International Planetary Aerial Systems Challenge 2021

Requirements and Guidelines

Mars Society South Asia's International Planetary Aerial Systems Challenge (IPAS Challenge) 2021 challenges the students to design an astronaut-assistive Unmanned Aerial Vehicle (UAV), which shall be fully equipped and mission ready for **Operation on Mars.** Teams are supposed to carefully plan each subsystem of the UAV considering various atmospheric parameters in design (Exceptions, if any, shall be mentioned in the EDR). This competition is designed for students to explore their mind and spark the innovative design thinking of individuals without putting any constraints on available physical resources. Students are encouraged to be as Imaginative, Creative and Insightful as possible within practical implementable limits for the Human Race.

General Guidelines:

The IPAS Challenge has the primary objective of designing a UAV that can perform certain Functions and Tasks to assist astronauts and carry out certain analyses of terrain while airborne on the Red Planet. The IPAS Challenge is an entirely off-site competition, and no physical inception of designs is mandated to the teams. Graduate and Under-graduate students are allowed to participate.

The Registration Window for the IPAS Challenge 2021 is 10th to 20th March 2021, and the Engineering Design Report (EDR) submission deadline is 5th May 2021.

The stated guidelines are intended to give the teams a direction and outline for their designs. The scenarios and specifics not mentioned in the UAV capabilities guidelines and UAV Subsystems can be treated as "Open to Interpretation". Teams are allowed to make certain assumptions in such scenarios while providing proper justification for them. This step is taken to promote imagination and creativity in the teams, rather than being bound by a higher number of constraints. It is also stated that there is no "Right Answer" in this competition. We are expecting to see a gamut of approaches and strategies from teams.
The results of the competition will be judged only on the merit of the Engineering Design Report. There are no further rounds.
MSSA reserves the right to use and reproduce the information submitted by teams in the competition for Non-Profit Research and Promotional purposes through any of its media channels while citing the team's contribution.

Any issues not covered by these published rule sets will be addressed on a case-by-case basis by the IPAS Judging Panel on contact@southasia.marssociety.org. And any such issues raised by teams shall be posted on the IPAS section of the MSSA website(https://southasia.marssociety.org).

The registration details and form will be available under the IPAS section at https://southasia.marssociety.org.

Engineering Design Report (EDR):

The Teams must formulate an Engineering Design Report (EDR) of their UAVs pertaining to the given mandatory parameters in this document. The EDR will be judged based on:
1. Compliance of UAVs to the given parameters and effectiveness on mentioned tasks.
2. Depth of extra-terrestrial and atmospheric conditions and parameters considered in systems.
3. The depth of justification and reasoning provided in the EDR on each design decision.
4. The Innovation and Imaginativeness of the Design.
5. System Sophistication.

Page 1 of the Engineering Design Report should bear the Team Logo, Institution Logo, Mars Society South Asia (MSSA) Logo, Team Name, Team Lead Name and Contact. Document Margins should be 2.54cm from each side. Font Sizes should range between(11pt-16pt) in the document, used appropriately for Headings, Sub-Headings, Text and Annotations. Font should be uniform across the entire Report. All Images should be Annotated. The teams are given the freedom to use any structural format for the EDR they deem most optimum for expressing their designs.
The Teams are required to include 1 Orthographic/Isometric Image of the Entire UAV on Page 2, labelling the primary systems of the UAV, with system descriptions not exceeding 10 words per system. A higher Number of Illustrations, Images, CAD Models, Flowcharts, System Calculations and Representative Figures are encouraged.
Teams must compulsorily cite any published material that they may use to develop their design at the end of the EDR in an Appendix section.
The Engineering Design Report shall not exceed a total of 26 Pages (Excluding appendix). Content exceeding FIRST 26 pages will not be evaluated.

UAV Capabilities:

The UAV is expected to be controlled from a base station on Mars and have autonomous capabilities. The UAV is not expected to travel further than a 5 km radius from the base station. The UAV should be capable of travelling over varying Martian terrain of different altitude known to humans to date.

The UAV should have sufficient power or generate capabilities to sustain a total continuous mission time of 10min per flight. The UAV is expected to travel during the day with clear weather conditions. Although, systems should be able to physically withstand any weather condition on the field, including temperature extremes, any time of the year.

The UAV should have 360-degree vision capabilities to view its surroundings during flight.

The UAV should also have cameras and sensors that provide necessary data back to the base station for further analysis.

The UAV should be designed while keeping modularity and the ease of serviceability of systems in mind to enable Astronauts to carry out repairs.

UAV Subsystem Guidelines:

Teams are encouraged to design the maximum proportion of the UAV indigenously. Teams are, however, allowed to use readily available products/parts in the market. In such cases, the reasoning and component selection will be judged rather than the actual design of such market-ready components.

1. Mechanical Design- All the mechanical systems, including but not limited to wings, motors, drive/actuation mechanisms, science module, should be readily operable on Mars.

2. Electronics Design- The Focus is to Design and Conceptualize a reliable Electronics System. The Judges understand that the on-board electronics are mainly Silicon Based on Earth, which may not function properly on Mars. Teams may treat this as an exception and are NOT required to look at material (Semiconductor Level) aspects of electronic components. All other parameters are to be considered for Martian operation. The system should be able to supplement the mechanical operations and will be judged on the system design's reliability and efficiency.

3. Coding System- Teams are expected to explain the architectures and algorithms used in the UAV for each primary system, including Autonomous Operation. Full Codes are not to be included in the EDR.

4. Science Package- All Martian parameters are to be considered, including the various soil patterns on Mars presently known to Humans.

Competition Tasks:

All tasks are independent and are to meant to be carried out one-by-one. The UAV can use multiple attachments for different tasks depending on required payloads.

1. Reconnaissance Mission – The UAV is required to capture a digital orthophoto using photogrammetric methods of a piece of land on Mars, measuring at least 300 square metres.
2. Logistics Mission – The UAV must be capable of picking up and delivering a package weighing 100gms from the base station to another delivery station. The package has to be in the form of a cube of at-least 15x15x15cm. UAV has to pick up/drop the package using its abilities, without human interference. Teams may put any external features on the package to help it attach to the UAV.
3. Atmospheric Analysis Mission– The UAV must be capable of collecting data of the relative abundance of various gases (CO_2, N_2, AR, O_2 etc.) present in the Martian atmosphere, relative humidity and temperature at any given co-ordinate.

Teams must design UAVs capable of completing all the tasks mentioned above to explain their approaches to each of them.