STEAM AZERBAIJAN

SAF 2025 INTERNATIONAL
STEAM AZERBAIJAN FESTIVAL

CUBESAT

CATEGORY

FINAL STAGE RULES

BAKU 2025

1. Introduction

The CubeSat competition encourages young people and technology enthusiasts to learn and use STEAM skills, experiment with space technology, explore the working principles of future technology, and develop engineering, design practices, and independent thinking skills to achieve results. The goal is to gain knowledge, collaborate, learn to compete, and have fun at the same time .

2. Teams

2.1. Teams must consist of 3 people (1 team leader, 2 students).

2.2. The team leader must be over 18 years old, and the students must be between **13 and 17** years old.

2.3. Each team leader and student can only participate in one team.

2.4. After registration is complete, a selection round will be held among the teams and the teams that will advance to the final will be determined. The terms and time of the selection round will be announced after registration is complete.

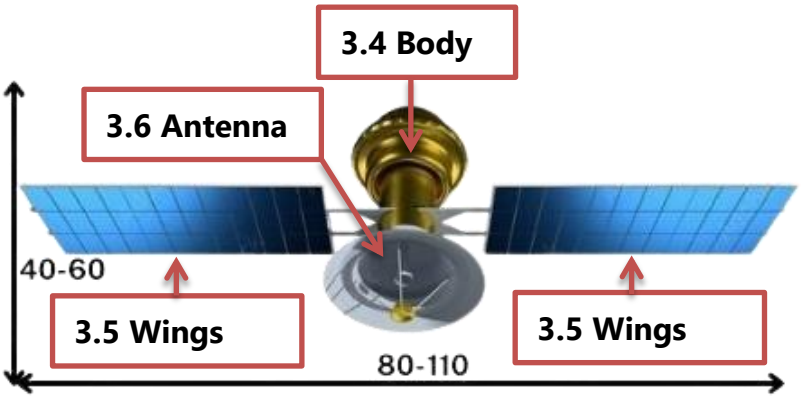
2.5. Anyone who wants to participate in the competition can join, provided that they meet the conditions and do not go beyond the equipment designated for CubeSat preparation.

3. Race description

3.1. The competition consists of two parts. In the first part, each team will be judged on the design and technology of the carrier satellite that will house the CubeSat. You can use this QR link for examples:

Figure 1. Carrier satellite model (example)

3.2. The size range given for the model here should be between 80-110cm in length, 40-60cm in width, and 40-60cm in height, with the wings and outer devices unfolded.



3.3. The satellite model should consist of 3 parts:

3.4. **Body** - the body part should be made of gold or aluminum. There should be a separate space in the body part for placing the CubeSat.

3.5. **Wings** – Sun panels should be visible. Both real and decorative photo paper panels can be used here.

3.6. **Antenna** - Each model must have at least 1 and a maximum of 3 antenna models.

3.7. **Note** : The prepared model must be placed on a stand in the central part during presentation.

3.8. In the second phase, each CubeSat will be lifted 6 meters into the air by helium balloons provided by the organizer. Each team must then establish wireless communication with their CubeSat and receive the following information:

- Air temperature,
- The humidity value of the air,
- Gyroscope (measures tilt angles along the X, Y and Z axes)
- GPS coordinates
- One photo

3.9. **The CubeSat, attached to a helium balloon, will first be launched with a start whistle. After the whistle, the team must attempt to establish contact with their CubeSat.**

3.10. After receiving the data, the CubeSat must release one of the five helium balloons carrying it and land on the ground.

3.11. The time calculated for the mission will be stopped when the CubeSat is re-landed by the launch vehicle and will be recorded in seconds to the team's account.

3.12. A CubeSat damaged during landing can be repaired before the next attempt.

3.13. The team will be given 120 seconds to complete all these tasks.

3.14. A CubeSat that does not land within 120 seconds will be considered incomplete.

3.15. Each team will be given 3 attempts and the points scored by the team in the 3 attempts will be added together to calculate the overall average coefficient.

3.16. The team's time to complete the tasks will be taken as the average of the total of 3 attempts.

3.17. For example:

4. Competition structure

4.1. The evaluation will be conducted by judges appointed by the organizers .

4.2. The dimensions of the CubeSat to be prepared must be 100x100x100mm (±1mm). Dimensions smaller or larger than these dimensions are not allowed in the competition!

4.3. The competition area will be a 6x6 meter tatami mat. The competition area will also be marked with numbers or letters to mark its edges.

4.4. There will be 1 Mars planet model and 1 Moon model with a diameter of 100 cm, 6 meters from the center of the competition area and 5 meters above the ground. Mars will be on the left side of the competition area, and the Moon will be on the right side.

4.5. Helium balloons will be provided by the organizer for transportation at the competition site.

4.6. The helium balloons will be in two parts. One of these parts will be fixed to the body, and the other will be connected to the launch mechanism on the CubeSat.

4.7. In the event of technical problems that occur during the race, which are not the responsibility of the team, the race is suspended and the race is resumed after the technical problem is resolved.

4.8. The competition gives 120 seconds to complete the tasks.

4.9. After placing their CubeSats on the carrier, teams must stand on the edge of the red tape.

4.10. Before starting the competition, the team must disconnect from the CubeSat and close the programs it will be using.

4.11. The data will be verified against real-world values when it is received and presented to the judges.

4.12. If any team sends default values with a ready-made template, that team's attempt will be **canceled** .

4.13. Each team's CubeSat must send data with at least 1 sensor and land on the ground.

4.14. If the CubeSat connection is lost during data transfer, the team may stop the competition, in which case there will be an incomplete evaluation and the team's time will be recorded as 120 seconds.

4.15. For wireless communication, 433Mhz, IP, WiFi, SMS and Bluetooth connections must be used.

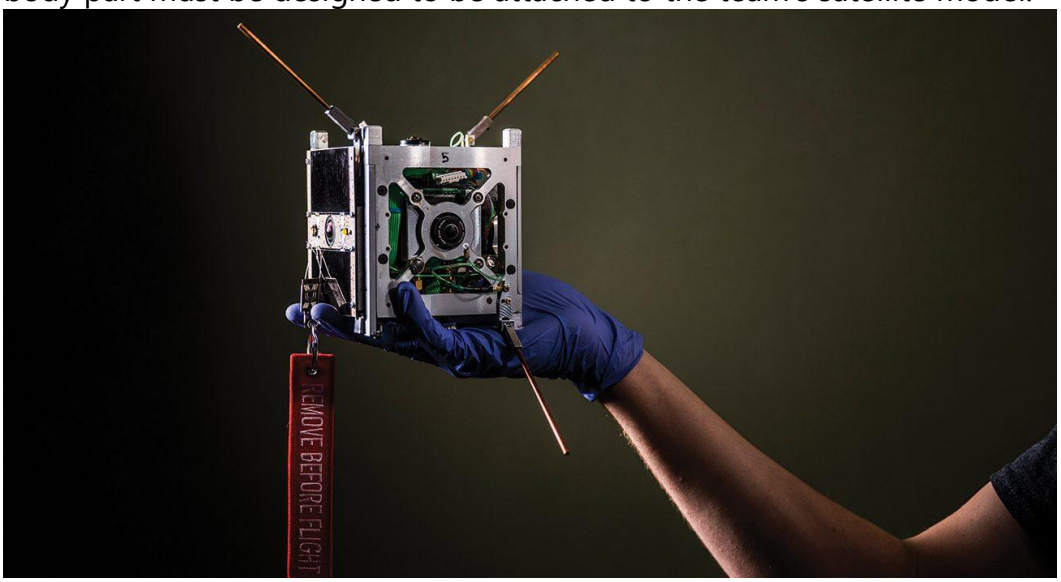
5. Elements required for CubeSat development

5.1. **Body -** Can be made from wood and plastic materials using a 3D printer or laser cutting, with edges measuring **100x100x100mm .**

5.2. The radius of the helium balloon release hanger will be **25mm** and the thickness will be **2mm.** The team must design the release mechanism according to these dimensions.

5.3. For the international standard of dimensions intended for CubeSat, this link should be used: https://upload.wikimedia.org/wikipedia/commons/3/33/ CubeSat _Design_Specification_rev._12_-_1U_dimensions.png

5.4. At least one part of the body must be open so that the interior can be seen. The body part must be designed to be attached to the team's satellite model.

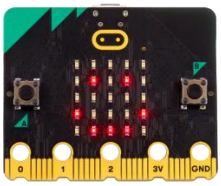


5.5. **Weight** - the movement of the CubeSat being built with a helium balloon must be taken into account. Therefore, the maximum weight should be **400 grams** .

5.6. There is no limit to the applications used for wireless connection. The recommended application is the BLYNK application. https://blynk.io/home-new

5.7. To calculate the operations, you need to use **an Arduino** nano (or uno), only the **ESP** modules shown in the picture, and **a MicroBit** .

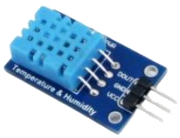


Arduino nano and uno **ESP32 or 8266** **MicroBit**

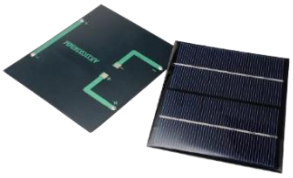
5.8. **The ESP32-CAM module must be used** to take or send a photo, which is the main part of the task .

5.9. For temperature or humidity values, **a DHT11** (or **DHT22**) sensor must be used. In addition, it is allowed to use a sensor other than this sensor.

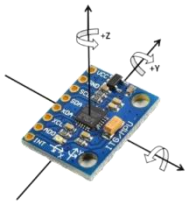


5.10. The most important data information of celestial objects is their coordinates in the air. For this, the NEO-6M GPS module can be used. However, other modules are also allowed. If the competition is held indoors, it will not be necessary to calculate this data.

5.11. Each CubeSat must have at least 1 operational solar panel.



5.12. A gyroscope should be used to study the position of a free-floating object in the sky relative to the ground. The recommended module here is **the MPU6050 .**



5.13. You are free to use other auxiliary electronic modules and equipment.

6. Task execution and scoring.

6.1. **Each team must use medical gloves during the presentation and competition.**

6.2. **10 points** when it is launched . After launching, if it is able to establish contact and display the CubeSat's (or team's) name on the monitor, it will be awarded **10** points. Here, a 500-gram lifting effect will be provided by the organizers to launch it into the sky.

6.3. After the start whistle, the time the team establishes contact with their CubeSat is recorded and added to the overall task completion time.

6.4. If the temperature is sent accurately (within ±2°C), **15** points will be awarded. If the temperature error is ±4°C, **10** points will be awarded. If any information is sent from the temperature sensor, it will be evaluated with **5** points.

6.5. If the humidity value of the air (value error ±2%) is sent, **15** points will be given. If the humidity value error is ±5%, **10** points will be given. If any information from the humidity sensor is sent, it will be evaluated with **5** points.

6.6. If GPS location data is sent , **25** points will be given. If the location data sent is within a 1km radius of the real location, **20** points will be given. If any information is sent from the GPS sensor, it will be evaluated with **5** points.

6.7. The photo limit is 2 and each is worth **20** points. If the team has taken several photos, they can submit the best one to the judge. The numbers and letters in the landing zone during the photo shoot will also be written 6 meters from the center and those numbers must be reflected in the photo. If there is a video during the takeoff, an additional **10** points will be awarded.

6.8. **5 points** each along the X, Y and Z axes . If angles along **3 axes are sent, an additional 10** points will be given. *The evaluation will check that the variable angles of movement during descent and ascent are functional.*

6.9. **5 points** for the solar panel on the spacecraft . The evaluation will be conducted after the CubeSat lands.

6.10. After sending the data, the CubeSat must release itself from the second helium balloon's tether and land freely on the ground. **20** points are awarded when the CubeSat releases itself from the carrier.

6.11. The time allotted for the task is stopped when the CubeSat lands.
6.12. the CubeSat is suspended in the air during flight and its height is less than **2** meters, its flight is not accepted and is terminated.
6.13. Each team outside the task can send 2 additional data using **2** sensors or 2 different data from the same sensors. In this case, **15** points will be awarded for each functional data.
6.14. Data reception with MicroBit is only accepted when presented by a computer program. Values displayed on the MicroBit's LED matrix are not accepted as a receiver.

7. Satellite and CubeSat design evaluation

Evaluation criteria:

7.1. The internal electronics of the CubeSat, the connection of circuit elements there,
7.2. Inter-board connections
7.3. Circuit element placement structure.
7.4. Preparation and design of the body element of the CubeSat, its weight and dimensions.
7.5. General appearance, dimensions and innovation of the satellite
7.6. Design of the satellite's wings and antennas