
UNAM
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PEU
PROGRAMA ESPACIAL UNIVERSITARIO
MUNDIAL
2025
CANCUN

SPACE MISSION GUIDE

WORLD CONTEST

CANSAT

2024 - 2025

University Space Program (Programa Espacial Universitario)

Coordinator:	José Francisco Valdés
Mission chief:	Alejandro Farah
PEU´s team for the CanSat:	Juan Antonio Sánchez
	Guadalupe Solís
	Fernando Ángeles
	Francisco Moisés García Hernández
	Gustavo Jiménez Montoya
	Ana Carolina Keiman Freire
	Karla Berónica López Padilla

Students/Advisors:

Lucero Cardoso, Cecilia Leyva, David Tejeda, Ericka Calderón, German Zamora, Jennifer Solís, Luz Rodríguez, Natalia Jiménez, Nirvana Galicia, Saúl Martín.

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1. MISSION INTRODUCTION

The International Space Agency (ISA) has now successfully synthesized the nutrients needed to grow trees on Mars, thanks to the established facilities in the *Hanami Greenhouse*. In the early 2040s, the ISA launched two space probes, the EcoMaru-1 and the EcoMaru-2, alongside a landing module on board EcoMaru-2. The first self-sustaining greenhouse design onboard EcoMaru-2 wasn't suited to manage the dust accumulation due to the massive Martian dust storms. On the other hand, EcoMaru-2 was also hit by a landslide, which affected its solar panels. Furthermore, the landslide tore apart the greenhouse's outer shell. It took one month for the EcoMaru-1 to lose communication with the EcoMaru-2 and the mission control centre on Earth. Two years ago, the EcoMaru-3 was launched. The mission was successful, and the rover on board built the primary structure of the Hanami, Mars' first greenhouse.

Mars' afforestation projects came from the hydroponics developed on board the International Space Station. As they saw positive results from growing plants in zero-gravity environments, as well as within an artificial climate, the international program to green Mars was approved. Three probes, the *Akai-Kasei*, *Ao-Kasei*, and the *Midori-Kasei*, landed on the Utopia Planitia Crater back in 2030, this milestone triggered the development of Mars intended technology. The probes investigated the Red Planet for 8 years, and the viability to perform botanic research was ascertained.

More than a decade after the probe's arrival, in 2040, the Ryomen probe sent Mars' soil samples back to Earth. Back home, in the ISA's space laboratory, Astrobiologist Flores, integrated the hydroponic space farming technique to the substrate, and she succeeded growing acacia and pine trees.

A group of scientists observes a hologram of the Utopia Planitia Crater in a conference room. Fuentes, the agronomist engineer said: with our nutrient surveillance system and DSc. Flores hydroponic space farming technique, we can start the tree's propagation.

We need a light satellite, but strong enough to deliver seeds and water, said DSc. Zenin, as she pointed out a diagram on the screen. DSc. Rivera was thrilled, and she asked when the ISA will send out the acceptance letters to mission Akai-Sakura.

Three more days, said Professor Satoru, as he leaned forward. Let's not forget the landing system, the load must remain intact, and the rover must reach the exact place that is needed.

DSc. Riviera nodded, as she was pleased with the team she had brought together. The Forestation of Mars, can you imagine? She sighed. Everybody had a decided look in their eyes, because they knew that if they received the Akai-Sakura invitations, one of the most difficult challenges in their careers would be in front of them.

> “Thursday, November 26th, 2047
> Dear Colleagues
>
> Congratulations! It is our pleasure to welcome you to the Akai-Sakura Mission. You have met all the requisites needed in the call for application. This mission’s objective is to green the Utopia Planitia, coordinates 46,7°N 117,5°E. The *Utopia Planitia* is one of the biggest impact basins on Mars, so far. The *Akai-Sakura* satellite will launch in July 2049. In the coming twenty months, you will go through every mission stage. The crew is meant to be on Mars’ orbit in 2051. And the descent will take place late that year.
>
> The satellite that you will build will carry two useful loads. One of them has the instrumentation, a quantum computer, the landing module, and two cameras. The other one will transport three types of seeds and fifty litters of water.
>
> We will be waiting for you on December 8th, 2047, in the main headquarters for the first stage.
>
> General Management of the International Space Agency"

DSc. Riviera read with a shaky voice. "We'll finally reach Mars!" She thought. All other crew members could not believe what she was saying, and each one had to read the letter again. They were official members of the Akai-Sakura Mission.

