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Mission Requirement & Preliminary Design Review Documentation Guidelines

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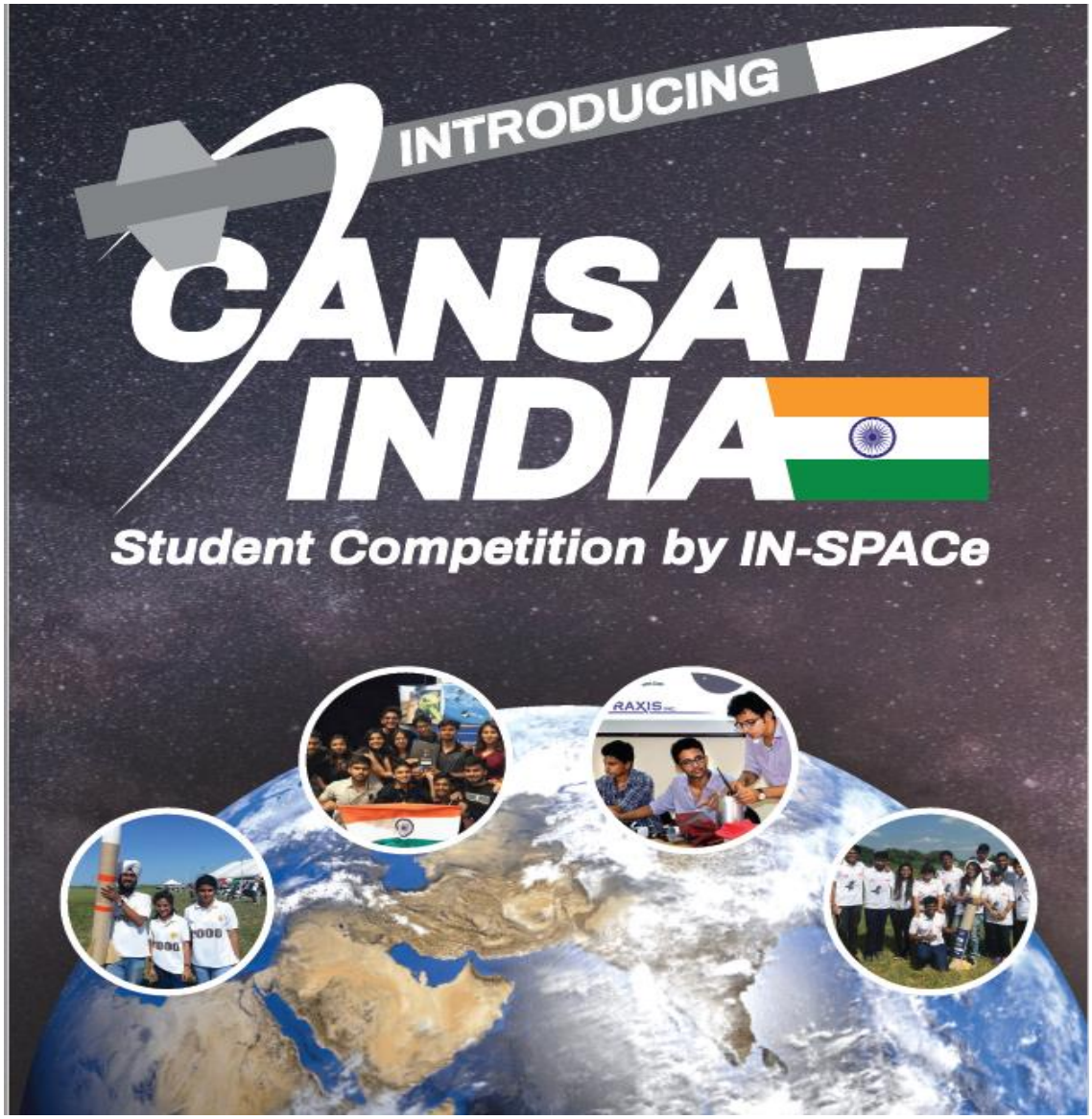

ASTRONAUTICAL SOCIETY OF INDIA

U. R. Rao Satellite Centre

Bengaluru 560017

IN- SPACe

CANSAT India Students Competition

by

ASTRONAUTICAL SOCIETY OF INDIA

Mission Requirement
&
Preliminary Design Review Documentation Guidelines

August 2022

ASTRONAUTICAL SOCIETY OF INDIA
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MISSION REQUIREMENTS

&

PRELIMINARY DESIGN REVIEW DOCUMENTATION GUIDELINES

	Name and Designation	Date	Signature
Prepared by	**Team CANSAT**	**August 2022**	
Reviewed by	**Organizing Committee**	**August 2022**	
Approved by	**Executive Secretary, ASI**	**August 2022**	

SUMMARY

CANSAT students' competitions are being conducted worldwide including in India. It is noticed that Indian students are participating and winning laurels for the nation. Taking cue from this Astronautical Society of India has decided to conduct IN-SPACe CANSAT India Student Competition 2022-2023. This document addresses the mission requirements for the IN-SPACe CANSAT India students' competition by Astronautical Society of India. The preliminary design review documentation guidelines are also provided.

