2024
12.	Awards Ceremony on National Space Day	23.08.2024

Note 1: Organisers reserve the right to change the dates depending on exigency of situation.

Note 2: All deadlines are at 8.30 PM (IST) on the respective dates.

Note 3: Organisers reserve the right to refine the task details of the challenge as we progress.

2.5. Venue

The final onsite competition to perform the required tasks is planned to be conducted in URSC Bengaluru Campus in the Month of August 2024. For information about the IRoC-U 2024 competition venue, please follow our updates on website.

2.6. Contact Information

Website address: <https://www.ursc.gov.in/IRoC-U2024>

Email address for Teams: irocu2024@ursc.gov.in

2.7. Awards and Recognitions

The first three teams will be awarded based on the evaluation by jury and fair play attitude of teams. Additionally, two consolation prizes are also planned. The awards in the form of cash and institute trophy are planned as follows:

1st place	Rs 5.0 Lakhs along with Institute trophy
2nd place	Rs 3.0 Lakhs along with Institute trophy
3rd place	Rs 2.0 Lakhs along with Institute trophy
Two consolation prizes	Rs 1.0 Lakh each along with Institute trophy

The teams qualifying for the Field Round and participating on challenge day will be awarded with an appreciation certificate to each of the team members and mentors.

The teams qualifying for the Quals and who have submitted the design report will be awarded with participation certificate to each of the team members and mentors. No certificates will be given to the teams who fail to submit the design report by the specified timeline.

First three Prize winning rovers (viz., places 1st, 2nd and 3rd) will get commemorative sticker placed on it by the organisers for each place.

2.8. Financial Assistance

Each team qualifying for the Field Round and participating on the challenge day will be provided with financial assistance of Rs 2.0 Lakhs.

2.9. Intellectual Property Rights

Intellectual properties (IPs) generated by the team qualifying for the Field Round during the IRoC-U 2024 challenge shall be sole property of URSC-ISRO. These teams shall enter into non-disclosure agreement with URSC-ISRO.

The rover design arrived by the teams qualifying for the Field round shall not be used by the teams in any other competition without the written consent of the organisers.

2.10. Qualls Model Funding

The organisers shall not provide funding in any form to the teams participating in Qualls Round. However, there is no restrictions on the teams obtaining private funding. The teams may carry a logo of size 10 cm x 15 cm of funding agency during Qualls round only.

3. PARTICIPATING TEAMS

3.1. Registration

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

1. Team login account creation.
2. Filling out the team details and download auto-generated registration form.
3. Upload duly signed auto-generated form.
4. Upload proposal file in .pdf format (Max. pages:30 and Max. file size: 10 MB) and presentation (Max. slides:15 and Max. file size: 5 MB).

NOTE: Registration shall deem to be completed only after uploading as per step 3 and 4.

3.2. Team Members

- The competition is open for students of Indian origin studying in educational institutions located in India.
- Only one team shall participate in the event from an Institute.
- The team to consist of students pursuing diploma/graduation/post-graduation/research.
- Team must consist of 10 students from the same Institute.
- The maximum age of any student member shall be 30 years as on 23rd August 2023.
- Team must be mentored by a faculty from the same Institute.
- Team may have an additional mentor from Industry.

3.3. Team Lead Responsibilities

- Each team should identify one member as team lead.
- Any communication from the organisers will be sent to only team lead and any query/clarification should also be raised only using the team lead's registered email id.
- No response will be provided to the email addresses other than that of the registered email id. These emails will be considered as spam.

3.4. Selection Process

The selection is a two-step process wherein, in the Prelims a maximum of 50 teams will be selected from initial registered teams based on the evaluation of proposals.

From the Qualls, a maximum of 10 teams will be selected for the Field Round based on the evaluation of design and demonstration of prototype. The decision of the organisers in this regard will be final and binding.

- **Prelims Requirement:** Registration and Submission of Proposal Report and presentation.
- **Quals Requirement:** Submission of Design Report and Demonstration of Prototype operation on the specified arena (Details shall be provided).
- **Field Round Requirement:** The final onsite competition to perform the required tasks is planned to be conducted at URSC Bengaluru (Details shall be provided).