The time to start the mission was there, and the details were given in the Mission Guide that was handed to each of them. Starting the Terraforming Mars Project was just months ahead, and the scientist’s excitement couldn’t be hidden.

2. BACKGROUND

A Canned Satellite, or CanSat, is a simulation of a real satellite, confined within the shape and volume of a can. The main use of a CanSat is that of an educational tool, so that the participants can become familiar with the development of space missions.

In the *CanSat World Cup 2025*, the challenge lies in designing and assembling every subsystem together. Some examples of a satellite subsystem are the power system, the electronics, sensors, mechanical structure, and the telemetries. All of these must fit within the parameters established by the University Space Program.

In this cup, the CanSat will be dropped off by a drone. The crucial part of the competition is to carry out a scientific experiment and to create a safe landing. The students are responsible for meeting all objectives and success criteria by using a special methodology for the project development and implementation; in this way, the students will develop a device which, alongside its ground station, is going to be designed to accomplish the mission through its launch and the analysed data provided by its sensors.

The University's Space Program (PEU, in Spanish) hosts this cup with the intention of bringing the students a once in a lifetime chance to obtain practical experience in a project in which they can test their space technology knowledge.

During the last 10 years, the PEU has established the CanSat Cup as the standard, at a national and international level, so that every student interested in space can have the experience of a mission with real objectives.

3. CALL ON FOR THE WORLD CUP

The University's Space Program of the National Autonomous University of Mexico (UNAM) calls for all universities and higher educational institutions in the world, to be a part of the CanSat World Cup, according to the following:

1. Each team must be made up of **at least four students, and a maximum of seven,** and each team may consist of a maximum of two postgraduate students.

2. Each student must be enrolled in an institution that is officially recognized by their country's education authorities.

3. Each student may only be a part of just one team in the cup.

4. Each team must register one academic advisor. They must be an academic who belongs to the same institution to which 50% or more of the team is enrolled to, and they must commit to give the team the appropriate technical advisory.

5. Each advisor may only register up to two teams.

6. The team registry to participate in the cup will start on **October 2nd, 2024**, at 23:59:59 hrs. in Mexico City's time zone (GMT-6) until Friday, **November 22nd, 2024.**

7. To participate, you need to fill up a **register form**, you can find this in the PEU's official website: peu.unam.mx.

8. The maximum number of teams is **limited.**

9. Teams must be aware of penalty reasons.

4. MISSION OBJECTIVES

- To simulate a real space mission in which all participants go through each stage, with the end goal of having the educational process and the experience of going through a space mission.

- The CanSat must transmit information about the pressure, temperature, speed, acceleration, and carbon dioxide levels throughout the lift up and free fall.

- The CanSat must hold, and guarantee landing safety of a chicken's egg (weighing roughly 60 +/- 10 grams), REPSA's endemic seeds contained in a maximum volume of 10 cm^3, and 125 ml of water in a container.

5. CANSAT REQUIREMENTS

- The electric energy in the CanSat must come from a 9 Volt square battery. No other type of battery is allowed.

- The CanSat must measure the carbon dioxide throughout the lift up and free fall.

- The Satellite must sense and transmit to the terrestrial station the pressure, temperature, speed, acceleration, and carbon dioxide throughout all its mission, from launch and until 30 seconds after it has landed.

- The CanSat design must hold the chicken's egg, the seeds, and the water inside in less than 30 minutes, before the launch, on the competition's day.

- All electronics, such as the telecommunication antenna, must be contained within the satellite's structure.

- The band's width for transmitting data may be assigned by each team. In case of conflicting interference, the organizers may ask you to change frequencies.