NB: While due care is taken to prepare this document. The decision of organizers will be final in case of any discrepancies etc.

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1 INTRODUCTION

The IN-SPACe CANSAT India 2022 competition is being organized by Astronautical Society of India, to inculcate the space science and technology temperament among the student community. This competition involves the design, development & launch of a CAN sized satellite to an altitude of 800 meters to 900 meters above the launch site. The competition will also help to create a wide scale ecosystem for Swadeshi Space activities in the country and bridge the industry academia skillset gap thereby enabling the future space force creation for the AatmaNirbhar Bharat.

This document describes the mission requirements and preliminary design review documentation guidelines. The optional indicative objectives are provided. Teams are free to select any other novel techniques to demonstrate the same. The communication, telemetry, flight software structure, power, descent and recovery requirements are provided.

The guidelines for team composition & management, communication and data handling, electrical power system and sensor subsystems etc. are enumerated. The details required for CANSAT algorithm, ground station, integration and testing and requirement compliance matrix is provided. The code of ethics and standards that needs to be followed by teams is listed.

The teams are being assigned a unique team identification number. Please use it in all the correspondences with the organizers. All the correspondence should be through faculty advisor.

2 COMPETITION TIMELINE

The competition shall be conducted in the seven phases which are as follows:

Phase	Activity	Outcome
Phase 1	It is the registration phase where the teams need to be registered as per the guidelines. The guidelines for the registration have been provided as annexure 1.	Team Registration & Selection
Phase 2	Submission of Preliminary Design Review (PDR) document followed by a presentation to the evaluation committee.	Team Evaluation & selection for next phase.
Phase 3	Optional phase for PDR qualified teams, where teams will be given opportunity to present their CANSAT proposals in front of sponsors for potential sponsorship opportunity. *Note: Participation in this phase is optional to the teams and ASI doesn't commit and guarantee any financial support to the teams.*	Sponsorship opportunity for Teams
Phase 4	PDR qualified teams will present Critical Design Review (CDR) document followed by a presentation to the evaluation committee. (During this phase PDR qualified teams shall finalize the design, initiate the components and material procurement and start the realization of CANSAT)	Assessment of CANSAT designs & selection for next phase

Phase 5	It is during the launch week, where CANSAT must be ready for the launch and teams shall present their CANSAT for flight readiness review (FRR) and launch clearance.	Flight readiness check & clearance for launch
Phase 6	It is the day of the launch where the teams will arrive at the launch site and the CANSATs will be launched on the rockets provided by the organizers.	Launch & Mission Evaluation
Phase 7	It is the Post Flight Review (PFR) the teams shall make presentation to the jury the flight results and the data analysis.	Final Evaluation & announcement of winners

The detailed guidelines for CDR, FRR and PFR evaluation and timeline shall be notified in due course.

3 MISSION REQUIREMENTS

3.1 MISSION REQUIREMENT FOR CANSAT INDIA 2022-23

Design a CANSAT weighing under 0.700 kg (+/- 0.050 kg), with dimensions not more than 0.125 m diameter and 0.310 m height. The objectives for the 2022-23 competition will be:

- **Innovative Mechanical Gyro-control** system that shall demonstrate the descent control of the CANSAT.
- **CANSAT descent control system** that shall open at an altitude of 500 m.

CANSATs will be launched to an altitude of 800.0 m to 900.0 m from the ground level and above the launch site & deployed near the peak altitude. During the ejection from the rocket orientation of the CANSAT is not controlled. The CANSAT must remain intact during the course of the entire mission and send the data to the ground station through a telemetry link.

3.2 INDICATIVE OPTIONAL OBJECTIVES (EXTRA POINTS WILL BE GIVEN FOR EACH CASE)

Few indicative optional objectives are listed below. However, teams are encouraged to propose novel techniques that they can demonstrate within the specified mass, power and budget constraints.

i. Novel descent trajectory control, Innovative materials,

ii. Additional innovative sensors and communication systems

iii. Provision of video capture from separation till final touch down

iv. Innovative recovery techniques viz. HAM radio/Advanced beacons.

v. Innovative Quality and reliability analysis methodologies.