The present document outlines rules for the Prelims. The rules for the Quals and Field Round shall be uploaded.

4. PRELIMS REQUIREMENTS

4.1. Prelims Task Requirements

One of ISRO's future goals is to collect sample from a location and deliver it to the lander for sample return mission. The area has to be examined by the rover and its on-board instruments that support the reconnaissance activities. Another main goal is to collect surface samples of the Lunar soil and return to Earth for further analysis. The challenge is modelled based on these assumed mission goals.

4.2. Arena

Refer Arena and Task Details V1.0 document (download from the website)

- a) Size of the arena: 5m X 10 m.
- b) Filling material of arena: M-Sand
- c) Sloped terrain: A sloped terrain with inclination of 15° 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 diameter 200 and 400 mm.
- f) Boundaries of the arena will be marked distinctly.

4.3. Navigation Task:

Refer Arena and Task Details V1.0 document (download from the website)

The team is required to design for demonstration of performance of the rover waypoint navigation in commanded and autonomous mode. The requirements for the rover design need to be generated based on the following asks of the navigation task:

- a) Obstacle identification using sensors: The obstacles given are 150 mm X 150 mm X 150 mm and 300 mm X 300 mm X 300 mm. The sensors serve to identify the dimension of the obstacles.
- b) Obstacle avoidance/traversal by mobility system: The rover must be capable of traversing over 150 mm X 150 mm X 150 mm obstacles avoiding the 300 mm X 300 mm X 300 mm obstacles.

- c) Crater identification using sensors: The craters of spherical shape are created of diameters 200 mm and 400 mm. The sensors serve to identify the dimension of the craters.
- d) Crater avoidance/traversal by mobility system: The rover must be capable of traversing through craters of diameter 200 mm avoiding the 400 mm diameter craters.

Note: It is desirable to design the obstacle and crater identification algorithms to detect irregular shapes but not mandatory for the Prelims and Quals.

4.4. Sample Picking Task:

Refer Arena and Task Details V1.0 document (download from the website)

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

- a) Target identification using visual sensors: The sample target of following details needs to be identified successfully before picking it up.

Details of sample collection tube:

- Mass: ~ 200 gm
 - Shape: Hollow Cylinder with closed ends
 - Size: OD 80 mm, ID 70 mm, L 125 mm (Approx.)
 - Material: 3D Printed ABS
 - Colour: Red
- b) Picking and loading on the rover chassis: The sample tube needs to be picked up from the surface using a gripper. The sample then needs to be placed securely on the rover before starting the mobility.
 - c) Target location identification: A cylindrical container of diameter 150 mm and height 150 mm placed at the target location needs to be identified.
 - d) Unloading and placement: The rover to approach target, unload the sample inside the cylindrical container.
 - e) Final Parking: After dropping the sample the rover has to be positioned within a circle of diameter 1500 mm from final point.

4.5. Task Duration:

Total time available to execute both tasks by the rover and manipulator arm is 40 min.

4.6. Rover and Manipulator Requirements

- a) Specifications: Each rover must be compliant with the specifications provided in Table-1 below.
- b) The teams need to specify in the proposal report the compliance of the proposed rover and manipulator with respect to the specifications.
- c) The rover has to be a standalone, mobile platform capable of working in non-GPS environment. The rover should not be connected with cables to external data and power sources during its operation.

- d) The use of satellite-based navigation systems, external markers, or local positioning systems is strictly prohibited. This rule emphasizes the need for participants to rely solely on the rover's on-board sensors and programming for navigation, mirroring the challenges faced by an actual planetary rover on distant celestial body where traditional Earth-based navigation aids are unavailable.

Table 1: Rover and Manipulator Specifications

Rover		
1	Type	Wheeled/Legged
2	End to End Dimension (Rover Alone) Length X Breadth X Height	< 1 m X 1 m X 0.8 m
3	Mass (Rover with Manipulator arm)	< 50 kg
4	Slope climbing capability	Minimum 15°
5	Obstacle climbing capability on slope	Minimum 150 mm
6	Power Source	Battery operated only
7	Communication	RF radiation mode only
8	Soil Type for mobility	M sand
9	Gravity	Under Earth's Gravity
Manipulator		
10	Type	Serial/Parallel
11	Payload Mass	200 gm

- e) The battery capacity has to be at least enough so that there is no need to change/charge the battery in between ongoing navigation task.
- f) The rovers having minimum mass, power, overall size and ability to complete the task within minimum time will have an added advantage in evaluation process.
- g) Use of readymade robotics kits is strictly prohibited.
- h) All rovers must be equipped with a “kill switch” placed on the rover’s exterior, accessible and visible at all times. This switch must cease any movement by the rover and withdraw all power draw from batteries in case of an emergency.
- i) Teams are required to build their own rover. Teams are recommended to use COTS (Commercial-Off-The-Shelf) components.
- j) The minimum speed of the rover to be equal to or greater than 1 cm/s. The maximum speed of the rover to be less than or equal to 50 cm/s.
- k) The Team should be able to control the rover via a radio link in real-time. Radio communication with the rover shall be designed for use of legally available frequencies and power levels. It is expected that the maximum distance between the rover and the antenna mast would be less than 25 m.
- l) The type of manipulator arm and degrees of freedom to be specified by the team.
- m) The sample tube should not be damaged while gripping and handling.
- n) The rover should be stable during the operation of rover or manipulator arm. The instability of rover while operation would lead to negative scoring.
- o) 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.

4.7. Proposal Report Submission

Each registered team must submit proposal. The proposal should introduce the team and provide explanation as to why the project presented by the team should be chosen for the IRoC-U 2024. The technical expertise as well as the experience of the team may be showcased to justify its selection based on the first draft of the proposed solution. It should confirm that the team has read, analysed and understood the task requirements.

Download the proposal report format and follow the guidelines provided in the document. The document (max 10 MB) needs to be uploaded on the website.

4.8. Proposal Presentation

A presentation summarising the proposal needs to be prepared and uploaded on the website to complete the registration. The team can choose the format of the presentation. There can be a maximum of 15 slides. The maximum file size is limited to 5 MB.

4.9. Scoring Criteria

#	Evaluated Parameter	Max. Score	Description of evaluated parameter
1	System Architecture	10	<ul style="list-style-type: none">• Illustration of the system architecture through a diagram.• Identification of interfaces among different sub-systems.• Inclusion of all essential sub-systems required in the system architecture.
2	Roving Mechanism	10	<ul style="list-style-type: none">• Schematic representation of the roving mechanism.• Comprehensive understanding of the chosen mechanism.• Explanation for selecting the proposed mechanism.
3	Mechanism for Sample Pick-and-Place Activity	5	<ul style="list-style-type: none">• Schematic representation of the chosen mechanism.• Thorough understanding of the selected mechanism.• Justification for selecting the proposed mechanism.
4	Emergency Response System	5	<ul style="list-style-type: none">• Identification of emergency situations.• Description of the Response System.
5	Hardware Identification	10	<ul style="list-style-type: none">• Sub-system-wise list of all required hardware for realizing the overall system.• Justification for selecting the type of hardware.• Estimated Bill of Material (BoM) for the system.
6	Software Identification	10	<ul style="list-style-type: none">• Identification of software requirements for operating the realized system.

			<ul style="list-style-type: none"> Algorithm selection for various computation tasks.
7	Hardware and Software Realization Plan	10	<ul style="list-style-type: none"> Categorization of identified hardware into various sources of realization. Specifications for purchased hardware. Realization plans for fabricated hardware. Implementation strategies for software.
8	Test Plan	10	<ul style="list-style-type: none"> Identification of required tests. Test plans for all identified tests.
9	System Specifications	5	<ul style="list-style-type: none"> Generate table of specification for the proposed system
10	Project Management	5	<ul style="list-style-type: none"> Identification of responsibilities among team members with a system breakdown structure. Strategy for schedule management. Cost estimation.
11	Novelty in the overall proposal	10	<ul style="list-style-type: none"> Originality in terms of system design, hardware/software selection, etc.
12	Any Other Relevant Information	0	<ul style="list-style-type: none"> Teams can include any additional information deemed necessary in the proposal.
13	Presentation	10	<ul style="list-style-type: none"> Presentation file
14	Non-compliant Documentation Format	-20 as penalty	<ul style="list-style-type: none"> Example of non-compliance: Small font or margin Exceeding the report length Plagiarism exceeding 40%
Total		100	Maximum Score

Annexure: General Rules and Regulations

The ISRO Robotics Challenge, URSC – 2024, referred to as ‘IRoC-U 2024’ is owned, coordinated, operated and judged by U R Rao Satellite Centre, Bengaluru. By taking part in the IRoC-U 2024, teams agree to place a promotional sticker on their rover (max. size of the sticker: 10 cm X 10 cm).

A1. Organisers’ Disclaimer

Teams SHALL take full responsibility for any damages, accidents or unsettling events caused by their hardware/software as well as for the members of the team. Teams are obliged to follow all safety and good conduct rules specified by the organisers. Any breach of safety rules and requirements will result in the disqualification of the team from the entire competition.

A2. Changes to the Competition Rules

The organisers retain the right to effect any essential / inevitable changes to the competition rules. However, any changes introduced shall not impact the overall design of rover. All changes will be announced in advance and updated on the website.

A3. Deadline Extension

The organisers retain the right to extend the deadline for submission of documents. All deadline extensions will be announced in advance and details will be updated on the website.

A4. FAQ

The query raised by the teams will be updated on FAQ section of the website. Queries to any challenge related questions that arise should be mailed to contact mail ID from team lead’s email ID with subject line FAQ. Teams are requested to check FAQ section before raising the query.

A5. Challenge Scoring Issues

All issues with scoring during the challenge will be resolved solely by the independent jury. Teams cannot appeal to any other party.

A6. Organisational Issues

Organisational issues, including team eligibility, conduct of challenge and execution of jury decisions will be resolved by the organisers.

A7. General Challenge Issues

In case any conflict related to the challenge is encountered, the organisers’ decision will be considered as final and binding.

A8. Disqualification

The organisers may disqualify a team in the event of a serious breach of the rules, safety regulations or fair play and organisers' decision shall be considered as final and binding. Teams cannot appeal to any other party including social media platforms.

A9. Cancellation of Event

The organisers reserve the right to cancel the IRoC-U 2024 finals in the event of circumstances preventing its safe organisation. In case of event cancellation, the organisers will decide on the alternative approach and present it to the Teams affected by the decision.

A10. Organisers' Responsibility

The organisers' civil liability is limited solely to the responsibility for organising a mass event in accordance with the local law and local regulations.

A11. Copyright of the challenge

The organisers retain all copyright to the competition rules, logo, tagline and the description of the tasks. No alterations or additions to the competition rules can be made and their sale is expressly forbidden. The rules can only be used or copied for the IRoC-U 2024 connected activities (e.g. registration process).

A12. Personal Data Storage

Team members agree to their personal data, the documentation delivered as well as other promotional materials and visuals being stored and processed in the organiser's computer systems for the purpose of the IRoC-U 2024 programme.

On the other hand, the organiser will keep all technical documentation confidential and will not publish or disclose it to any third parties without prior approval from the team's representatives. The sole exception to this is the challenge's jury team – technical documentation will be disclosed to judges for scoring and mentoring purposes only.

The team members also give the organiser, parties designated by the organiser and the audience, the right to disclose and publish any photos, videos or other visuals, their names and surnames, identifiable pictures of themselves and any other persons, as well as pictures of machines, devices and equipment in any and all of the available formats, by any and every known method, in any and every known medium.

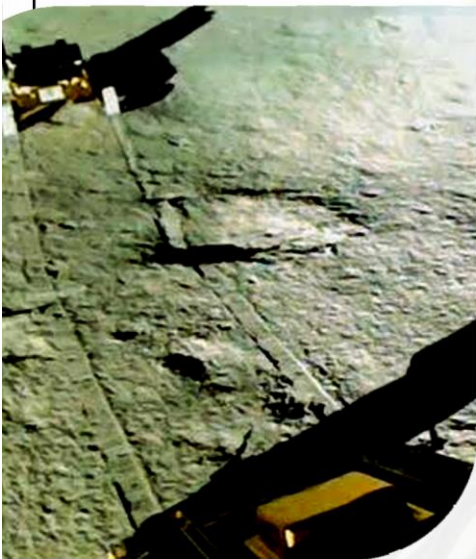
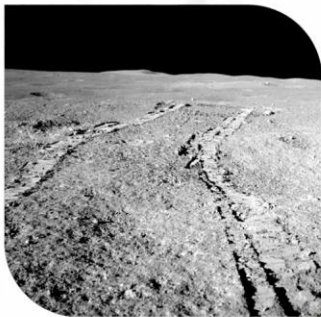
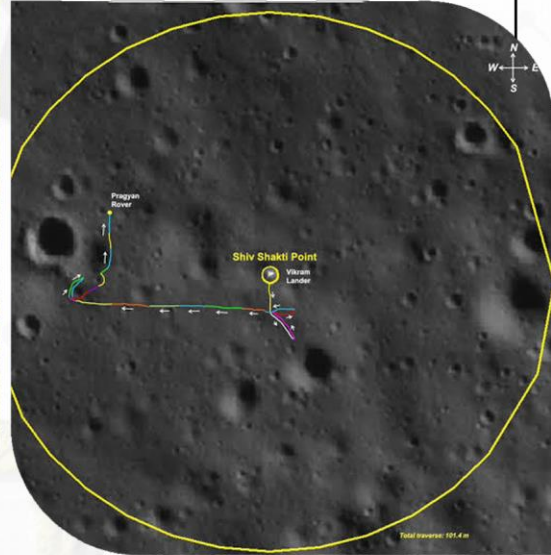
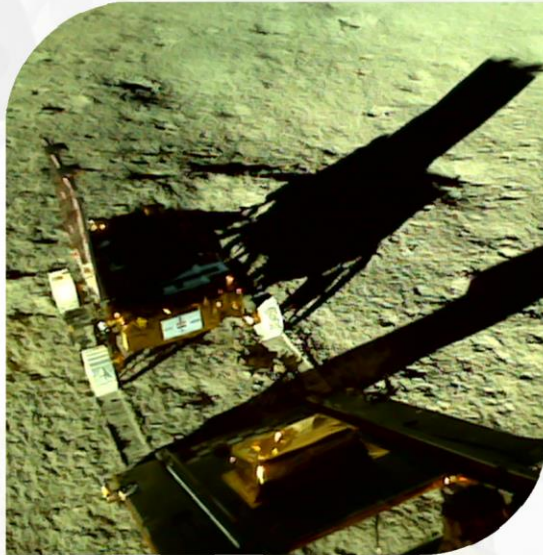
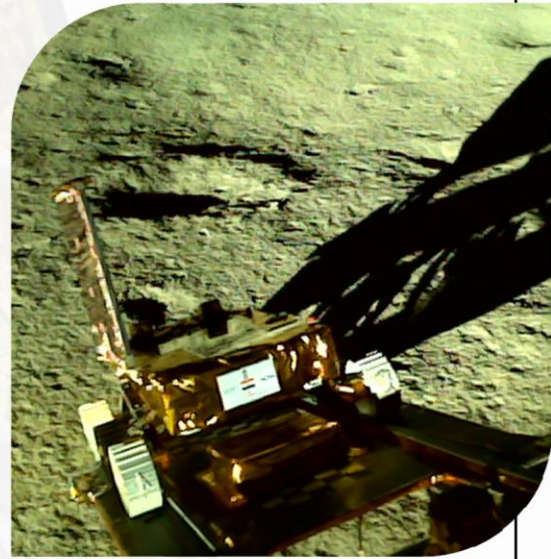
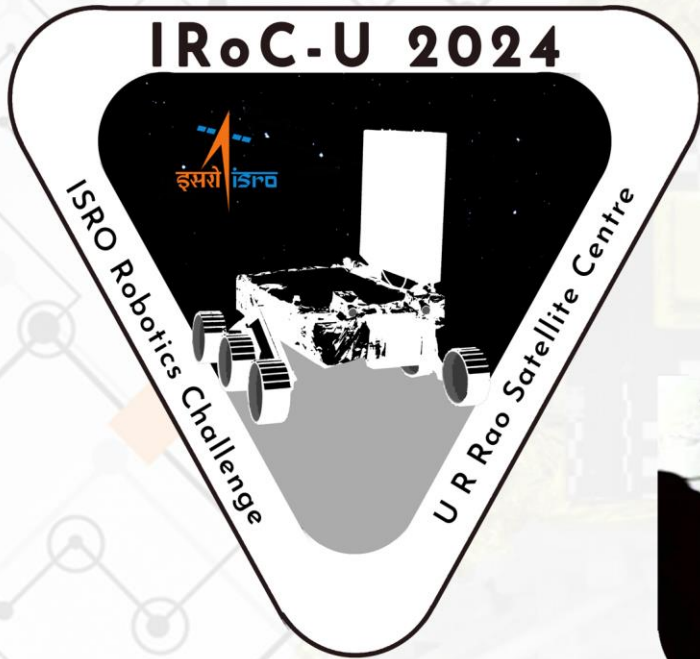
Teams grant permission to the organiser to use promotional materials and visuals (e.g. photos and videos), as well as any additional photos, videos, portraits, documents, interviews and other materials resulting from participation in the challenge (using the name of the participant or not) on all media, in any language, anywhere in the world, in any manner, for advertising and promotional purposes.

A13. Miscellaneous

- Individuals or teams may be excluded from participation at the discretion of URSC/ISRO for unauthorized behaviour, including but not limited to (i) impersonating

a URSC/ISRO official whether intentionally or in a manner that results in confusion, (ii) misuse of the logos or identifiers of URSC/ISRO, any sponsoring organisation, or any infringement of a commercial logo or trademark, (iii) failure to abide by competition rules, directives or instructions from the competition host or organisers, and (iv) asserting or implying a URSC/ISRO affiliation or sponsorship where none exists.

- URSC/ISRO does not host pre-competitions or competitions conducted by any organisation other than URSC. This URSC competition is neither affiliated with, nor sponsors or endorses any Rover Challenge competition other than the IRoC-U 2024. Outside competitions have no bearing on the IRoC-U 2024 qualification or registration process, and representation to the contrary is strictly prohibited. No competition may imply any affiliation with URSC/ISRO or use the URSC/ISRO logo without permission of URSC/ISRO Headquarters. Any assertions made by organisations that represent themselves as “URSC/ISRO”, “Official URSC/ISRO Rover Ambassador”, “URSC/ISRO Judge”, or any similar titles suggesting a tie to URSC/ISRO are unauthorized. Representations or suggestions that any organisation or individual can assure teams of being accepted for registration or participation in the challenge are unauthorized. All requirements for participation in the IRoC-U 2024 are outlined in this rules book.
- Participant hereby waives any claims against URSC/ISRO, its employees, its related entities, (including, but not limited to, contractors and subcontractors at any tier, grantees, investigators, volunteers, customers, users, and their contractors and subcontractors, at any tier) and employees of URSC/ISRO’s related entities for any injury, death, or property damage/loss arising from or related to the IRoC-U 2024, whether such injury, death, or property damage/loss arises through negligence or otherwise, except in the case of wilful misconduct. Any team member or advisor found to be exhibiting unsportsmanlike conduct may be disqualified from the challenge individually or as a team. All scoring decisions are final. If an appeal is warranted, the advisor or the team leader shall submit the appeal in writing for consideration to the Activity Lead within 30 minutes of the posting of score(s) in question. The final decision of the Activity Lead and Head Judges shall prevail.
- Students on the team will do 100% of the project, including design, construction of their vehicle and task components (including performing work that is supported by a professional machinist for the purpose of training or safety), written reports, presentations, and competition preparation. Any team found in violation of this will be disqualified. Excessive use of past work will result in disqualification, but teams may use vehicles designed in 2020-2023.
- Teams not meeting any requirement listed may be disqualified.



Reach us at:
www.ursc.gov.in/IRoC-U2024

U R Rao Satellite Centre
Vimanapura Post, Bengaluru