- The CanSat must include an on/off switch in order to avoid the battery from draining during the wait for the drone to lift it. This switch may be placed on

any of the outside structure of the satellite, as long as it still meets the specified requirements.

6. CANSAT SPECIFICATIONS

- The shape and dimensions of the CanSat must be those of two units of a standard CubeSat (See Figure 1).

- The mechanical structure to support the satellite must be made of wood or any material agglomerated from wood.

- The outside area of the structure must be continuous. The outside shell of the structure may have protrusions of maximum one centimetre, without exceeding the maximum dimensions of the outside shell.

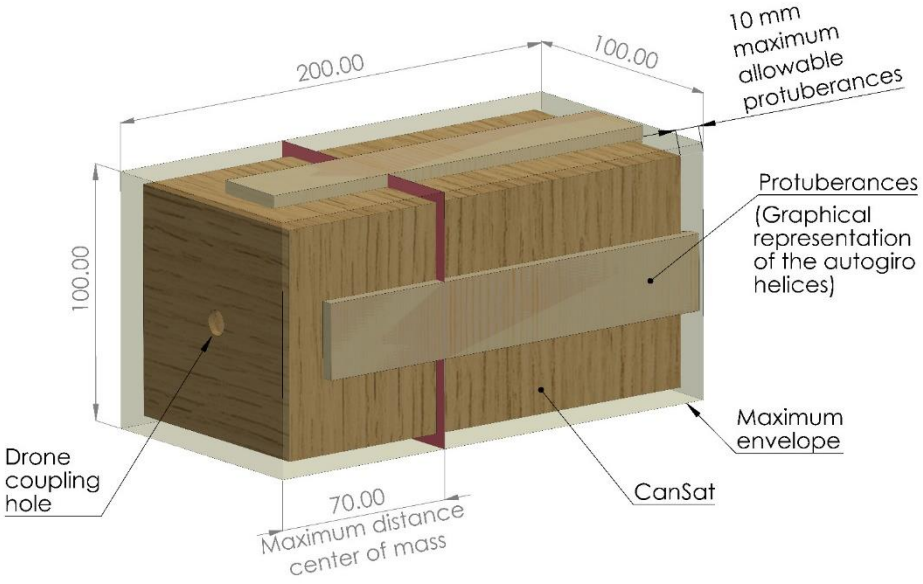

Figure 1. CanSat's maximum dimensions and outside Shell of the structure in 2025.

- It cannot have dangerous or explosive components.

- The satellite must keep transmitting, at least for 30 seconds after the landing.

- The autogyro system must be contained inside the shell, it may have protrusions of maximum one centimetre measured from the external surfaces of the CanSat structural support. This autogyro must activate at 200 meters high, above the ground in which it is lifted up (See Figure 1).

- The chicken's egg, the seeds, and the water container must survive the impact of the landing without breaking or spilling. Each team is responsible for including the container for the water inside the CanSat.

- One chicken's egg, the seeds, and 125 millilitres of water will be supplied the launch day by the Organizers. The egg's weight should be considered as 60 +/- 10 grams. These elements must be given back after the satellite's landing, and the Jury will review its physical integrity.

- The total maximum weight must be under 700 grams. This includes all of the satellite's components, the chicken's egg, the seeds, and the 125 millilitres of water.

- The CanSat's centre of mass must be located within a maximum of 7 cm away from the hole in which the support structure will hold the CanSat. The autogyro system must be placed on the opposing side of the support structure hole (see Figure 1).

- The CanSat may not contain any liquid or fluid that cannot hold its own shape. Except for the air inside the CanSat and the 125 milliliters supplied by the PEU.

- Every satellite's launch will take place on the same latitude and longitude coordinates, at a height of 300 to 400 meters above ground level, on the launch site.

- The CanSat may descend with the help of an autogyro, this will guide it to the least possible distance of a target with a diameter of 3 meters. The auto-gyro system must make it so that the descending velocity is less than 18 meters per second before landing. This system may not be assisted by any type of electro mechanism or motor, except for the guidance system.