4 MISSION OBJECTIVES & REQUIREMENTS

4.1 BASIC REQUIREMENTS

i. Total mass of the CANSAT shall be under 0.700 kg (+/- 0.05 kg)

ii. CANSAT shall fit in a cylindrical body of 0.125 m diameter x 0.310 m height. Tolerances are to be included to facilitate container deployment from the rocket fairing.

iii. Teams are free to use any design process and material for the cylinder development.

iv. Any sharp edges on the container body shall be avoided as it can cause problems during the CANSAT ejection from the rocket.

v. For ease in location of the CANSAT, the color of the CANSAT body shall be painted with fluorescent colors i.e., pink, red or orange, and shall embody the Indian flag.

vi. Rocket Airframe will not be allowed to be used as a part of any CANSAT operation.

vii. Additional weightage will be given to the MADE IN INDIA components in the making of CANSAT.

viii. The Global Navigation Satellite System (GNSS) sensor that includes Navigation by Indian Constellation (NavIC) will be given extra weightage.

ix. The CANSAT shall consist of necessary sensors to provide the following mandatory Real-time datasets: Position data, altitude, pressure, temperature, orientation data, power data & system status.

x. The data shall be displayed in near real-time on the ground station User Interface/Software. Teams are free to use any design to build their own user interface.

xi. CANSAT software shall have provision to record the data and save it into an onboard SD card, in case of telemetry connection loss during flight.

4.2 STRUCTURE REQUIREMENTS

i. All electronics shall be enclosed and shielded from the environment. No electronics can be exposed except for sensors. There must be a structural enclosure.

ii. CANSAT structure shall be built to survive 15 Gs of launch acceleration & 30 Gs of shock.

iii. Electronic circuit boards must be hard mounted using proper mounts such as standoffs and screws. High-performance adhesives can also be used.

iv. Team number, email address and phone number must be placed on the structure in English, Hindi and the regional language of the launch state to aid in recovery.

v. An audio beacon shall be installed on CANSAT as a recovery assist. It may be powered after landing or operate continuously. The audio beacon must have a minimum sound pressure level of 92 dB, unobstructed.

4.3 POWER REQUIREMENTS

i. The CANSAT shall have an external power switch with an indicator light or sound for being turned on or off, in order to avoid the disassembling of CANSATs on the launch pad.

ii. The CANSAT shall have a battery capacity to support up to 2 hours of wait in on the launch pad with additional time for flight operations.

iii. The battery source may be alkaline, Ni-Cad, Ni-MH or Lithium ion. Lithium polymer batteries are not allowed. Lithium cells must be manufactured with a metal package similar to 18650 cells.

iv. An easily accessible battery compartment must be included allowing batteries to be installed or removed in less than a minute and not require total disassembly of the CANSAT.

v. Spring contacts shall not be used for making electrical connections to batteries. Care must be taken as the shock forces can cause momentary disconnects of power.

4.4 DESCENT & RECOVERY REQUIREMENTS

i. The CANSAT shall contain a total of 2 descent control mechanisms, to be used at different stages while descent.

ii. 1st mechanism shall be a parachute while the second mechanism shall be decided by the teams. Few examples for the second descent control mechanism are: secondary parachute/streamer/glider/rotor mechanism etc.

iii. CANSAT shall immediately deploy the 1st parachute after ejection from the rocket.

iv. The 1st parachute shall be connected to the outer body of the CANSAT and no ejection mechanism shall be attached to it.

v. The descent rate of the 1st parachute shall be 20 m/s (+/- 5m/s).

vi. The second descent control mechanism shall open at an altitude of 500 m (+/-10 m) to further decrease the descent rate of the CANSAT to 1 to 3m/s

vii. The descent control system shall not use any hazardous chemical-based explosive or pyrotechnic devices. However, green propulsion is allowed if being used under the same weight constraint.

viii. CANSAT shall stabilize itself during the decent using the Mechanical Gyroscopes.

ix. The descent control mechanism & all the attached components in CANSAT shall survive 30 Gs of shock at the time of launch and separation.

x. All the electronic components shall be enclosed and shielded from the environment with the exception of sensors.

5 COMMUNICATION REQUIREMENTS

i. The CANSAT communications radio shall be the XBEE radio series 1/2/pro.

ii. The XBEE radios shall have their NETID/PANID set to the team number.

iii. The XBEE radio shall not use the broadcast mode.

iv. The XBEE radio can operate in any mode as long as it does not interfere with other XBEE radios.

5.1 GROUND STATION

i. Each team shall develop and use their own ground station. All telemetry shall be displayed in near real-time during launch and descent. All telemetry shall be displayed in international system of units i.e., SI system. Teams shall plot data in real-time during flight.

ii. The ground station shall command the CANSAT to start transmitting telemetry prior to launch.

iii. The ground control station antenna shall be elevated from ground level to ensure adequate coverage and range.

iv. Stability of the ground station must be ensured.

v. The CANSAT shall not transmit telemetry until commanded by the team. Command can be executed while the CANSAT is in the rocket on the launch pad.

vi. The ground station shall be able to command the CANSAT to calibrate gyros, barometric altitude, accelerometer to command the parameters to zero as the CANSAT sits on the launch pad.

vii. The ground station shall generate .csv files of all sensor data as specified in the Telemetry Requirements section.

viii. Telemetry shall include mission time with one second or better resolution.

ix. In case of processor reset the mission clock/time stamp & system state shall be maintained.

x. Teams shall plot each telemetry data field in real-time during flight.

xi. The ground station shall include one laptop computer with a minimum of two hours of battery operation, XBEE radio and a hand-held antenna.

xii. The ground station must be portable so the team can be positioned at the ground station operation site along the flight line and if required the team can also move to a different location, in case of distant landing location, in order to locate the CANSAT.

5.2 FLIGHT SOFTWARE

i. The flight software shall maintain and telemeter an indicator of the CANSAT flight software state. An example set of states is 0 (BOOT), 1 (TEST_MODE), 2 (LAUNCH_PAD), 3 (ASCENT), 4 (ROCKET_DEPLOY), 5 (DESCENT), 6 (AEROBREAK_RELEASE), and 7 (IMPACT).

ii. In the event of a processor reset during the mission, the flight software shall be able to determine the correct state.

iii. The states shall be described in the review presentation by each team.

5.3 TELEMETRY

i. Upon powering up, the CANSAT shall collect the required telemetry at a 1 Hz sample rate or better. The telemetry data shall be transmitted with ASCII comma-separated fields followed by a carriage return in the following format:

<TEAM ID>,<TIME STAMPING>,<PACKET COUNT>,<ALTITUDE>, <PRESSURE>, <TEMP>,<VOLTAGE>,<GNSS TIME>,<GNSS LATITUDE>,<GNSS LONGITUDE>, <GNSS ALTITUDE>,<GNSS SATS>,<ACCELEROMETER DATA>, <GYRO SPIN RATE>, <FLIGHT SOFTWARE STATE>,<ANY OPTIONAL DATA>

ii. The received telemetry for the entire mission shall be saved on the ground station computer as a comma-separated value (.csv) file that will be examined by the competition judges. Teams will provide the file to the judges immediately after the

launch operations via USB drive. The .csv file shall include headers specifying each field of data.

iii. The telemetry parameters display format with resolution needs to be provided as given in the table below. The telemetry data file shall be named as follows:

A. Flight_<TEAM_ID>.csv. It is recommended the ground software produce this file, with the correct name, easily from the ground system user interface.

S. No.	TM Parameter	Function	Resolution /Format
1.	<TEAM ID>	Team Number	2022ASI-XXX
2.	<TIME STAMPING>	Time since the initial power	Seconds
3.	<PACKET COUNT>	Count of transmitted packets	
4.	<ALTITUDE>	Altitude in units of meters and must be relative to ground	0.1 meters
5.	<PRESSURE>	Measurement of atmospheric pressure	1 pascal
6.	<TEMP>	Temperature in Celsius	0.1 ^{o}C
7.	<VOLTAGE>	Voltage of the CANSAT power bus	0.01 Volts
8.	<GNSS TIME>	Time generated by the GNSS receiver	Seconds
9.	<GNSS LATITUDE>	Latitude generated by the GNSS receiver	0.0001 degrees
10.	<GNSS LONGITUDE>	Latitude generated by the GNSS receiver	0.0001 degrees
11.	<GNSS ALTITUDE>	Altitude generated by the GNSS receiver	0.1 meters
12.	<GNSS SATS>	GNSS satellites connected	integer number
13.	<ACCELEROMETER DATA>	Data received from the gyroscopic sensor i.e acceleration and roll & pitch parameters	m/s^2
14.	<GYRO SPIN RATE>	Spin rate of Mechanical Gyro wrt. CANSAT	deg/s

15.	<FLIGHT SOFTWARE STATE>	Operating state of the software	(boot, idle, launch detect, deploy, etc.)
16.	<OPTIONAL DATA>	Any data coming from the optional mission objectives	

B. Additional data fields may be appended after the required fields as determined necessary by the team's design

C. It is suggested that teams make use of onboard data storage. Only the transmitted telemetry is graded, however, the backup data can be used when completing the Post Flight Review.

6 Preliminary Design Review Documentation Guidelines

Preliminary Design Review (PDR) - is a detailed design review of the system to ensure that the system can proceed into detailed design, and can meet the mass, dimensional, budget, schedule and other specified constraints for the CANSAT India 2022-23.

It shall consist of:

i. Details about the CANSAT mission requirements and how the team plans to incorporate it.

ii. Details about derived and allocated system-level requirements

iii. Details about the operational aspects of the CANSAT.

iv. Detailed overview of the preliminary design that meets the mission's specified requirements.

v. Details about the identified components, subsystems, processes, simulation results or any other details to support the preliminary design.

vi. Details of the identified testing criteria to support or finalize the preliminary design.

vii. Budget details

viii. Development schedule of the CANSAT

The PDR document along with the presentation should be submitted as per the guidelines mentioned below. The team leader is responsible to present the slides in the specified format. The Presentation time is limited to 30 minutes. Anything longer than that will lead to deduction

of points. In case any acronyms are used, it has to be mentioned at the beginning of both the doc and PPT file. Any reference used is to be mentioned in Annexures reference section.

The following are the points to be taken care of while developing the PDR document:

6.1 TEAM COMPOSITION AND MANAGEMENT

This should include the entire team detail i.e., course, graduation detail, institute, area of specialization (if any), and role in the team.

The team shall assign a team leader who is responsible for giving up the presentation. The teams are required to mention the entire expenses incurred during the entire CANSAT development. The team is required to provide the bill of material (BOM) of their entire purchase.

Make a table of financials containing BOM and other costings which should include:

- Cost of each component
- Estimate vs Actual cost with any deviation if any
- Any second-hand hardware
- Ground station
- Parachute
- Designing
- Prototyping
- Testing
- Fabrication
- Contingencies
- Any other relevant cost

Any source of sponsors can also be mentioned in this section

NOTE: ASI DOES NOT PROVIDE ANY KIND OF PROJECT FUNDING SUPPORT

A project milestone chart showing breakup of various activities like task start and stop dates and durations shall be presented. The purpose of the project timeline chart is to keep things on track and monitor the progress. Periodic update meetings are assumed to be scheduled to evaluate the team's progress.

6.2 MISSION OVERVIEW

Mission overview should provide the overall mission objective. This should include all the primary and the secondary/add-on objectives the team is looking for.

Provide an overview of all system-level requirements. Any other external support taken from the facilities apart from the participating institute needs to be mentioned here.

The system overview should cover all the design traits taken care while at development stage. Include diagrams, tables, and demonstration results where the need arises.

The System Overview presentation should include:

- CANSAT configuration
- Major components
- Engineering drawings
- Launch and descent strategy
- Post-launch recovery
- Data retrieving and Analysis

6.3 SUBSYSTEM DETAILS:

i. Payload Subsystem:

This should include a detailed design of the payload i.e. main & optional objectives of the competition, its electrical & mechanical interfaces, deployment mechanism and specifications. What were the design constraints team faced keeping in view of the Mass, power and volume budget? Any trade-off while considering the design. Any add-on sensor the team has put on board should be mentioned in detail.

ii. Housekeeping Subsystem

The housing subsystem contains all the necessary sensors, actuators, attitude controls, power system, communication systems etc. just like a satellite Bus.

The CANSAT housing contains the following subsystems:

A. Mechanical Subsystem

B. Communication and Data Handling Subsystem

C. Electrical Power Subsystem

D. Sensor Systems

6.4 MECHANICAL SUBSYSTEM

The mechanical subsystem should Include all major structural components, container mechanical configurations, electronic mounting, housing, material selection and interface definitions, thermal management etc.

The Key constraints in mechanical designs of CANSAT hardware and component selection should be mentioned in detail. Any major trade-off should be mentioned separately.

A detailed explanation of the CANSAT hardware shall be provided including the following points:

- Design & Simulations
- Methodology
- Placement of the various subsystems in the container

The team should clearly mention the Mass of payload, container, sensors other than payload, parachute, and any other component used.

6.5 COMMUNICATION AND DATA HANDLING SUBSYSTEM

The Communication and Data Handling Subsystem should mention clearly the TxRx antenna design & details, link margin, Boot time, Processor type, data interfaces, memory slots, CANSAT real-time clock, antenna material, XBEE radio selection, transmission control, backup in case of transmission loss, data format.

6.6 ELECTRICAL POWER SUBSYSTEM

The Electrical Power Subsystem should include schematic showing power connections that includes all power sources, resistor arrangements and all major components. The CANSAT should have an external switch.

Note: Use of Lithium Polymer batteries is prohibited.

All types of connections and mounting need to be shown clearly. Describe the power trade-off and selection. The kind of connection done (parallel or series) needs to be explained in details.

The Power budget should include:

- Energy Balance
- Power consumption of each component/subsystem
- The total power consumed

6.7 SENSOR SUBSYSTEM

The CANSAT Sensor subsystem details should include a summary of all the sensors selected and the purpose for which these sensors are being used. Detailed information like interfaces, resolution, weight, cost, reason of selection of each of the following sensors is also required:

- GNSS Sensor
- Altimetry
- Pressure
- Temperature
- Gyro sensor (Orientation/Acceleration data)
- Power Status
- Any other sensor

The team is required to clearly mention any trade-off while sensors selection power requirements and other supporting documents.

7 CANSAT ALGORITHM DESCRIPTION

This section should include the details of functional requirements and mathematical formulations used in development of the CANSAT software. The CANSAT algorithm should be described in the form of a flow chart. The software change log should be maintained using standard software packages. This should also describe basic software architecture, programming language used, development environment and brief summary of the software tasks.

The following details should be included in the document viz.

- Software sequencing timing diagram
- Sampling rate or processor cycle time used for execution of various tasks
- Telemetry and Telecommand details
- Data storage and Handling
- Software reset loop
- Simulation mode strategy

- Test methodology
- Proto version testing details

8 GROUND STATION

The ground station includes a laptop, antenna, power supply etc. The ground station is supposed to remain ON at the time of launch for real time data collection and processing. However, the following points are needed to be considered and mentioned in the presentation:

- Ground station power supply and duration of operation
- Antenna pattern
- Antenna type
- Telemetry display
- Command software and interfaces
- Real-time data collection scheme
- Last data command at console display
- User interface for real-time data collection
- Describe in simulation mode how the ground system transmits the commands and uploads the data.
- Ground software design for the transmitter to submit telemetry packets
- CANSAT Sensors & Payload telemetry
- Libraries used
- Communication test plans
- The file format should be .csv for the data saved

9 CANSAT INTEGRATION AND TESTING

Once all the subsystem level design and development are complete, this is followed by CANSAT integration. The goal here is to understand each team's methodology used for the integration of the module and make it a working system.

The following tests are to be performed while integration:

- Subsystem test plans

- Payload and associated Sensors
- Mechanical Structure
- Command and Data Handling
- Power Supply
- Ground Station
- CANSAT Algorithm

- Drop Test
- Thermal test
- Vibration test
- Housing Fit check test
- Integrated level functional test plans
- Environmental test plans
- Simulation test plans
- Parachute Deployment test
- Polarity test, if required to verify sensor polarity definitions and conventions

10 Mission Operations & Analysis

The mission operation and analysis includes a detailed explanation of the sequence of activities which are to be performed on launch date:

- Arrival at the launch site
- CANSAT recovery mechanism
- Data analysis

It should also include:

- Mission sequence of events
- Antenna design, development and ground station setup
- CANSAT assembly and testing

- Any color-coding team has done

11 Requirements Compliance

The requirements compliance details should be provided clearly as below. Any deviation should be clearly brought out, stating the reason thereof.

S. No	Requirement
1.	Total mass of the CANSAT shall be under 0.700 kg (+/- 0.050 kg).
2.	CANSAT shall fit in a cylindrical body of 0.125 m diameter x 0.310 m height. Tolerances are to be included to facilitate container deployment from the rocket fairing.
3.	Any sharp edges on the container body shall be avoided as it can cause interfere during the CANSAT ejection from the rocket.
4.	Color of the CANSAT body shall be fluorescent i.e., pink, red or orange, and shall embody the Indian flag.
5.	Rocket Airframe will not be allowed to be used as a part of any CANSAT operation.
6.	The CANSAT shall consist of necessary sensors to provide the following mandatory Real-time datasets: Position data, altitude, pressure, temperature, orientation data, power data & system status.
7.	Each data field shall be displayed in real-time on the ground station user interface/software.
8.	CANSAT shall also record the data and save it into an onboard SD card in case of telemetry connection loss
9.	All electronics shall be enclosed and shielded from the environment. No electronics can be exposed except for sensors. There must be a structural enclosure.
10.	CANSAT structure shall be built to survive 15 Gs of launch acceleration & 30 Gs of shock.
11.	Electronic circuit boards must be hard mounted using proper mounts such as standoffs and screws. High-performance adhesives can also be used.
12.	Team number, email address and phone number must be placed on the structure in English, Hindi and the Regional language of the launch state to aid in recovery.
13.	An audio beacon shall be installed on CANSAT as a recovery assist. It may be powered after landing or operate continuously. The audio beacon must have a minimum sound pressure level of 92 dB, unobstructed.
14.	The CANSAT shall have an external power switch with an indicator light or sound for being turned on or off, in order to avoid the de-assembling of CANSATs on the launch pad.

15.	The CANSAT shall have a battery capacity to support up to 2 hours of wait in on the launch pad with additional time for flight operations.
16.	The battery source may be alkaline, Ni-Cad, Ni-MH or Lithium ion. Lithium polymer batteries are not allowed. Lithium cells must be manufactured with a metal package similar to 18650 cells.
17.	An easily accessible battery compartment must be included allowing batteries to be installed or removed in less than a minute and not require total disassembly of the CANSAT.
18.	Spring contacts shall not be used for making electrical connections to batteries. Shock forces can cause momentary disconnects.
19.	The CANSAT shall contain a total of 2 descent control mechanisms, to be used at different stages while descent.
20.	CANSAT shall immediately deploy the first parachute after ejection from the rocket.
21.	The first parachute shall be connected to the outer body of the CANSAT and no ejection mechanism shall be attached to it.
22.	The descent rate of the 1st parachute shall be 20 m/s +/- 5m/s
23.	The second descent control mechanism shall open at an altitude of 500m (+/-10 m) to further decrease the descent rate of the CANSAT to 1 to 3m/s
24.	The descent control system shall not use any hazardous chemical-based explosive or pyrotechnic devices. However, green propulsion is allowed if being used under the same weight constraint.
25.	CANSAT shall stabilize itself during the decent using the mechanical gyro mechanism.
26.	The CANSAT communications radio shall be the XBEE radio series 1/2/pro.
27.	The XBEE radios shall have their NETID/PANID set to the team number.
28.	The XBEE radio shall not use the broadcast mode.
29.	The XBEE radio can operate in any mode as long as it does not interfere with other XBEE radios.
30.	Each team shall develop and use their own ground station. All telemetry shall be displayed in real-time during launch and descent. All telemetry shall be displayed in engineering units (meters, meters per second, Celsius, etc.). Teams shall plot data in real-time during flight.
31.	The ground station shall command the CANSAT to start transmitting telemetry prior to launch.
32.	The ground control station antenna shall be elevated from ground level to ensure adequate coverage and range.
33.	Stability of the ground station must be ensured.

34.	The CANSAT shall not transmit telemetry until commanded by the team ground station. Command can be executed while the CANSAT is in the rocket on the launch pad.
35.	The ground station shall be able to command the CANSAT to calibrate gyros, barometric altitude, accelerometer to command the parameters to zero as the CANSAT sits on the launch pad.
36.	The ground station shall generate .csv files of all sensor data as specified in the Telemetry Requirements section.
37.	Telemetry shall include mission time with one second or better resolution.
38.	Mission time/timestamp and system status states shall not be affected in the event of a processor reset during the launch and mission.
39.	The ground station shall include one laptop computer with a minimum of two hours of battery operation, XBEE radio and a hand-held antenna.
40.	The ground station must be portable so the team can be positioned at the ground station operation site along the flight line and if required the team can also move to a different location in case of distant landing location in order to locate the CANSAT.
41.	The flight software shall maintain and telemeter an indicator of the CANSAT flight software state. An example set of states is 0 (BOOT), 1 (TEST_MODE), 2 (LAUNCH_PAD), 3 (ASCENT), 4 (ROCKET_DEPLOY), 5 (DESCENT), 6 (AEROBREAK_RELEASE), and 7 (IMPACT).
42.	Upon powering up, the CANSAT shall collect the required telemetry at a 1 Hz sample rate or more. The telemetry data shall be transmitted with ASCII comma-separated fields followed by a carriage return

- State current design compliance to requirements
- Any deviation from the set design parameters is to be mentioned with proper reasons

12 Code of Ethics and Standards

The teams are advised to follow code of ethics and standard during all times of the competition. Additional, noncompliance's are provided below, that can lead to disqualification of teams from the competition:

- copying any designs from any other CANSAT competition.
- copying codes/ground station software.
- Submission of incomplete PDR/CDR documents.
- Any team not meeting the competition timelines.
- Teams found outsourcing the CANSAT development.
- Usage of any restricted or hazardous chemicals etc.

NB; The decision of organizers will be final and binding on all the teams

13 Additional Information

- Teams will be notified regarding the launcher interface details as and when launcher is finalized.
- In case of CANSAT ejection system failure from the rocket a second launch opportunity will be provided to the teams at free of cost.
- If the CANSAT is destroyed due to the rocket launch failure, the team shall be given preference in the finals of the subsequent CANSAT competition.
- In case of any clarifications/queries regarding the document the teams are advised to contact organizers through their faculty advisor via email, within 15 days of the release of this document.

14 Conclusion

It should contain brief description of the work with the derived conclusions from the problem statement.

Annexure-1

Guidelines for

IN-SPACe CANSAT India Student Competition 2022-23 organized by ASI

1. The competition is open to all undergraduate students enrolled in Indian colleges/universities.

2. Applicants shall apply for the competition in teams and the team applying for the competition shall have a minimum of 5 members and shall not exceed 8 members.

3. Only 1 team is allowed per college/university. If the college is affiliated to a university one application from each of these affiliated colleges is allowed.

4. Additionally, the Undergraduate Student team can have 1 faculty coordinator/advisor and up to 2 mentors who could be the graduate students enrolled in the university's higher education courses *or* faculty *or* the alumni of the institution. If there is no mentor than the faculty coordinator/advisor shall act as mentor.

   The role of the faculty coordinator/advisor is to:

   - Act as a point of contact for the team, both with the university and ASI
   - Assist teams with logistics such as arranging conference rooms, lab resources etc.
   - Providing general guidance throughout the competition.
   - The faculty advisor shall not make design decisions or direct recommendations or participate in more than an oversight role during reviews.

The role of the mentor is to:

   - Act as a liaison between the team and the competition committee. The mentor will be responsible for scheduling all competition reviews and coordinating all communications with the team. Mentors are also responsible for tracking the team's progress throughout the competition.
   - Team mentors shall be available to answer questions and provide general guidance.
   - The mentor shall not provide design recommendations.

5. The team applying for the competition must provide an approval letter from the institution consisting of the details of all the team members including the name, Institute ID, course enrolled in branch, year of graduation and the role in the Team (roles can be defined as per the tasks assigned to the team members) on the institute's letterhead duly signed by the head of the institution. The scanned copy of the letter shall be attached with the registration form. (Approval letter template can be downloaded from ASI website: https://www.asindia.org)

6. **Last Date to Apply**: **31 July 2022**

7. In case of any changes in the team after the registration, an official request shall be made by the faculty coordinator/advisor regarding the same to asindia.org@gmail.com with a subject

line: Team Change Request CANSAT India by IN-SPACe. No change shall be permitted post PDR.

8. Additional details:

- After the registration timeline is complete, participants will be provided with a mission requirement document for the CANSAT competition.
- The participants will be required to submit preliminary design review document (PDR) along with a non-refundable participation fee of Rs. 5,000/- (Rupees Five Thousand Only).
- The teams can start marketing pitch to attract sponsorship.
- All registered teams will then present their preliminary design review (PDR) to the jury.
- After the qualification at PDR stage teams, the qualified teams will have to pay Rs. 20,000/-(non-refundable) to further participate in the competition.
- The participants will be required to submit comprehensive design review (CDR) document within a specified period. The maximum cost of the CANSAT cannot exceed Rs. 1,00,000/- (Rupees One Lakh Only). The cost break up shall be presented during the CDR. The usage of make in India components will be given due weightage during the evaluation.
- The CDR qualified team shall be permitted to fly their CANSAT, after mission/flight readiness review. The further rounds of review and will be communicated in due course. The organizing committee can introduce college/lab visits at any stage of the competition.
- The teams are advised to approach sponsors and will be allowed to adopt and sponsor a team (max. Rs. 1,00,000/- (Rupees One Lakh Only) for which the cost break-up shall be presented along with Critical Design Review. The qualified teams' details will be displayed on the ASI website.
- After the CDR the jury will check the CANSATs for the flight readiness during the Flight Readiness Review and launch dates will be given to the teams.
- In the final stage, CANSATs will be launched and after the flight review of the CANSATs winners will be decided.
- Launcher will be provided by the organizers. Further guidelines and evaluation criteria will be provided in due course.

➢ **The tentative timeline for the CANSAT India student competition is provided below:**

S.No.	Activity	Start Date	End Date
1.	Registration	01-07-2022	31-07-2022
2.	Mission Requirements and PDR documentation Guidelines Release	01-08-2022	15-08-2022
3.	PDR Document Submission	15-08-2022	30-09-2022
4.	Preliminary Design Review Completion	01-10-2022	31-10-2022
5.	Market Pitch and Critical Design Review Document Submission	01-11-2022	31-01-2023
6.	Critical Design Review Completion	01-02-2023	28-02-2023
7.	Flight Readiness Review & Launch Window	15-04-2023	15-06-2023
8.	Post Flight Review and Results Declaration	15-06-2023	30-06-2023

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Approval by Executive Secretary, ASI: Signature: