



MUNDIAL CANSAT 2024



SPACE MISSION GUIDE

MUNDIAL

CANNED SATELLITES

2023 - 2024



Programa Espacial Universitario

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1. INTRODUCTION

We are in the year 2048, after twenty–four failed attempts to reach and descend on the icy surface of Europa, one of Jupiter’s moons, we’ve finally completed two missions. The members of your team comprise the Odysseus Mission, the first crewed expedition. You have been selected not only for your unwavering passion for discovery but also for your capacity to adapt to the moon’s conditions.

The suits that you are wearing are meticulously made to protect you from the ionizing radiation that permeates the place. As part of this mission your crew's goal is to transport two explorers, a year long food supply and their research instruments, which must resist the trip to this Galilean satellite. The first task is to design the mission’s satellite. Your team will go through detailed instruction and training. This is an essential step that will ensure the safety of the people within. The stakes are high given that the survival of these explorers and their equipment takes us closer towards inhabiting this natural satellite.

It’s a treacherous journey through the vast depths of space, the thousands upon thousands of meteorites, the gravitational pull of Jupiter, and finally, the descent on the icy moon's surface.

You are embarking on this great adventure, and can't help but feel a sense of awe and anticipation. So, as the countdown begins, the engines ignite into life, you take a deep breath, ready to face the challenge ahead. Your journey to Europa awaits, and with it, the opportunity to make history.



2. BACKGROUND

A canned satellite (or *CanSat*) is a simulation of a real satellite, integrated in a volume and shape approximating that of an aluminum can. In the *Mundial CanSat 2024*, the challenge for students is to incorporate all the main subsystems found in a satellite, such as: power stage, electronic components, sensors, mechanical structure, mechanisms and the telemetry system within this volume. In addition to having a ground station for communications with the CanSat itself.

In this competition, the canned satellite will be released with the help of a drone from a height of 450 meters. It is at this point that the fundamental part of the competition and the mission begins; **conducting a scientific experiment and achieving a safe landing**. The students are responsible for meeting the mission objectives, designing the canned satellite and a ground station, integrating the components for testing, preparing the launch and analyzing the data received. The University Space Program (*Programa Espacial Universitario* or *PEU in Spanish*) organizes this competition with the intention of providing upper level students with a unique opportunity to get hands-on experience in a space technology project.





3. CALL FOR THE COMPETITION

The University Space Program of UNAM calls on all universities and institutions of upper level education in the world to participate in the *Mundial CanSat 2024* with the following specifications:

1. The teams must comprise a minimum of four and a maximum of seven students; no more than two members of which may be graduate students.
2. Each team must have an academic advisor. The advisor must be an active academic of the institution where at least 50% of the team participants study and must be committed to provide technical advice to the team.
3. An academic advisor may be responsible for a maximum of two teams.
4. Students must be enrolled in any institution with official recognition of upper level education in any country in the world.
5. Each student can only belong to one team.
6. For more information on registration and competition guidelines, please visit: peu.unam.mx
7. Registration for teams to participate in this competition will be open from **Monday, October 9, 2023** until **Friday, December 15, 2023 23:59:59 h** (Mexico Central Time).
8. The maximum number of registered teams is **limited**.



Project Roadmap



May 25th, 2024

STAGE 7

Document of results and analysis of the mission.
Delivery of the report describing the results and conclusions of the space mission.

May 27th, 2024

AWARDS

Award ceremony and closing event of the course-competition.

April 22nd to 26th, 2024

STAGE 5

Acceptance tests.
The tests are carried out with the parameters established for the contest.

May 24th and 25th, 2024

STAGE 6

Acceptance.
Checking the operation of the device.
Release of the canned satellite.
Launch of the Cansat to 450m with drone support.

February 12th to
March 22nd, 2024

STAGE 3

Preliminary design review.
Describe the systems you will use.

April 1st to 12th, 2024

STAGE 4

Critical design review.
Delivery of a document that includes everything concerning the system and its integrations.

December 18th, 2023 to
February 2nd, 2024

STAGE 2

Introduction to the Cansats and mission objectives.
Conceptual design review.

October 9th to
December 15th, 2023

REGISTRATION

Complete team registration, advisor registration and badge.





4. MISSION GOALS

- The canned satellite must transmit pressure, temperature, orientation and acceleration information during the ascent with the drone and during the free fall from a height of approximately 450 m above ground level of the place from where the drone is lifted. With this data, the team must calculate the speed during the entire flight and the maximum height achieved. The team shall send all this information after finishing its launch.
- The canned satellite must carry two chicken eggs inside, which must survive the impact of the landing without breaking.

The satellite should consist of two stages:

1. The primary payload has to include a chicken egg and all the electromechanical components to satisfy the mission objectives. Likewise, this stage must incorporate an autogyro system capable of substantially reducing the drop speed, which should be immersed in the maximum permissible envelope.
 2. The secondary payload must also include a chicken egg inside, which should detach from the primary payload at the moment of releasing the gyroplane system and thus perform its free-fall trajectory.
- The canned satellite must deploy the gyro system at an altitude of 250 m measured from the ground where the drone initiated the ascent..
 - The canned satellite (the primary payload) must continue to transmit once it has landed, for at least 10 more seconds.
 - The primary payload must be able to detect the distance and direction in which its secondary payload is located.
 - The release should be performed in the same position for all satellites, 450 m above a circular target of 3 meters in diameter marked on the ground. The primary payload should land as close as possible to the center of that reference.



5. STAGES OF THE COURSE-COMPETITION

The course is divided into 7 stages in which the participants will take a theoretical and practical module which will support them in the development of the canned satellite.

The stages consist of:

STAGE 1: Registration

Registration must be done online from the *PEU* website: <http://peu.unam.mx>

To register the team, you must fill out the form found within the same site, completing all the necessary information, with the registration of the team members, advisor, their badge and the distribution of work areas.

**In order to fill out the form you must log into a Google account.*

Once your registration is completed, you will be sent via e-mail the access to the Moodle platform, where you will work on the theoretical module and

Due date for uploading the file:



Friday, December 15th, 2023

at 23:59:59 h.

Mexico City, Mexico time.

STAGE 2: Conceptual Design Review

Participating teams will find the template corresponding to this delivery in the Moodle platform, which must be filled out and uploaded with the name,

PEU_MC_2024_CoDR_EQUIPO.pdf

with everything requested by the organizers, as well as with the conceptual proposals of the different systems that make up the canned satellite including the concepts for the protection of chicken eggs.





The document submitted will be reviewed and weighted by the UNAM canned satellite team. Based on the results of this evaluation, the organizers will indicate which teams will move on to Stage-03 of the competition.

Deadline for uploading the file:



Friday February 2nd, 2024
at 23:59:59 h
Mexico City, Mexico time.

STAGE-03: Preliminary Design Review

The document should be submitted with the name:

PEU_MC_2024_PDR_EQUIPO.pdf

according to the template provided to the teams through the Moodle platform.

This document will describe the ideas, diagrams, schematics, calculations and preliminary programs they have developed to achieve the mission objectives with the canned satellite.

Deadline for file upload:



Friday, March 22nd 2024
23:59:59 h,
Mexico City, Mexico time.

STAGE-04: Critical Design Review

At this stage the document should be named:

PEU_MC_2024_CDR_EQUIPO.pdf

according to the template that will be made available to the teams that satisfactorily completed Stage-03 of the competition.

The reference document should describe in no more than 10 pages, everything concerning the design work, calculations, system integration, tests and expected performance with the canned satellite.



Deadline for file upload:



Friday, April 12, 2024
23:59:59 h,
Mexico City time, Mexico

STAGE-05: Acceptance tests

Teams that reach this stage of the competition will be assigned a time to perform acceptance tests either in person at the offices of the University Space Program or remotely via digital platform.

The acceptance of the canned satellite will consist of demonstrating that the device transmits at a maximum distance of 250 meters and that it complies with the specifications and requirements outlined in this call. Acceptance also includes a review by the judges of the rigidity and mechanical integrity of the canned satellite.

Date for acceptance tests:



Starting on Monday, April 22, 2024
according to the schedule assigned
by the organizers of the competition.

STAGE-06: Acceptance and Release of the Canned Satellite



Friday, May 24th:

At this stage, each team must present its canned satellite for flight certification testing. That same day the judges will conduct a series of tests to verify that the device meets specifications, otherwise, *the team will have the opportunity to correct the problems until Saturday, May 25 prior to the assigned release date.*



Saturday, May 25th:

With the help of a drone, the contest organizers will raise the canned satellite to 450 meters above ground level. The satellite will be released to carry out its space mission. The release of the satellites will take place in the facilities of Ciudad Universitaria of the UNAM, in Mexico City.

The flight schedule for each team will be assigned once the flight certification is approved.

STAGE-07: RESULTS DOCUMENT AND MISSION ANALYSIS

The latter document should be submitted with the name:

PEU_MC_2024_RAM_EQUIPO

according to the template that will be sent only to the teams that successfully completed the release of their canned satellite. In this template they should describe the results and conclusions of the mission carried out by their canned satellite. ***At the end of the release test, you must send your mission results and analysis document no later than one hour after your canned satellite has returned to the ground.***

AWARDS



Monday, May 27th:

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



Final CanSat Contest 2023. Gaceta, UNAM.

CANNED SATELLITE SPECIFICATIONS

- The dimensions and shape of the canned satellite, once assembled, should be equivalent to those of a cylinder with a diameter of 9 to 10 cm and a height of 20 to 23 cm. The primary load should have a maximum height of 16 cm and the secondary load should have a maximum height of 7 cm.

- The envelope should be part of the satellite and cover it in its entirety. Said surface of the canned satellite should be smooth to the touch and should not be wavy (see Figure 1).

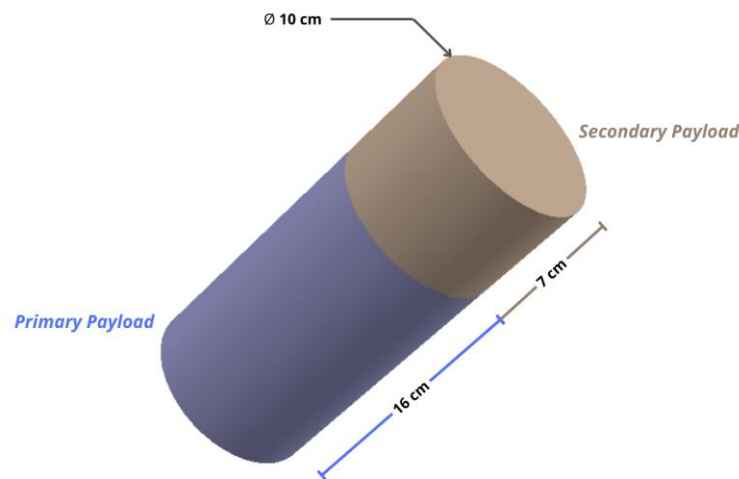


Figure 1. Maximum Dimensions of the Canned Satellite.

- The autogyro system should be embedded inside the satellite and should not have any protrusions.
- The top lid of the satellite cylinder should have a central hole of 9 to 10 mm in diameter. This hole will be used to attach the satellite to the drone, so the lid must be sturdy enough to hold the canned satellite in its entirety. This hole is the only hole that the canned satellite envelope should have.
- The telecommunication antenna must be inside the canned satellite.
- It should not have hazardous or explosive components.
- It may not have any type of fluid, flour or foam in liquid state.
- It may not contain compressed gasses.
- Glues may be used as long as they are already cured.



- The maximum weight of the assembled canned satellite, including batteries, eggs and antenna, shall not exceed 600 grams.
- Both eggs will be supplied on the day of release by the organizers of the competition, the weight of each one must be considered 65 grams and must be returned after the launch to the organizers without alteration in its shape,
- with the identification seal and in the same state with which it was delivered to the team leader. Thus proving the success of the proposed mission.
- The canned satellite must have an autogyro system immersed in its primary payload. This device cannot be coupled to any type of electric motor. The descent speed once the system is activated and before reaching the ground must be less than 12 meters per second and more than 8 meters per second..
- The bandwidth will be assigned by the contest organizers according to the electronic components with which the canned satellite is developed.
- Electrical power in canned satellites shall be supplied by 9 volt square type batteries. **No other type of battery will be accepted.**
- The canned satellite must include an off/on switch to prevent it from running out of battery power while waiting for a turn to be hoisted with the drone. This switch must not protrude from the canned satellite enclosure and must not affect the surface of the canned satellite packaging.

6. GENERAL REQUIREMENTS

- On the day of the launch, the team leader should be the one to attach the canned satellite to the drone and the other members of the team should be alert to the correct reception of data from the satellite at the ground station.
- The canned satellite must only transmit information.
- The maximum amount that each team can invest is **\$600.00 USD**. The amount invested must be reported in the final mission results and analysis document (RAM).
- The maximum time to place both eggs inside the satellite, once they are delivered to the team leader, is 45 minutes. Once inside the satellite, the satellite must be handed over to the contest organizers for release.



- The ground station must be designed at the discretion of the students. During the transmission of data from the canned satellite the judges will verify the real-time transmission of the data.
- Once the satellite lands, the team leader should deliver the chicken eggs to the contest judges.
- Finally, submit your mission results and analysis document no later than one hour after your canned satellite has returned to the ground.

7. CANNED SATELLITE COMPONENTS

The following is a description of a series of guidelines on the components that make up the canned satellite, which the competing teams must abide by as part of the **Mundial CanSat 2024** rules.

- The mechanical subsystem has no design restrictions other than those described earlier in this document.
- The flight computer can have any type of architecture (Arduino, PIC, Teensy, Raspberry, etc.).
- The use of any communication module for telemetry is allowed. To avoid signal interference between the satellites of the different teams, this module with the frequency it will use, must be described in its design documents. At the request of the contest organizers, the frequency to be used may be different from the desired one.
- For the sensors, the use of the IMU GY-80 is recommended (see figure below). However, it is possible to use any other type of sensors, taking into account the maximums stipulated in the Space Mission.

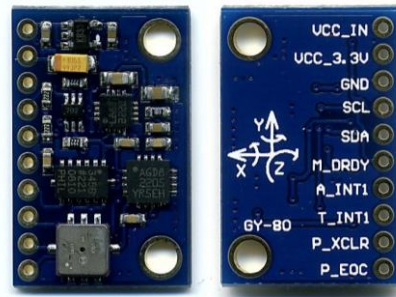


Figure 2.
Sensor IMU GY-80.

- Only 9V square batteries are allowed. The capacity (mAh), as well as voltage regulators and passive and active electronic components are left free, considering the maximum limit stipulated by the contest organizers.

8. DELIVERABLES

All participating teams must submit in electronic format the results and analysis document of the Stage-07 mission with at least the following topics, in at least 8 pages and in accordance with the template that will be sent to you via email:

- Technical description of the canned satellite.
- Basic operation diagrams.
- Analysis of the information received by the canned satellite during ascent and free fall.
- It should include measurements or calculation of time, altitude, pressure and temperature, as well as other mission parameters. Present them graphically, noting the maximum and most relevant values.
- Conclusions.
- Critical analysis of your mission performance.



9. EVALUATION CRITERIA

The jury will consider the following criteria for the evaluation of the team:

- Cost, the lower the better.
- Weight, the lower the better.
- The more data transmitted during the duration of the test, the better (the number of data will be divided by the total transmission time).
- Quality of the documents.
- Originality to solve all aspects of the mission: conception, design, construction, testing, performance and reporting.
- Teamwork of the members during the development of the mission.
- Status of the canned satellite and eggs after impact.

10. ADDITIONAL INFORMATION

-The team of reviewers of the competition stages will be appointed by the PEU Coordinator and the Head of Mission, based on criteria of autonomy and impartiality.

-The jury evaluating the performance in the release stage will be announced one week before the stage is held. Its decisions shall be final.

-The members of the teams that obtain the first five places will be awarded prizes, according to the budgetary capacity of the organizers.

-The UNAM team with the best place in the final results of the competition will be the representative team supported by the PEU in other international competitions to be held in 2024.

All unforeseen situations arising during the competition will be resolved by the competition organizers and their decisions will be final.



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