- The CanSat may include a camera to guide the descending path to the target on ground level.

- The hole in which the support structure will hold the CanSat must have a diameter of 9 to 10 mm. The inner face of this surface must be separated from any other CanSat internal component by at least 1 cm of free space. This hole will be used to attach the CanSat to the flying drone, that means that the cover must be robust enough to carry the CanSat in its entirety. The attaching device will be provided by the Organizers.

7. CANSAT COMPONENTS

Here is the guideline to the components that may constitute the CanSat. These must be complied by every team, as part of the cup's rules.

- The mechanical subsystem has no other design restrictions except those written in the CanSat Requirements and Specifications.
- The flight computer may have any type of architecture (Arduino, PIC, Teensy, Raspberry Pi, etc).
- Any type of communication module is allowed for telemetry purposes. In order to avoid any signal interference between different teams, this module and the frequency used must be described in the design documents. Please bear in mind that the organizers may ask you to use a different frequency on launch day.
- One of the recommendations is to use the IMU GY-80 sensor. Nevertheless, the use of any other type of sensors is allowed, according to the rules in this mission guide.

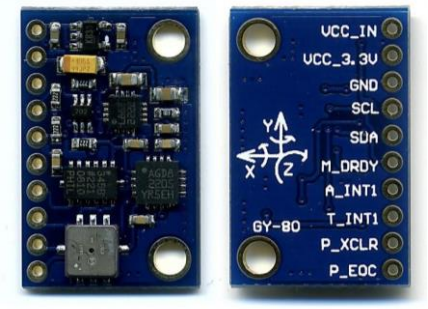

Figure 2. Sensor IMU GY-80.

- Please note that the only batteries allowed are the 9 volts square type, and the electric current in milliamperes is not restricted.
- The use of voltage regulators and electronic components (both passive and active) is allowed.

8. GENERAL REQUIREMENTS

- On launch day, team leaders will be the ones to attach the CanSat to the drone. The other teammates must remain on the ground station, operating it and monitoring the received data.
- The CanSat must only transmit information.
- The maximum amount of money that each team may spend is USD $600.00. The invested sum must be reported in the document detailing the results and mission analysis. (RAM, in Spanish)
- The ground station must be designed according to the student's criteria. During the launch, each team will be assigned a specific space to receive the data transmitted from the CanSat. The judges will verify the data reception in real time.
- Once the satellite lands, the team leader must pick up their satellite and give it to the jury so that they can vary its physical integrity, as well as the survival of its crew member, the seeds, and the water.
- Each team must send the required documents throughout the different stages in a timely manner.

9. COURSE-CUP STAGES

The course-cup is divided into 5 stages. In each of them, the participants will take theoretical and practical modules to help them develop the CanSat.

Throughout these stages, participants will be required to hand in assignments that will be reviewed and evaluated by the CanSat team at UNAM. According to the result obtained in the evaluation process, organizers will determine which teams will move forward to the next stages of the contest. The stages during development are:

ENROLLMENT

Start date: October 2nd, 2024.

Each teams' enrolment must be carried out by completing the online form from the PEU'S website: http://peu.unam.mx

The information needed is:

- Each teams' member registry (personal information and about the institution in which they belong).
    - The name used for the registry will be the one that appears in the certificate of participation; participants should check that the information provided is correct.
- Advisor's registry (personal information and about the institution in which they belong)
    - The name used for the registry will be the one that appears in the certificate of participation; participants should check that the information provided is correct.

- Distribution of work areas.

To fill out the form it is necessary that you use a gmail account. We recommend creating one for each team.

Once you complete the registration process, you will receive an email with access to the online platform where you'll find the theoretical units of the course.

Enrolment deadline:
Friday November 22nd, 2024
23:59:59 h, México City time.

STAGE-01: Conceptual Design Review (CoDR)

Start date: December 2nd, 2024.

On Stage-01 each team will develop the conceptual proposal of the different systems that make up the CanSat, including the concepts for protecting the on-board elements.

The template corresponding to this assignment, along with all the information to fill out can be found on the digital platform.

To be graded, participants must complete it and uploaded with the name:

PEU-MC-2024-CoDR-TEAM.pdf

The deadline to upload this file is on:
Friday, January 10th, 2025
23:59:59 h, México City time.

STAGE-02: Preliminar Design Review (PDR)

Start date: January 20th, 2025.

On Stage-02, each team will develop the preliminary design for their satellite. This means they must explain their idea and make diagrams, calculations, and programs to achieve the CanSat's mission objectives.

To be graded, the team must fill and upload the corresponding template in the digital platform with the name:

PEU-MC-2025-PDR-TEAM.pdf

The deadline to upload this file is on:
Friday, February 21st, 2025
23:59:59 h, México City time.

STAGE-03: Critical Design Review (CDR)

Start date: March 3rd, 2025.

On Stage-03, each team will describe in at most 10 pages, everything concerning the design, calculations, system integration and expected performance of the CanSat.

To be graded, the team must fill and upload the corresponding template in the digital platform with the name:

PEU-MC-2025-CDR-TEAM.pdf

The deadline to upload this file is on:
Friday, April 4ht, 2025
23:59:59 h, México City time.

STAGE-04: Operational test

On stage-04, the teams must prove that the artifact can transmit data at a minimum distance of 250 meters and that it meets the specifications and requirements mentioned on this Mission Guide.

These demonstrations must be recorded in a video of maximum 2:30 minutes where the team must show the objectives detailed on the “evaluation criteria” section. The video presentation will be made in a remote way in the schedule assigned to the teams that have qualified to this stage.

Date for the acceptance trials:
The week from April 14th to April 24th, 2025
Contest organizers will assign the specific time and date.

STAGE-05: CanSat launch

In Stage-05, students will demonstrate the success or failure of the mission in person, in Mexico City.

All teams that get to this stage will be assigned a space to complete the flight trial certification; they will also receive the CanSat crew (chicken egg, seeds, and water)

**Teams will have some time to check and correct any mistakes in the device, in case it is not accepted.*

With the help of a drone, contest organizers will lift the CanSat to a height of 300 to 400 meters above ground level from the place of the drone’s take-off.

The CanSats will be launched on Ciudad Universitaria, UNAM, in Mexico City.

The launch schedule will be assigned once the teams pass the flight certification.

STAGE-5.1: Results and Mission Analysis Report (RAM)

In Stage 5.1, the teams that launched their CanSat, must describe the results and conclusions of the mission.

These documents must be sent at the time set by the committee after the CanSat’s return to ground. No document will be received after the deadline. The corresponding template will be sent only to the teams that reach this stage. It must be filled and uploaded to the digital platform with the name:

PEU-MC-2025-RAM-TEAM.pdf

The deadline to upload this file is on:
Saturday, May 24ht, 2025
Contest organizers will assign the specific time.

AWARD CEREMONY

The award ceremony will be held at UNAM facilities in Ciudad Universitaria.

Date of the ceremony:
Monday, May 26th, 2025

Imagen 9-1. CanSat contest launch day in 2023. Credits: Gaceta UNAM.

PROJECT ROADMAP

ENROLLMENT

Team registration and advisors.
Please share the requested information found in
http://peu.unam.mx/cansat2025eng.html

October 2nd to November 22th

STAGE 01

CONCEPTUAL DESIGN REVIEW (CoDR)
COURSE: Introduction to CanSats, mission objectives and project management.
EVALUATION: January 13 to 16, 2025

December 2nd, 2024 to January 10th, 2025

STAGE 02

PRELIMINARY DESIGN REVIEW (PDR)
COURSE: Subsystems - Mechanics/Electronics and Power.
EVALUATION: February 24 to 27, 2025.

January 20th to February 21th, 2025

STAGE 03

CRITICAL DESIGN REVIEW (CDR)
COURSE: Ground station, Analysis of Results and Data
EVALUATION: April 7 to 11, 2025.

March 3 to April 4, 2025

STAGE 04

ACCEPTANCE TRIALS
Video submission and online presentation.
EVALUATION: April 24th 2025.

April 14th to April 24th, 2025

STAGE 05

SATELLITE LAUNCH Y ENTREGA DE RESULTADOS
The main event will take place within Ciudad Universitaria facilities.

May 24th, 2025

AWARD CEREMONY

AWARD CEREMONY
This event will take place within Ciudad Universitaria facilities

May 26th, 2025

These dates are subject to changes. In such cases, they will be announced through the digital platform.

Coordinación de la Investigación Científica

UNAM PEU PROGRAMA ESPACIAL UNIVERSITARIO

11. EVALUATION CRITERIA AND ADMONITIONS

Throughout the process, teams will be evaluated according to their performance in the following areas:

- **Overall course performance:** Evaluation of the assignments from each unit.
- **Contest participation:** Quality of the presentation, how well the team can answer the jury's questions, and complete the tasks and documents according to the established periods of time in each stage.
- **Launch success:** Achieving the mission's objective, the jury's evaluation based on your satellites, and the evaluation by the committee throughout the entire launch process (measurements, weight and data transmission).
- **Final Report:** Clarity and conciseness in presenting the results, data analysis and improvement proposal.

The results in each evaluation will directly affect the teams' final score and its advancement to the next stages.

PARTICIPATION IN THE CONTEST

Throughout the competition, the teams must submit different assignments on each stage. These will be evaluated by the committee according to the following:

- Document submission must include all the information and proposals required in each step.
- Only the documents submitted with the proper name and format required will be evaluated.
- Assignments must be submitted within the time frame specified. No submissions will be accepted out of time.
- The creativity to solve all aspects of the mission: conception, design, construction, trials, performance and written reports.

Stage 4 will be evaluated based on the following criteria:

- Videos must last at most 2:30 min.
- Videos must show the progress in the construction and of the satellite, as well as its functioning.

- Videos must contain: dimension and weight of the satellite, manufacturing, assembly, mechanical trials, electronic components, and total cost so far. If teams reach this stage they will receive more specifications regarding these aspects.
- Videos must be named:
  PEU-MC-2025-TeamName
- Videos must be submitted at the established time.
- The team will present the evaluation remotely.

SUCCESSFUL LAUNCH

On launch day, evaluation will be divided into the next moments:

FLIGHT CERTIFICATION TRIALS

- Teams must attend promptly and on time to the weight and measure processes.
  *Teams that are not on time will be admonished.
- Weight and measure of the satellite.
- Orifice included.
- Protrusions revision.

PRESENTING THE CANSAT TO THE JURY AFTER THE LAUNCH

- The jury will review the state in which the satellite, the egg, the seeds and the water are after impact.
- The answers that team leaders provide when being questioned by the jury.
- Data transmission, quantity, and presenting them.

FINAL WRITTEN REPORT

The teams must hand in the report digitally. The document must contain the results and analysis of the mission corresponding to Stage-05 with the following points to address in the template that is going to be sent:

- The CanSat's technical description.
- Basic diagrams of operation.
- Analysis of the information received by the CanSat during its lift up and free fall.
- It must include the measurements or calculations of: time, altitude, pressure, temperature, as well as the other parameters specified. The

results must be presented with graphs, emphasizing the highest and most relevant values.
- Conclusions.
- Critical performance analysis in your mission.

Post-launch, the team must hand in the CanSat's obtained data in an USB memory, this USB will be provided by the organizers.

12. ADDITIONAL INFORMATION

- The reviewers who will grade the team will be assigned impartially by the mission leader and by the PEU coordinator.
- The jury of the performance in the launch stage will be announced a week prior to that stage's date. Their decisions are unappealable.
- The team members that obtain the top 5 placements will receive prices according to the organizers' budget capacity.
- UNAM's team with the best placement in the top 5 spots in the end of the contest, will become the representative team, backed up by the PEU in other international contests that take place in 2025.

Every unforeseen situation will be solved by the contest organizers with unappealable decisions.

CONTACT

peu@astro.unam.mx

@peu.unam

@peu.unam

@peu_unam

@peu.unam

SPECIAL THANKS: