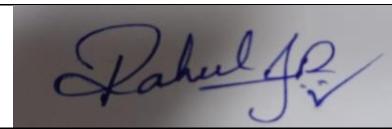
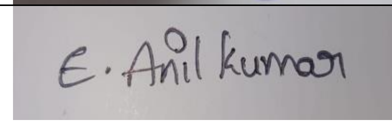
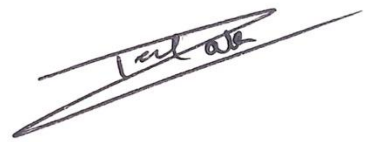
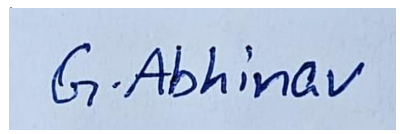
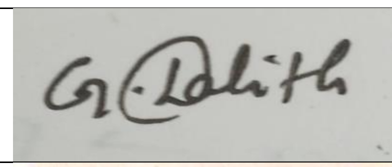
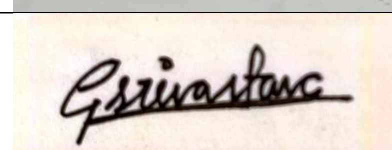
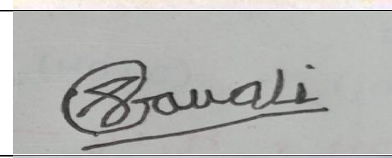
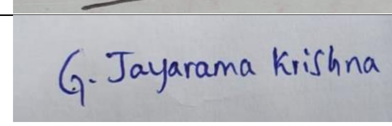
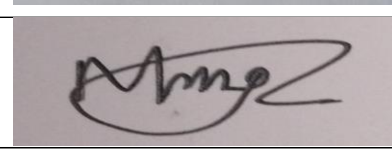
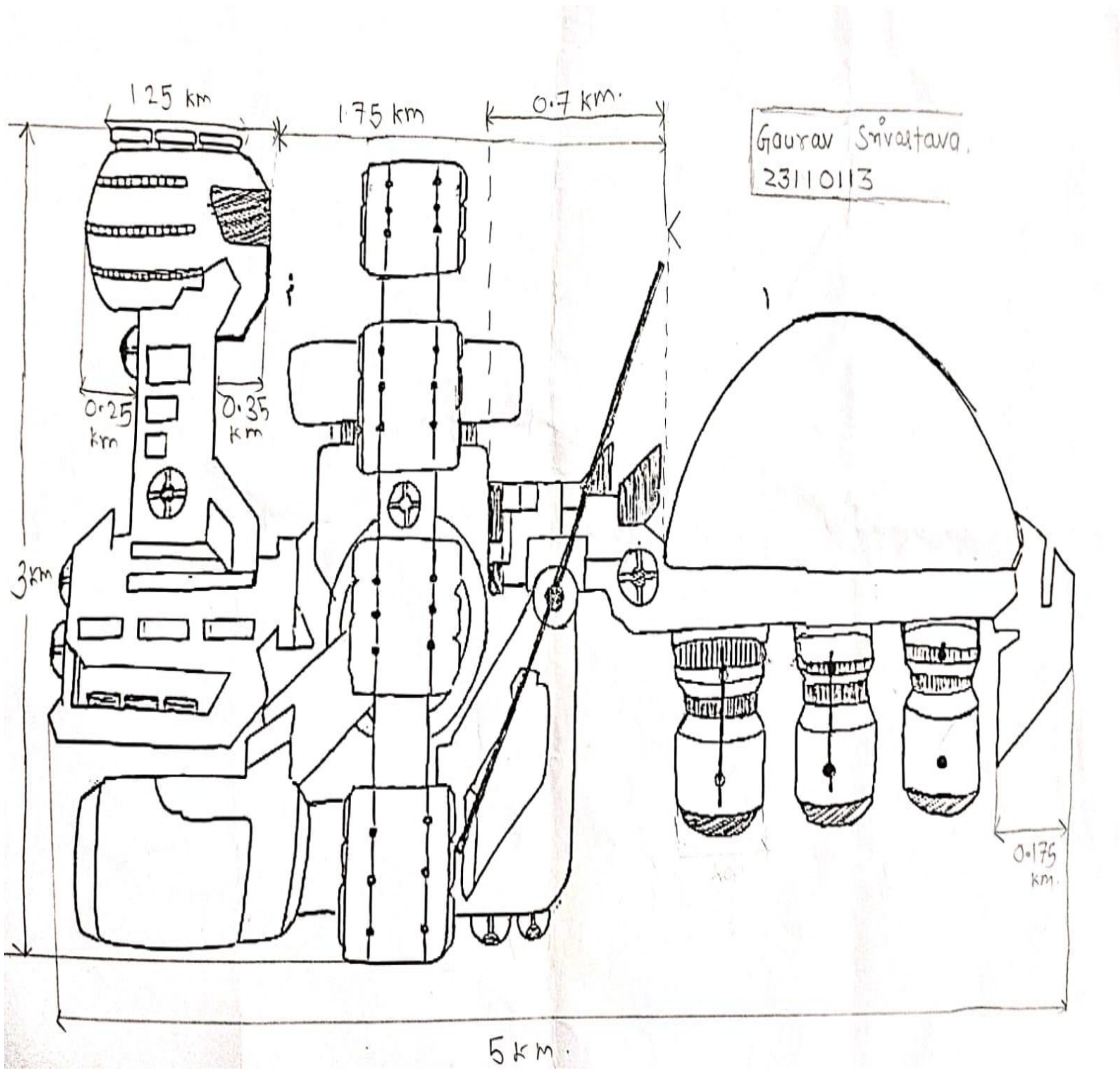
Engineering Graphics

Group 11
Project Sketches:
Interstellar Generational SpaceCraft

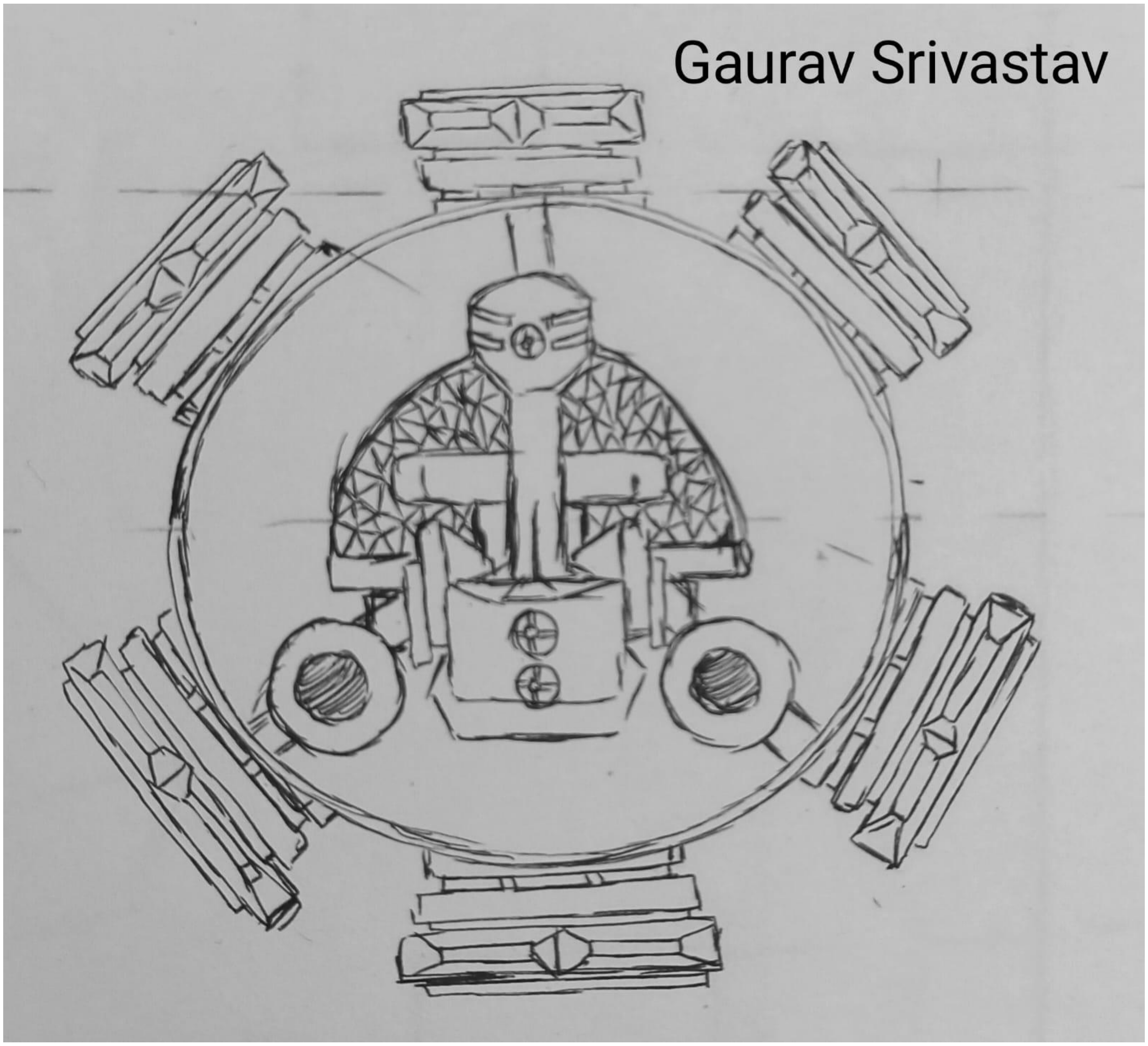
Si. No.	Student Name	Signature
1	Dungavath Rahul naik (23110107)	
2	Eete Anil Kumar (23110108)	
3	Faayza Vora (23110109)	
4	Gadhave Deepak (23110110)	
5	Gadiparthi Abhinav (23110111)	
6	Ganivada Lalith (23110112)	
7	Gaurav Srivastava (23110113)	
8	Gawali Sai (23110114)	
9	Gella Jaya Rama Krishna (23110115)	
10	Manas Gharpure (23110116)	

Interstellar Generational SpaceCraft

Final Revised Structure



Back view

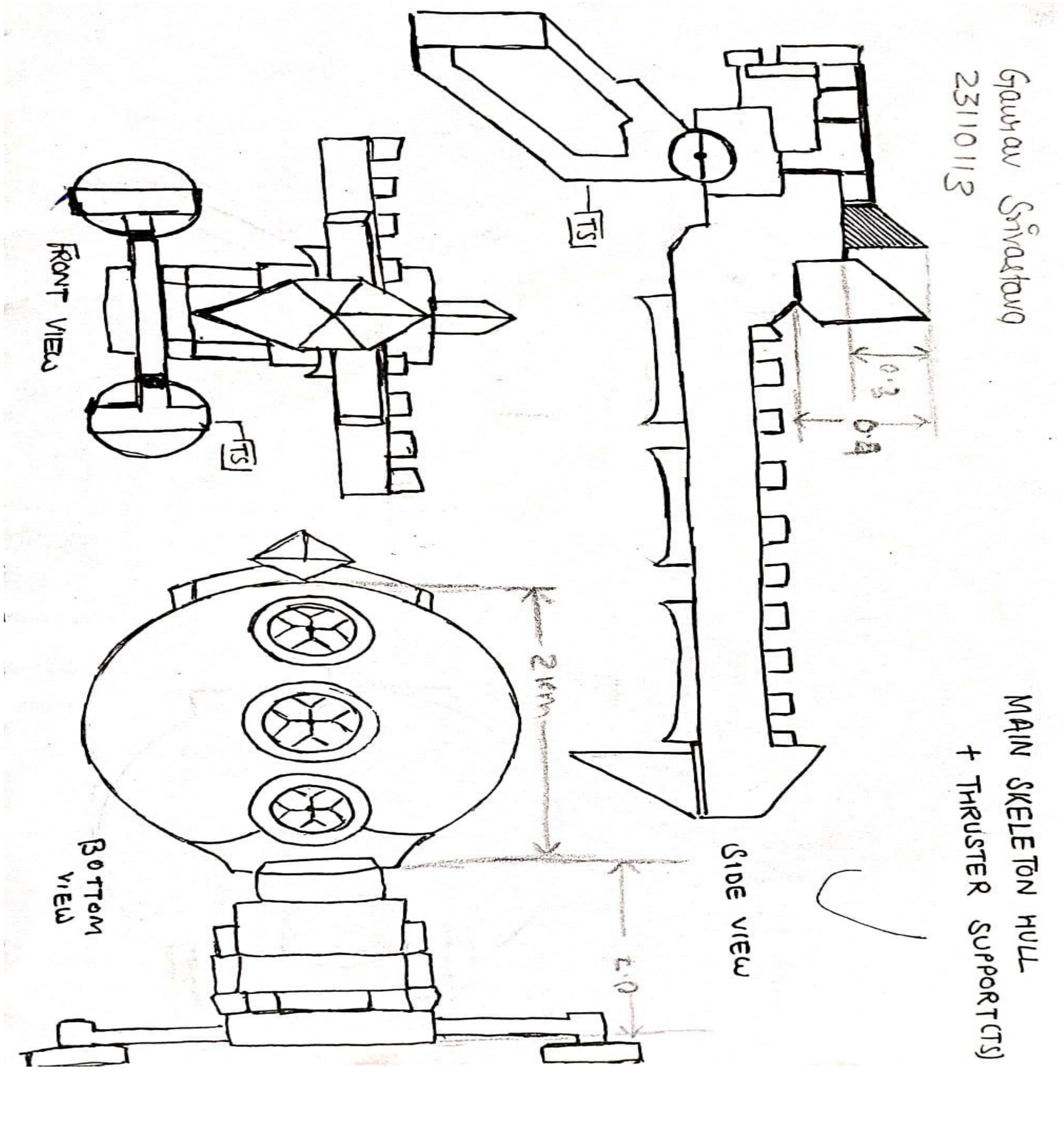


Sketches of Parts

**Disclaimer

This is a collaborative collection with various parts of documents collected from different members of the group. Each member is responsible for their own parts respectively. Wherever there are mistakes and omissions, that is their own doing and others have no hand in that.

1.Main Skeleton Hull



The second most vital structure in the ship after Artificial Biosphere dome. Located in the center front part of the ship, while it doesn't have a special function per-say, but its necessity cannot be denied. Its a very important part structure wise as it connects the dome and the rest of the spaceship, along with being attached to the Radiation Panels and providing a pathway between Dome and the escape pods, which are also attached to it, directly below the Biosphere dome. The thruster support is also attached to this, so as to provide structure support and integrity to the front part during high speed space travel and launching from atmosphere. It also has numerous pathway suitable for humans tranport as well as many high conductivity cables for transfer of various datas and commands.

Reason for Dimensions

As Artificial Dome is the core of our structure, everything else has been scaled to accommodate it, and it is especially true for Main hull. Lengthwise, it spans a total distance of 2.875 Km The circular base has nearly the same radius as that of dome. The thickness of base is 0.25 km, a length that is neighter too long nor too short, and just enough to house all the facilities and functions described above. The front end is 0.175 km,enough to support the dome in case of sudden stops. The back end is 0.70 Km long and 0.80 Km wide, it was chosen as such because it must be long and wide enough to house all facilities and provide structural integrity.

Material:

Having such an vital position, sustainability, toughness, fracture resistance, temperature resistance etc are important parameters we hae to look at before selecting the material. The Craft has to travel at temendous speeds to reach its destination. To prevent heat buildup, we must use a heat shield panels. Fibreglass Honeycomb Filled Polymer Resis seems s suitable material for it. To prevent microcracks* and crazing**, we can use experimental two-dimensional nanomaterials.

***Microcracks**: Tiny (micron-sized) damage that form on the surface or within materials. Because of their size, damage from microcracks is usually not visible to the naked eye.

****Crazing:** A network of fine cracks formed on the surface of a material.

Name- Gaurav Kumar Srivastava

Roll No- 23110113

*Part Added

2. Thruster Support

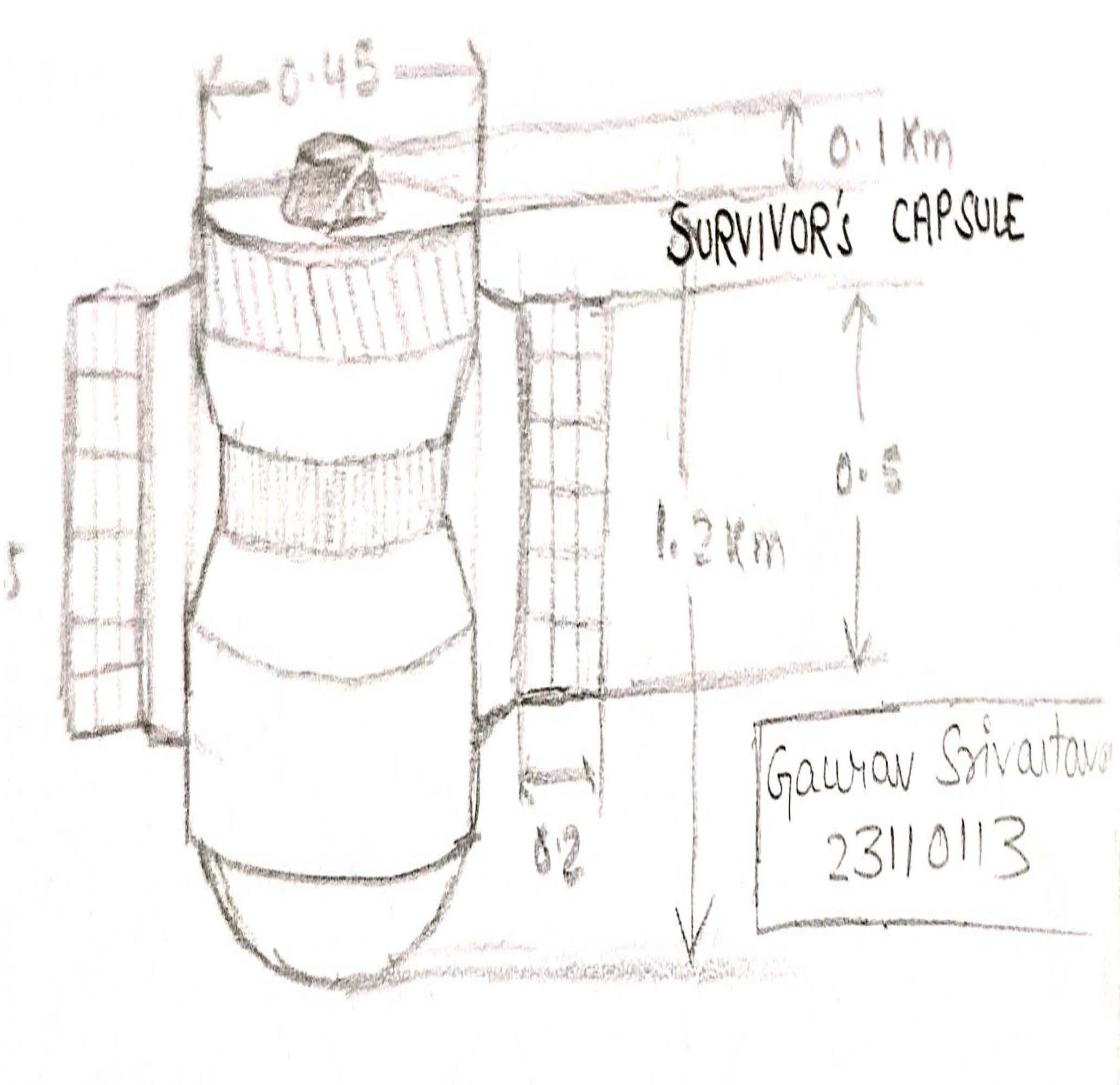
A additional part has been added in our spacecraft structure which was not documented in proposal. Its called Thruster support and it has been drawn alongwith Main thrusters in the above sketch. Due to its position, we could not separate it from the rest of the Main skeleton hull with which it is attached with. Its just a structural component which has no other function other then providing support to main skeleton hull during high speed travel that the ship has to partake. Its other end is connected to the main thrusters on both sides.

Its dimensions are subject to change based on the 3d model made as it is very difficult to assign it dimensions based on sketch only.

Reason for adding:

Main skeleton hull became too complex on its own when this part was also in the sketch so it had to be broken down into 1 big and 1 small part. Currently it can be seen in the above as well as full ship sketch.

3.Survivors Escape Pod



Having a backup plan is always necessary. That statement hold even more importance when you are sending a bunch of humans on a long voyage across interstellar space, full of unknowns and dangers that tag along it. Escape pods are self-sufficient, autonomous structures attached to the Main hull, total 3 in count with minor differences present between them, which are primarily due to the residents it is supposed to carry. 2 of them are primarily human carriers, with some amount of flora and fauna while the last one is more of a wildlife reserve with less of human presence.

They also have their own radiation panels to further advance the self sufficiency of pods.

Reason for Dimensions:

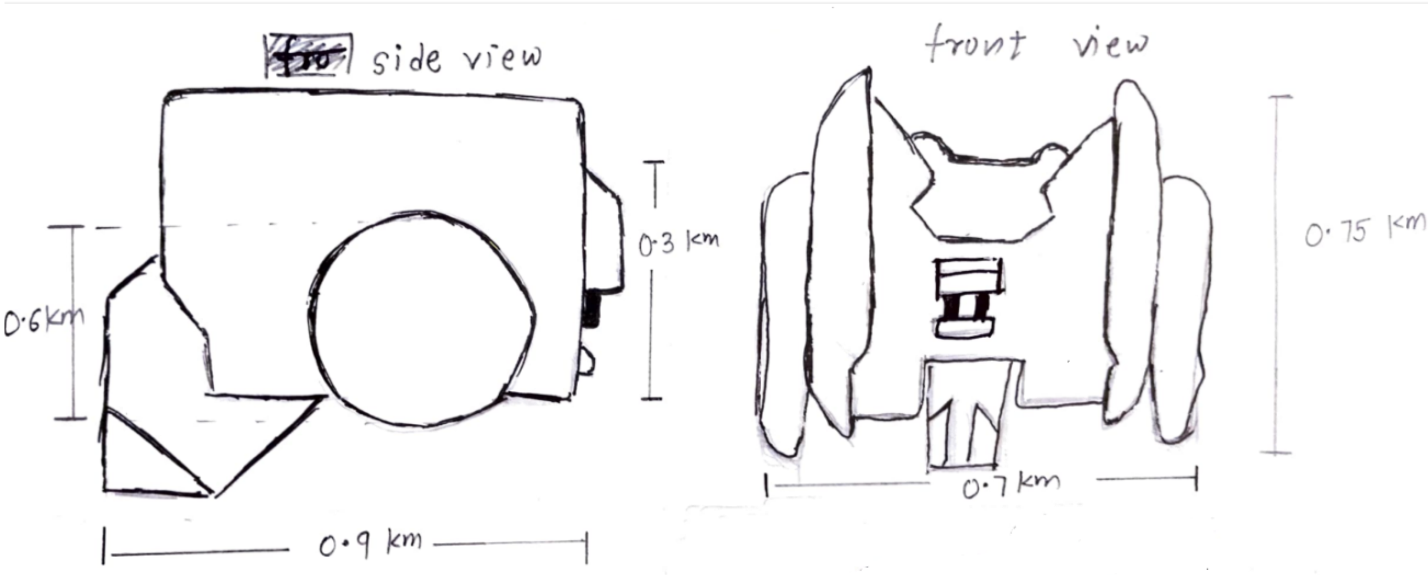
In respect of cost and sustainability, these structures cannot be too big length or breadth-wise.

As they are cylindrical structures, specifying diameter is foremost. It is 0.45 km in diameter at upper end. It just seems right to avoid cluttering and easy detachment. The radition panels, in total 2, will ne 0.5 km long and 0.2 km wide, attached to escape pod in such a eway that different panels arent crowded together.

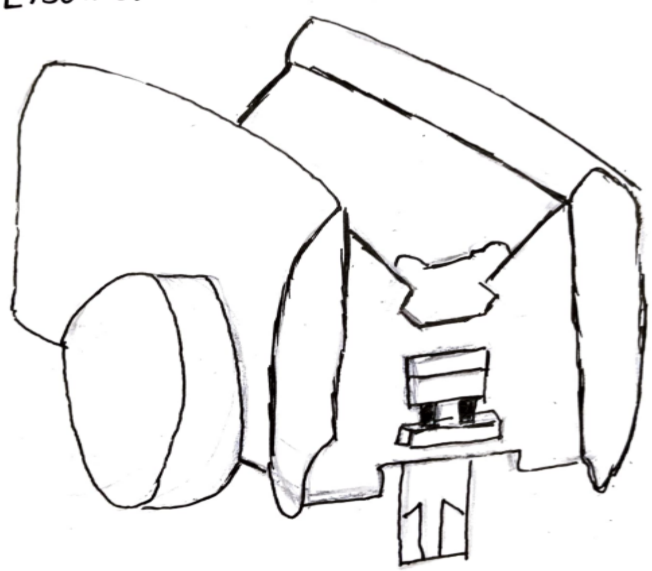
Materials:

Following the rest of craft, its exterior skin will be a multilayered structure. We may use fibreglass Honeycomb filled Polymer Resin in the outermost layer as heat shields. We may also use Resin Impregnated Carbon Fibre alternatively. For structural toughness, we can add a second layer of Carbon nanotube reinforced polymer composites..

4.Main Power Engine



Main Power Engine
[isometric view]

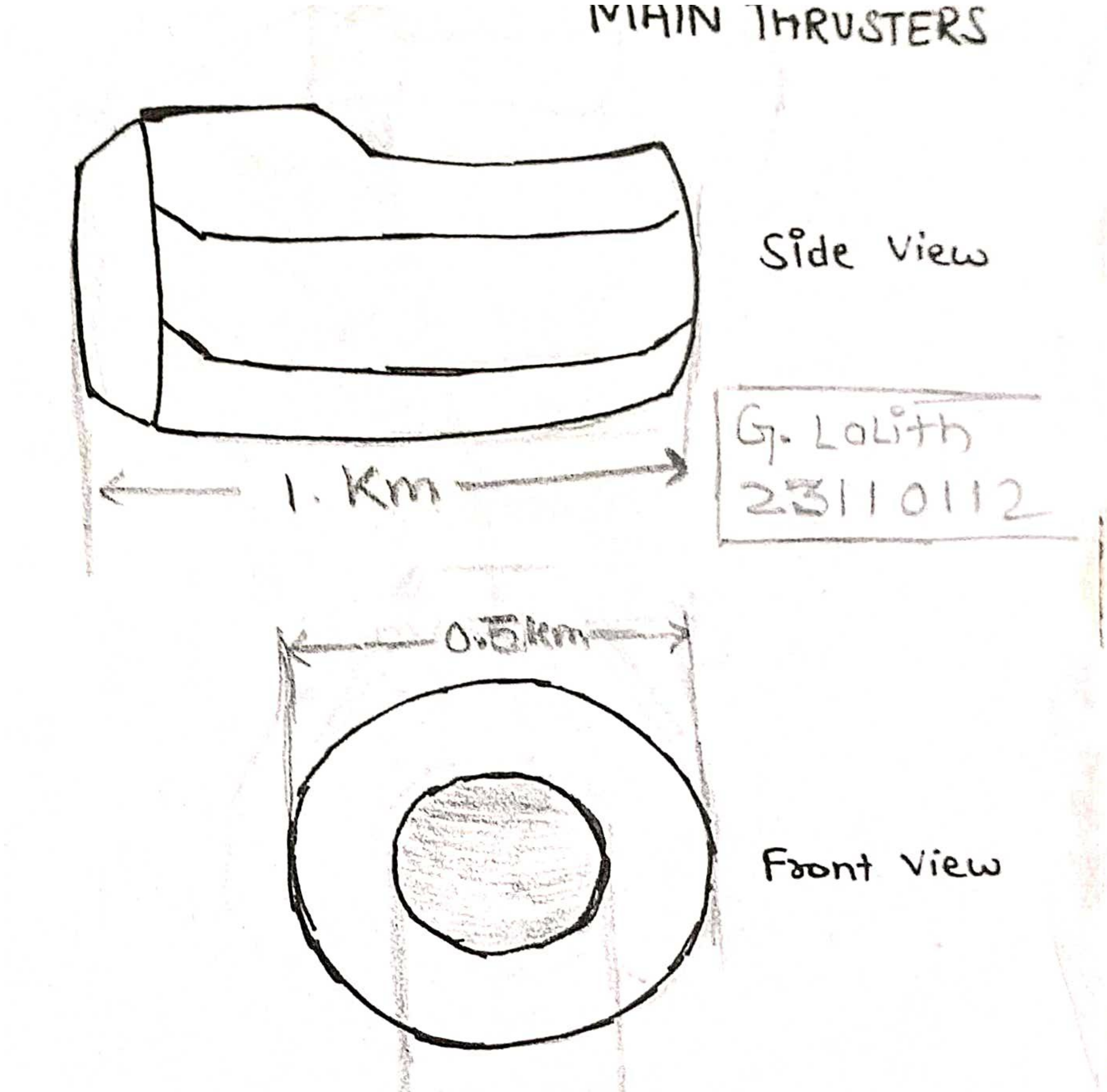


Manas Gharpure
[23110116]

Materials used for Main Power Engine : Space is an environment where temperature varies between the two extremes. Hence, various tests are undertaken so that no part of the engine faces any problem due to specific properties of materials. Several materials are tested on numerous parameters, after which a particular one is selected. To start with, to withstand the harsh vacuum of Space and minimize maintenance requirements, the exterior surface of this central component is manufactured of a highly resilient material. Further, precise details are considered when selecting a material for satisfying energy needs. Solar Panels : Spaceships use solar panels of semiconductor materials like crystalline silicon, gallium arsenide, or thin-film materials such as amorphous silicon or cadmium telluride to generate power. These materials convert sunlight into electrical energy effectively. Over a while, solar cells may get worn out. A cover glass made of tempered glass or specialized space-grade plastics is used to protect solar cells from harsh conditions. The cover glass adds mechanical strength to solar cells and resistance to radiation. Copper indium gallium selenide (CIGS) is a modern thin-film solar panel material with the potential for cheap manufacturing costs and excellent efficiency. Nuclear energy : Since 1961, radioisotopes have been an essential energy source in space exploration. In spaceships, systems based on nuclear energy have less mass than solar panels, considering equivalent power generation. This provides ease in orienting and directing the spaceship. Scientists use specialized materials to make these nuclear tanks so that the chain reaction cannot be triggered. Control rods in the reactor are made from B4C. The body of the engine is made of aluminum and its alloys because of its lightweight properties. This helps to minimize weight and to provide resistance against mechanical stress. Titanium is another such metal having similar characteristic properties. It is frequently used for imparting resistance against heat. Generally, copper and aluminum are used in electrical wirings of the engine due to their high conductivity. Heat is a significant concern for engines during re-entry into the atmosphere. Special heat shields are designed from a material called carbon phenolic. This substance is basically made up of layers of carbon fabric held by special plastic glue. The dimensions of the engine are as follows : The engine has a unique structure such that the entire engine can be placed in a cuboid of 0.9 km in length, 0.7 km in breadth and height of 0.75 km. The circular cross-section of the engine had a radius of 0.3 km, so it matched with the SHH. The uppermost point of the circular cross-section rises up to a height of 0.5 km from the base.

Manas Gharpure
23110116

5.Main Thrusters



The main thruster consists of a large number of parts, out of which some of the vital parts are:

- Main Fuel Valve
- Combustion Chamber
- Heat Exchanger
- Thrust Chamber
- Nozzle Extension
- Gas Generator

DIMENSIONS:

The Dimensions of the main thrusters are taken as follows:

The length of the thruster is taken as 1 kilometer which makes the thruster capable of producing force, which is enough to glide the spacecraft through space. Further, if we look at the thrusters from the front, we see that the outer diameter of the thruster is 0.5 kilometer's and the inner diameter is 0.3 kilometer's allowing the thruster to exert more energy, which allows the spacecraft to increase the upper limit of speed it can achieve due to which it can move more easily and swiftly.

REASON FOR TAKING THESE DIMENSIONS:

The above-given dimensions are being taken for the thrusters as those dimensions are most suitable for the spacecraft. By taking into account the size of the spacecraft, we felt that in order to maintain the proper ratio of the primary system, secondary support mechanisms, and the thrusters, we needed to have large main thrusters that have a more comprehensive nozzle extension, providing more space for releasing the energy.

In the design of the thrusters, stainless steel is used at the head section, and the niobium alloy is used at the nozzle for the thruster's hot section. Niobium is used at the nozzle extension because almost any other metal will melt under the 2,000°F temperature differential produced.

Which later goes through the thrust chamber through which the force-creating element moves out of the thrusters.

There is a combustion chamber in the thruster that oxidises the hydrogen fuel, and the energy released in this process moves to the heat exchanger for the proper stabilization of the energy.

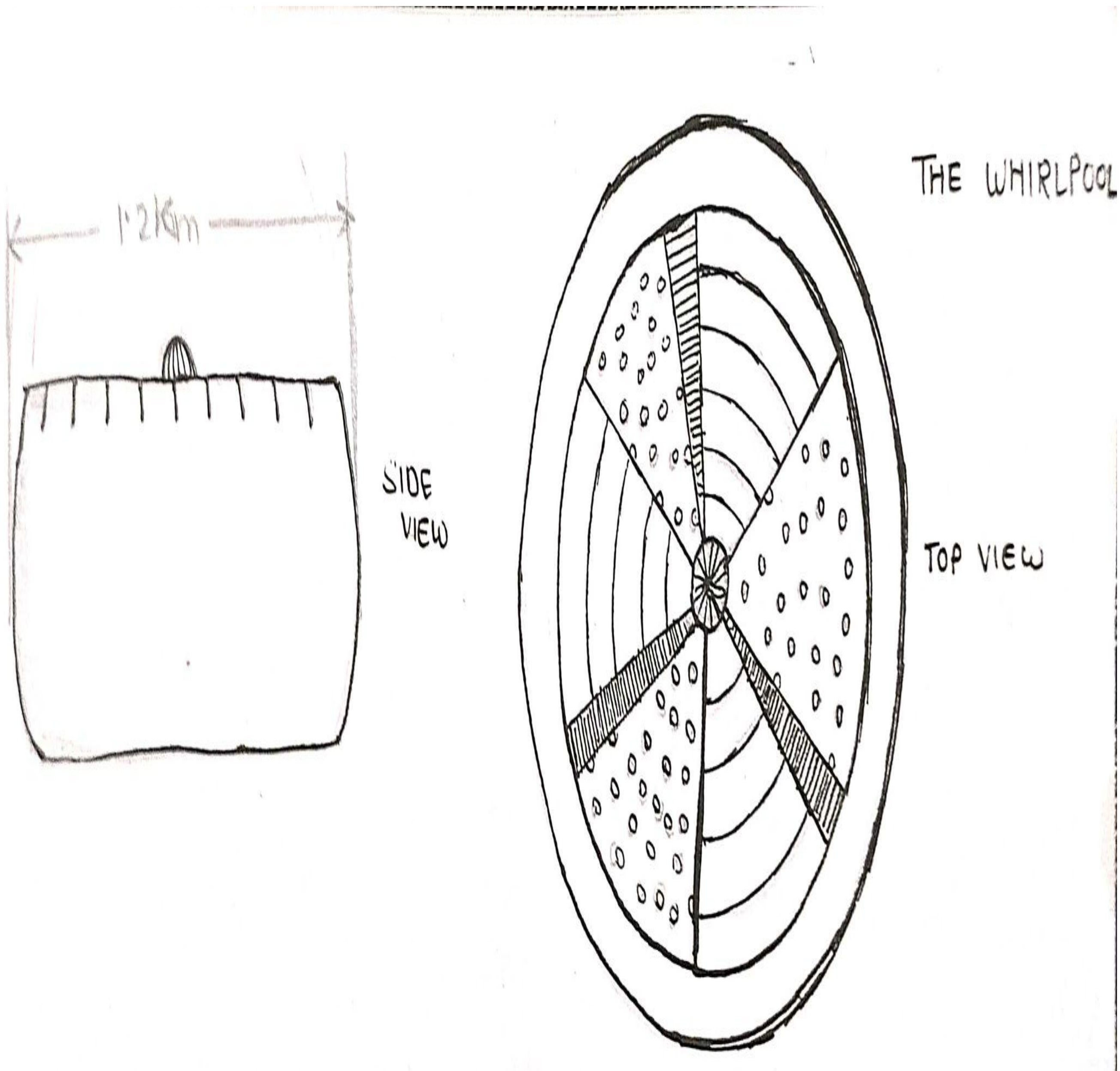
The gas generator is responsible for producing high-pressure gases that act as fuel for running the minor components in the thruster system. Its dimensions are carefully selected to ensure that it generates the required gas flow rates and pressures.

The thrust chamber is responsible for converting the high-pressure, high-temperature gases generated in the combustion chamber into thrust, which is used to change the spacecraft's direction and velocity whenever required. Its dimensions have been carefully selected to regulate the expansion of gases and maximize thrust production. A well-designed thrust chamber ensures that the propellant gases are accelerated to high velocities by providing the necessary propulsion for the spacecraft.

The heat exchanger plays it's role by efficiently transferring thermal energy from the combustion process to the Thrust Chamber. The heat exchanger's dimensions are designed to maximize the heat transfer volume while minimizing the component's overall size and weight.

In this spacecraft, a wider nozzle extension has been chosen in order to allow greater expansion of the gases. This results in higher velocities and more efficient propulsion. The dimensions of the nozzle extension are taken care of with high precision to satisfy the spacecraft's mission profile.

6.Whirlpool



HYDROGEN WHIRLPOOL:

The main parts of the Hydrogen Whirlpool are:

- Container
- Safety system
- Rotational mechanism

DIMENSIONS:

If we look at the whirlpool from the side view, we get a view of the length of the whirlpool, which is 1.2 kilometers, making it long enough in order to increase the amount of hydrogen processing that takes place per unit time, allowing more raw energy to dissipate. The small extension present is assumed to be 0.1 kilometers long.

If we look at it from the top view, we get to see 9 structures that complete the circles and look like pie slices in which there are 3 sets with different dimensions. The thickness of the wall is 0.1 kilometer while the outer diameter is 1 kilometer and the inner diameter is 0.8 kilometers.

In the design, we see that there are 2 sets (i.e., 6 slices) which are of the same dimensions, and the rest 3 slices are of smaller measurements. In 3 of these slices, we see small holes of 10-metre diameter which allow easy transfer of particles.

REASON FOR TAKING THESE DIMENSIONS:

We took these dimensions in order to satisfy the energy production requirements of the thrusters. Various holes in the structures are present to allow the free flow of air and particles of gases as and when required.

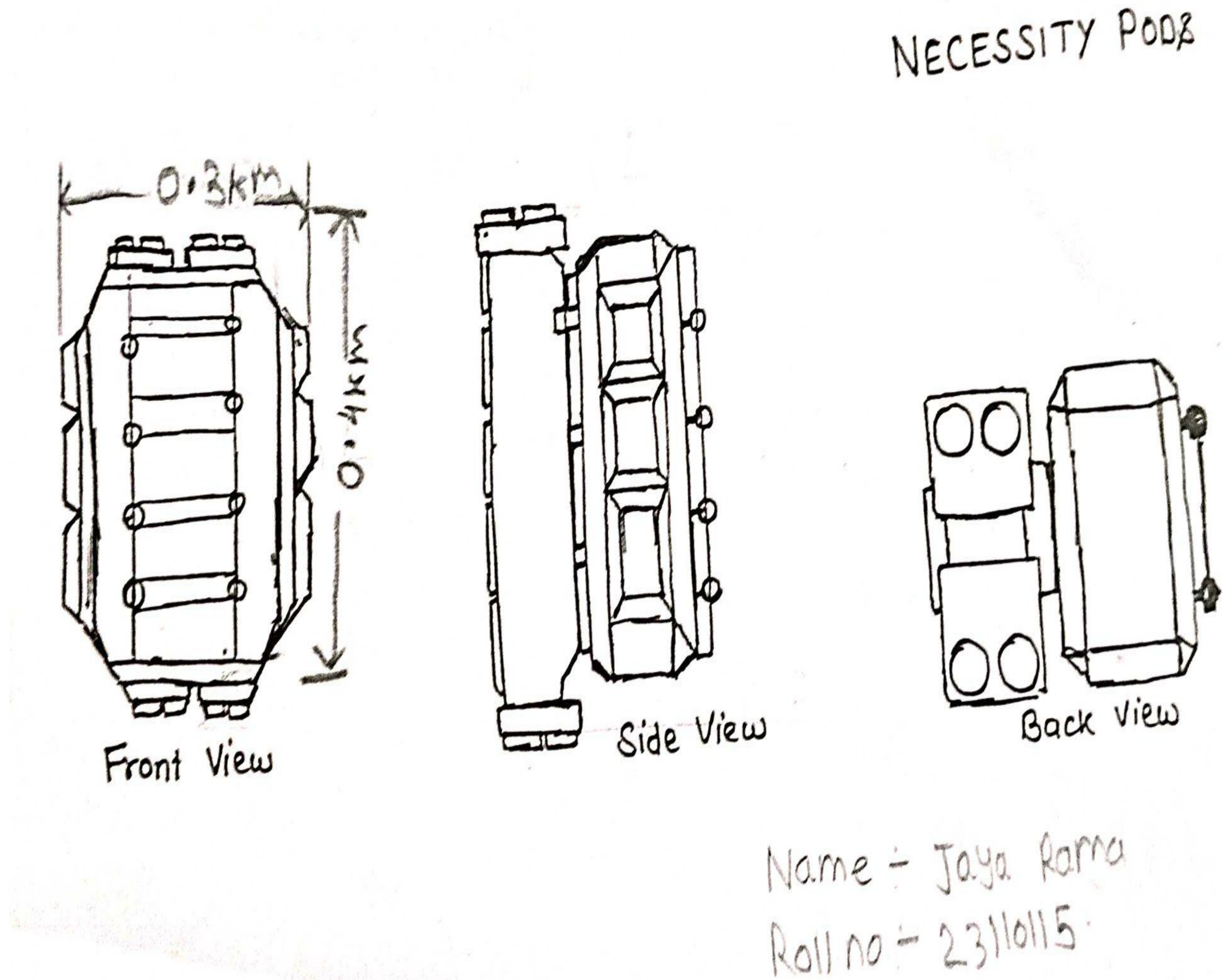
The device is 1.2 km in length in order to facilitate the requirements of the spacecraft. It even has a safety system that cools down the system as soon as the temperature limit is breached or any sort of mishap happens. Thus presenting a safer environment to the cosmonaut.

There are rotational mechanisms by the sides that control the movement of the system and even control the RPS as and when it goes overboard.

Hence, in accordance with all these features, we can say that the Hydrogen Whirlpool plays an important role in the generation of hydrogen power.

Name- Ganivada Lalith
Roll no- 23110112

7.Necessity pods



Research pods:

Research pods are used for research purposes, and these are large enough and are also separated into different compartments for various types of research. The research found is helpful for scientific investigations during space missions. These research pods are attached to the equator ring. These pods are in open space and are attached to solar panels.

Reason for selected dimensions:

The reason for the selected dimensions is that I need to fit 16 pods around the equator ring and the circumference of the ring is 8.7 km, so the length that I chose for research pods is 0.4 km. The breadth and height dimensions are 0.3 km, I chose this because they should be spacious enough the gap between each pod is 0.1km, and the thickness of the wall is 1.5 meters also, some soft materials are added to the wall for safety purposes of the people. These walls are thermally stable, and this pod is also divided into different compartments.

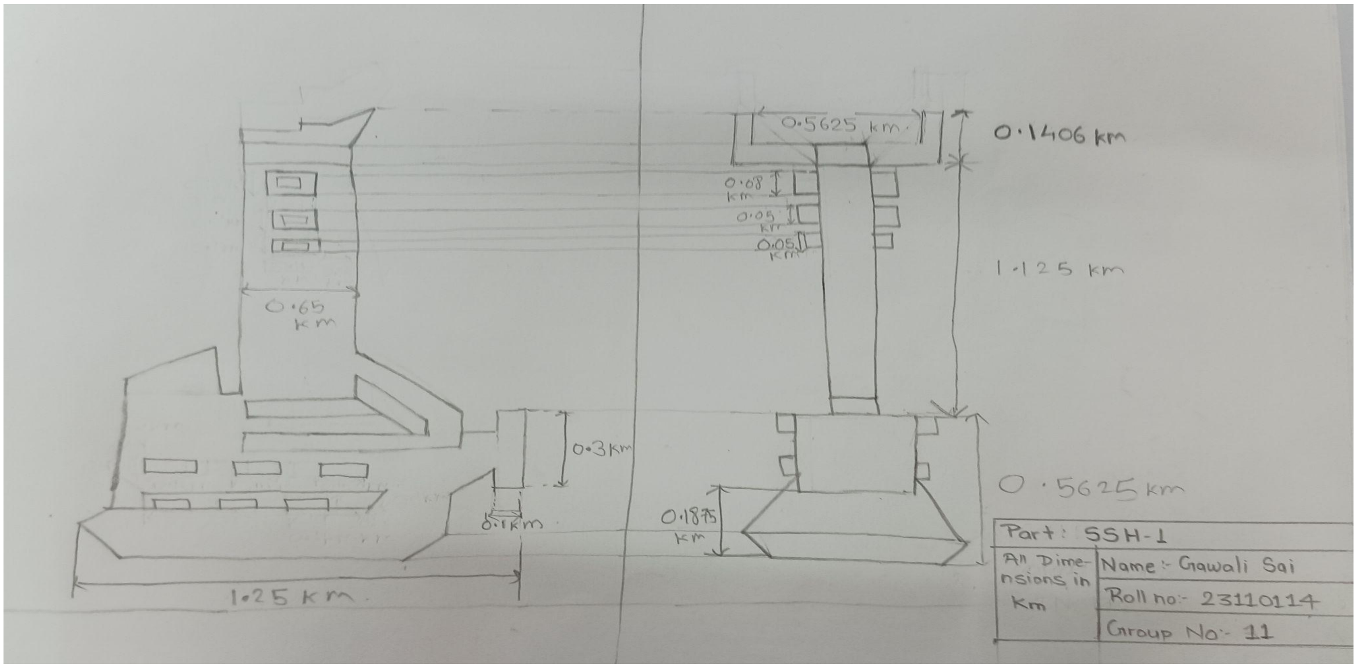
Materials:

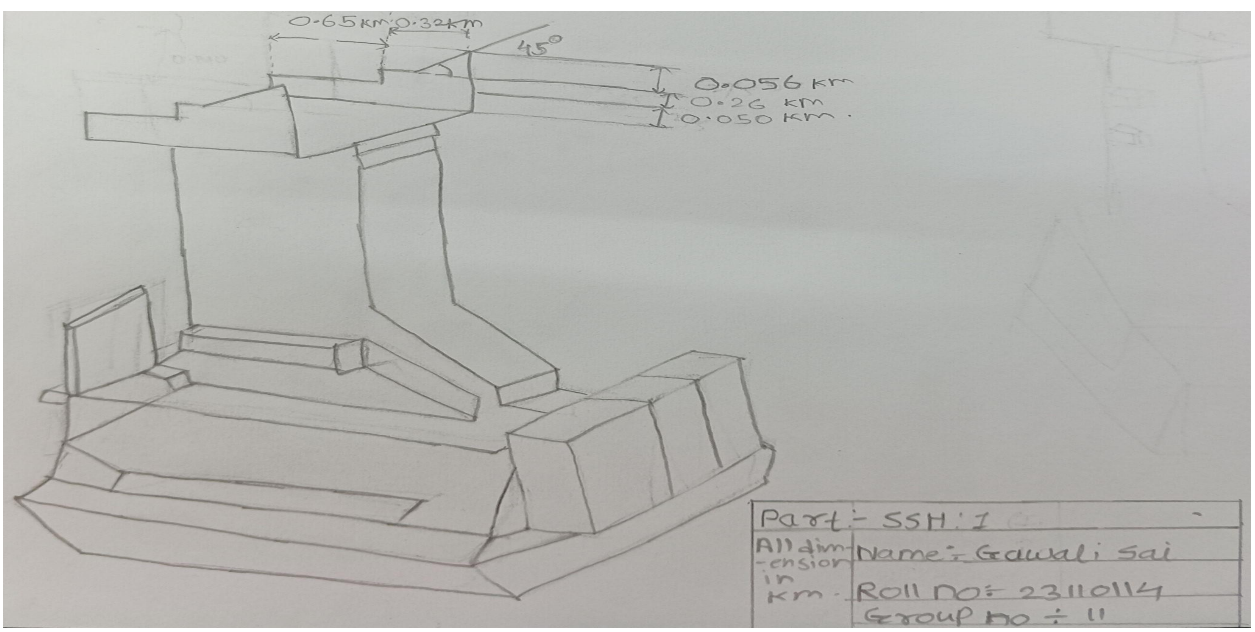
These are in cuboidal shape, and to make the structure, we use different kinds of metals; these are lightweight metals we use are aluminum and titanium. For temperature purposs, we use aerogels and multi-layer insulation blankets. Lead and polyethylene to protect sensitive equipment and from space radiations. Specialized glass may be used as windows to see outer space used for research and be used to protect from radiation.

Name: Gella Jaya Rama Krishna

Roll no- 23110115

8.SSH 1


0.5625 km
0.1406 km
0.08 km
0.05 km
0.05 km
1.125 km
0.65 km
0.3 km
0.1 km
0.1875 km
0.5625 km
1.25 km
Part: SSH-1
All Dimensions in Km
Name:- Gawali Sai
Roll no:- 23110114
Group No:- 11


0.65 km
0.32 km
45°
0.056 km
0.26 km
0.050 km
Part:- SSH-1
All dim-ension in km
Name:- Gawali Sai
Roll no:- 23110114
Group no:- 11

As a secondary Skeleton Hull-1 is one of the important part of the Interstellar generation spacecraft. It helps to hold the command module station as the functioning of the spacecraft is done from the command centre. The main function of the secondary skeleton is done from the inside, but the structure of the inside parts of the secondary skeleton is so complex, so I am making this part from the outside only. Many space-related things are made from an aluminium alloy as aluminium is a lightweight metal and also an excellent thermal insulator, so for making this part, we are going to use aluminium as a material. Also, during the selection of material for making the parts of the spacecraft, we have to check many properties of that material like rigidity, strength, etc for this part, strength is important because, from the inside of this part, there is a way which connect command centre to the other parts of spacecraft. so, we are going to use carbon composite materials, such as graphite-epoxy. Graphite-epoxy is a material which is generally used in spacecraft because graphite fibres provide strength and rigidity to the spacecraft. The above materials are also used in some other parts of spacecraft.

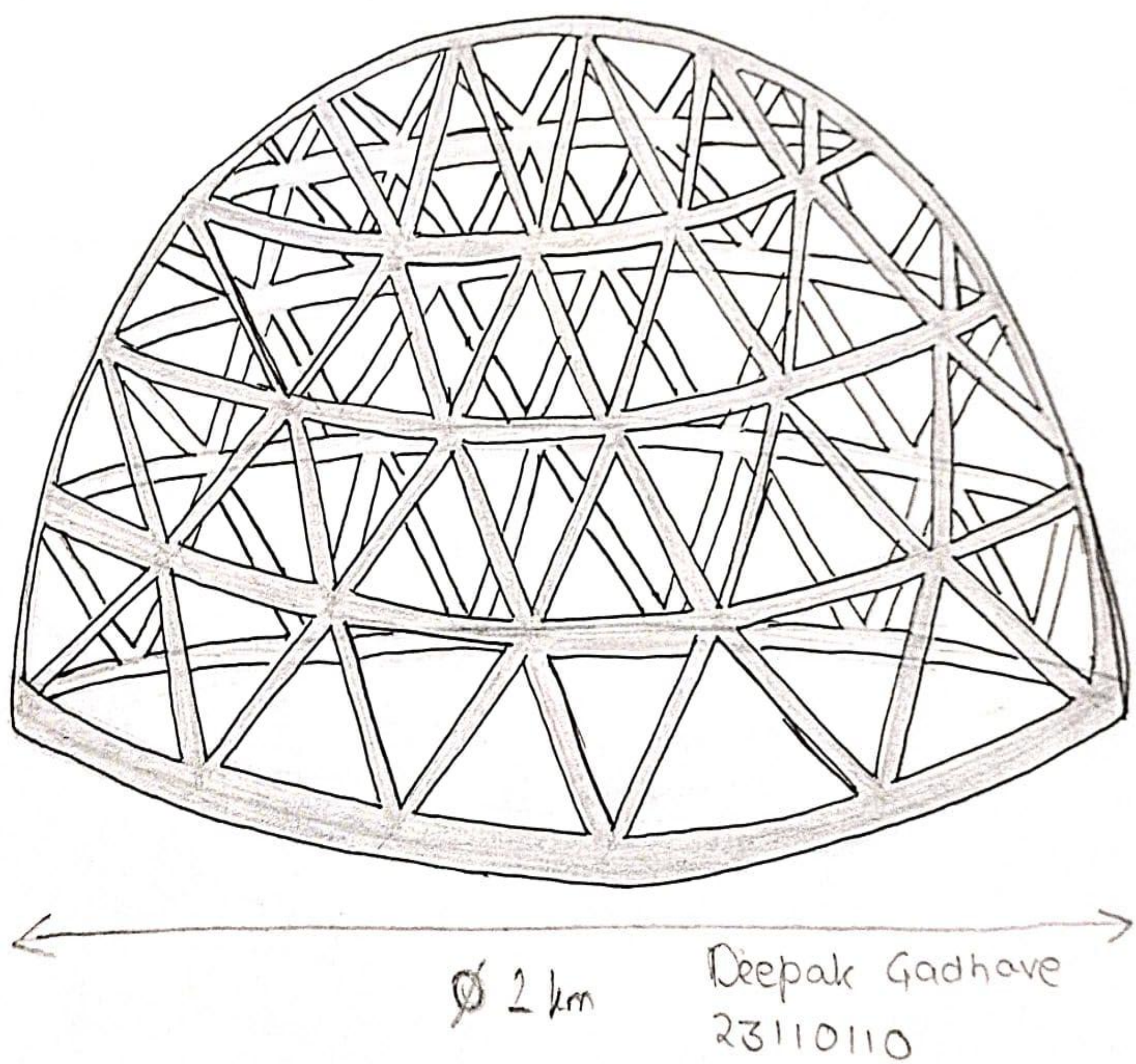
Reason for selected dimensions:

One of the works of the secondary Skeleton hull-1 is to hold the command module station. So the length of the middle part should be less than the width of the command centre. The total height of the secondary Skeleton hull is in that proportion so that the command module becomes the highest part of the spacecraft. The height of the lower part of the secondary Skeleton hull is fixed in that way such that it takes some distance between the secondary Skeleton hull and the Main Thrusters. The length of the upper part of the secondary Skeleton Hull is greater than the length of the base of the command module station. The command module station base is fixed in between the two jaws of the secondary Skeleton Hull-1. The dimensions of other parts should be taken appropriately in a manner so that it suits the overall structure.

Name - Sai Gawali

Roll no - 23110114

9.Dome



Reasons for selected dimensions: (Dome)

The biosphere dome is the central part of the spacecraft in which colonies will be established, and an artificial environment will be created for the living creatures to flourish. The diameter of the dome is 2km. The dimension of the drone is decided keeping into consideration the weight as a bigger diameter would lead to a greater weight which would cause an imbalance in the spacecraft. The dimensions of all other parts of the spacecraft are decided according to the dimensions of the artificial biosphere dome, as colonization of living beings is the main motive of our model, which is finding an alternative to Earth for colonization.

Materials:

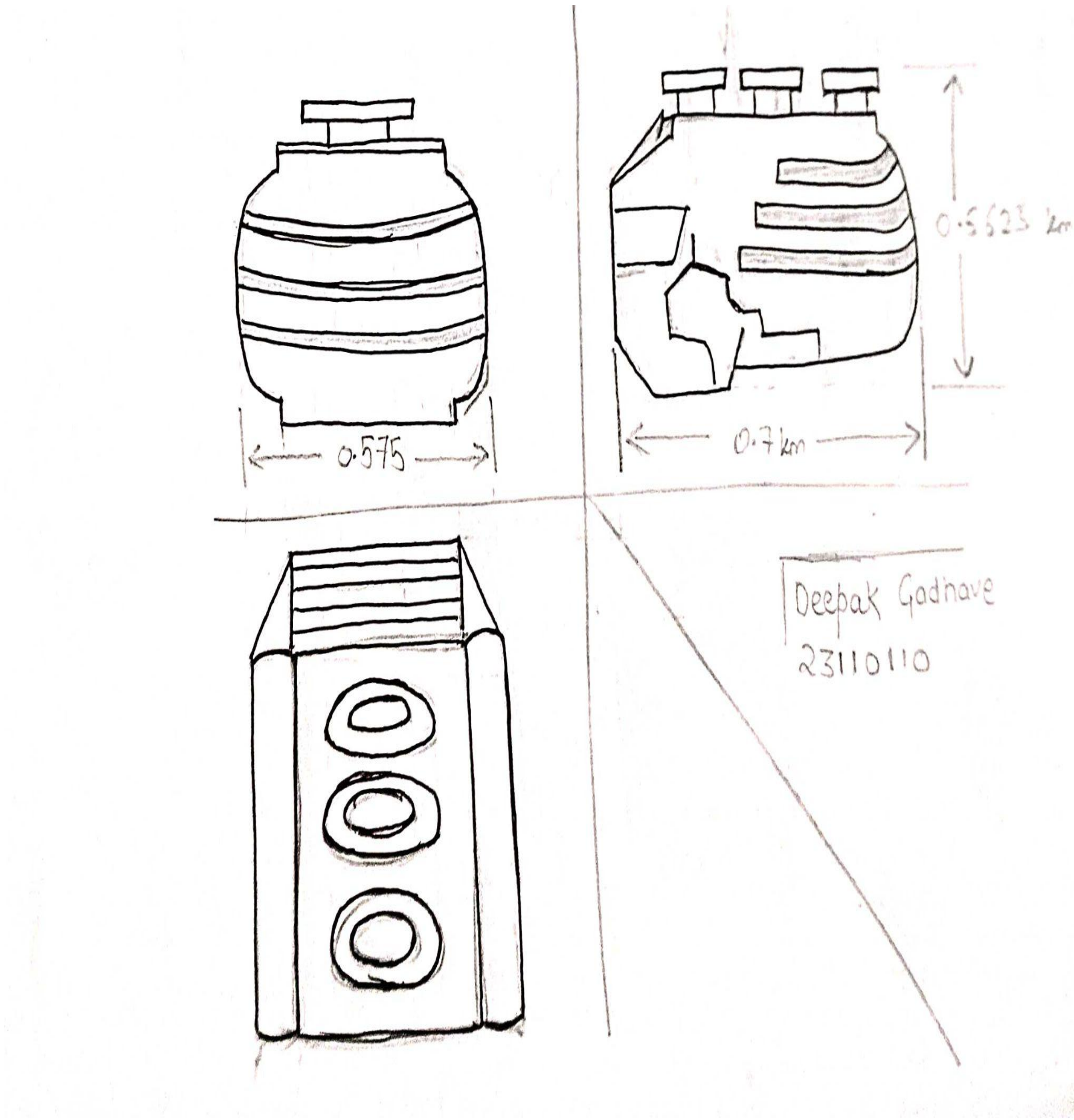
The material used for the shell is specially engineered. It is a fully transparent material that allows an unobstructed view of the biosphere's interior. Its transparency creates a profound immersion, enabling inhabitants to feel like they are a part of the natural world. The dome has triangular pattern, creating a rigid network dispersing stress force. The material of the dome should only allow light to pass through and reflect the harmful radiation from the Sun, as it can damage DNA within our cells. To overcome this problem, we can use a new-glass-based composite material created by researchers at Zhejiang University and South China

University of Technology in China. It is good at absorbing radiation. The materials are fabricated using the sol-gel method. The glass was first evolved as sol and then desiccated slowly over weeks to transform the material into a gel. Drying the gel to evaporate the remaining liquid revealed a glass material, which was then heat-treated. When produced with this method, the key to the material's radiation-busting abilities is its self-limiting nano crystallization, when made with this method. To maintain the interior environment, the shell incorporates a dynamic shading system. This system adapts to the intensity of external cosmic radiation and sunlight, ensuring that the biosphere and human habitat receive the optimal amount of light and radiation for photosynthesis and human comfort. Additionally, the dome itself is designed to self-repair minor damage, ensuring the long-term integrity of the biosphere's protective barrier.

Name- Gadhave Deepak

Roll no- 23110110

10.Command Module



Reasons for selected dimensions: (Command Module Station)

The command module stands as the undeniable captain of the vessel, orchestrating every daring maneuver and safeguarding the legacy of Earth’s native creatures. The dimensions of the command module are 0.7km x 0.5625 km. It is dimensioned according to the space occupied by parts required for continuously monitoring the biosphere, propulsion systems, and overall ship’s health, which is controlled by an AI model. So we have to take into consideration all the monitoring and controlling parts of the spacecraft that are going to be controlled from the Command Module Station before deciding the dimension of the Command Module Station.

Materials:

The rectangular structure of the command module with rounded corners is meticulously designed to maximize interior space. Aluminum alloys these are commonly utilized as lightweight structural components. Titanium Alloys, renowned for their sturdiness and resistance to high temperatures Its sides are adorned with transparent glass, similar to the biosphere dome. The same glass is selected for its exceptional transparency. It offers the command crew an uninterrupted visual connection with the ship's myriad components (Earth's native creatures), This will enhance their situational awareness and help will facilitate precise control

Name- Gadhave Deepak

Roll no- 23110110

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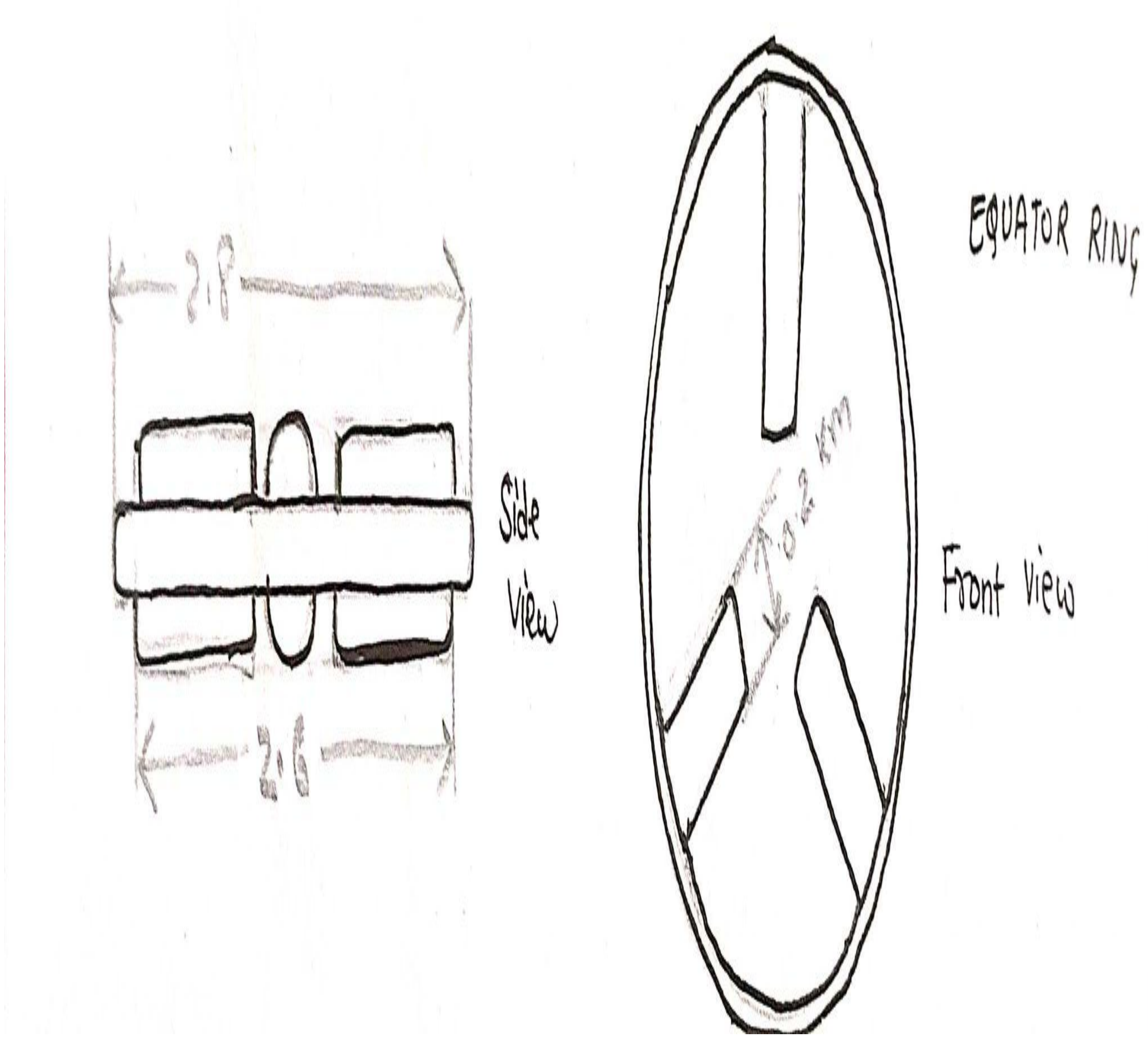
11.Equator Ring

PART NAME



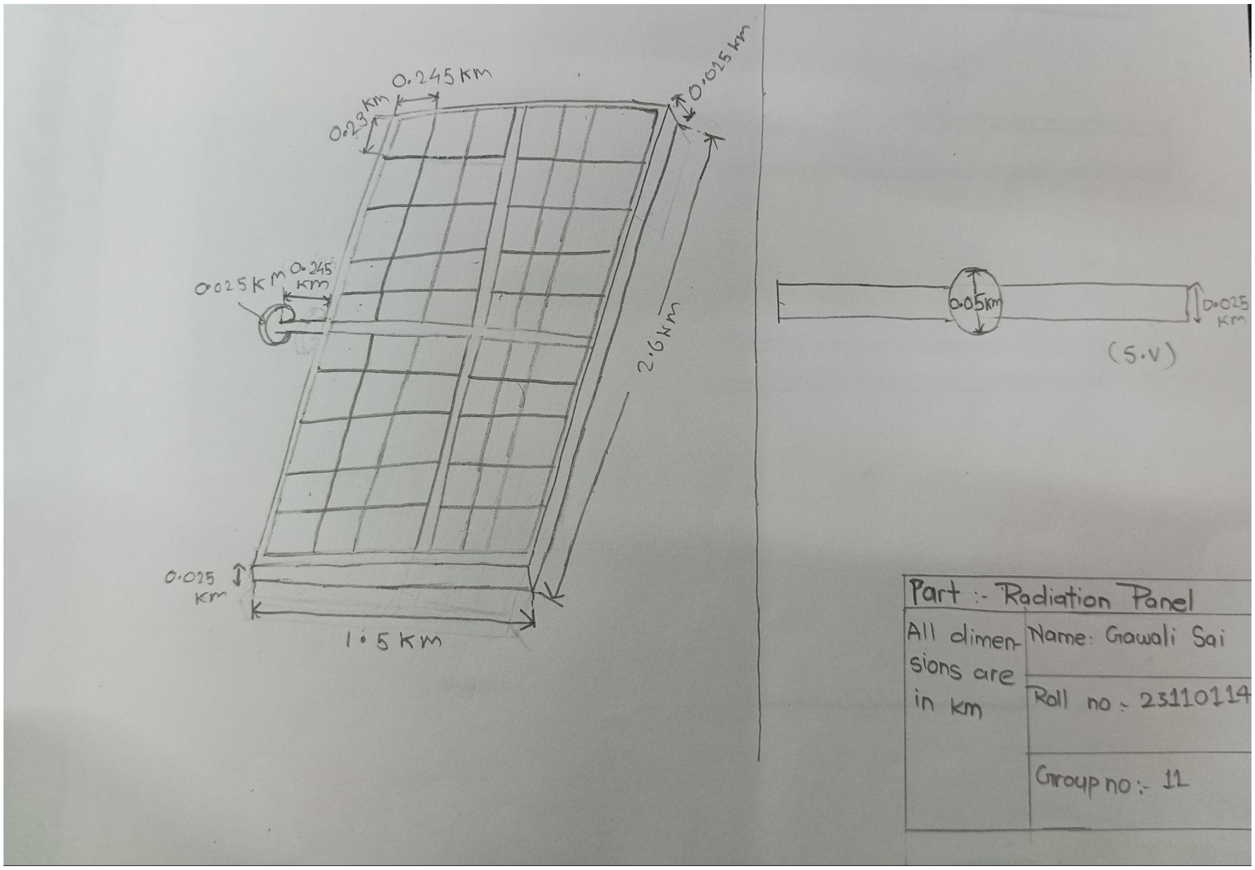
NO:

EQUATOR RING: Equator ring on a starship is a circle that circles its midsection, like the equator of the planet. It isn't something that is frequently encountered on spacecraft, but if it were, it might act as a reference point or a location where forces are balanced, similar to the equator on Earth. This idea is more typical of science fiction than of actual spacecraft design, though.

NAME: Anil Kumar

23110108

12.Radiation Panel



Material:

The radiation panel absorbs all types of radiation. Radiation panel is similar to solar panel. It consists of cells which can absorb all kinds of radiation like radiation from the sun, radiation of alpha particles, etc. So it can make electrical energy from all types of radiation. Also, it protects some parts of the dome from the radiations present in space by absorbing them. Presently, in solar panels, we use semiconductors like silicon and germanium for photovoltaic effect. The concept should be the same for the radiation panel's core material, but the difference is that the bandgap should be such that other wavelengths of light should be able to display the same effect. As for cosmic radiations, we presently do not know about their nature, but we conceptualized that we might find materials suitable for that in future.

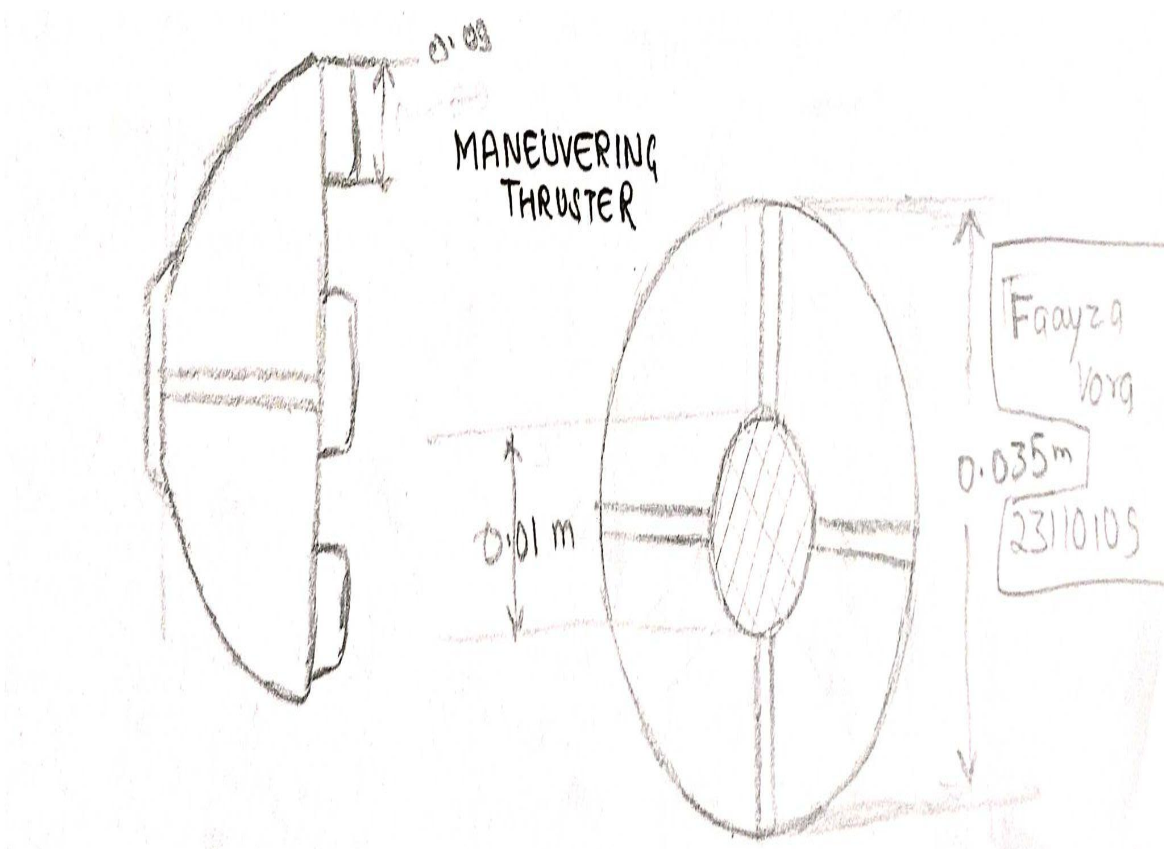
Reason for selected dimension:

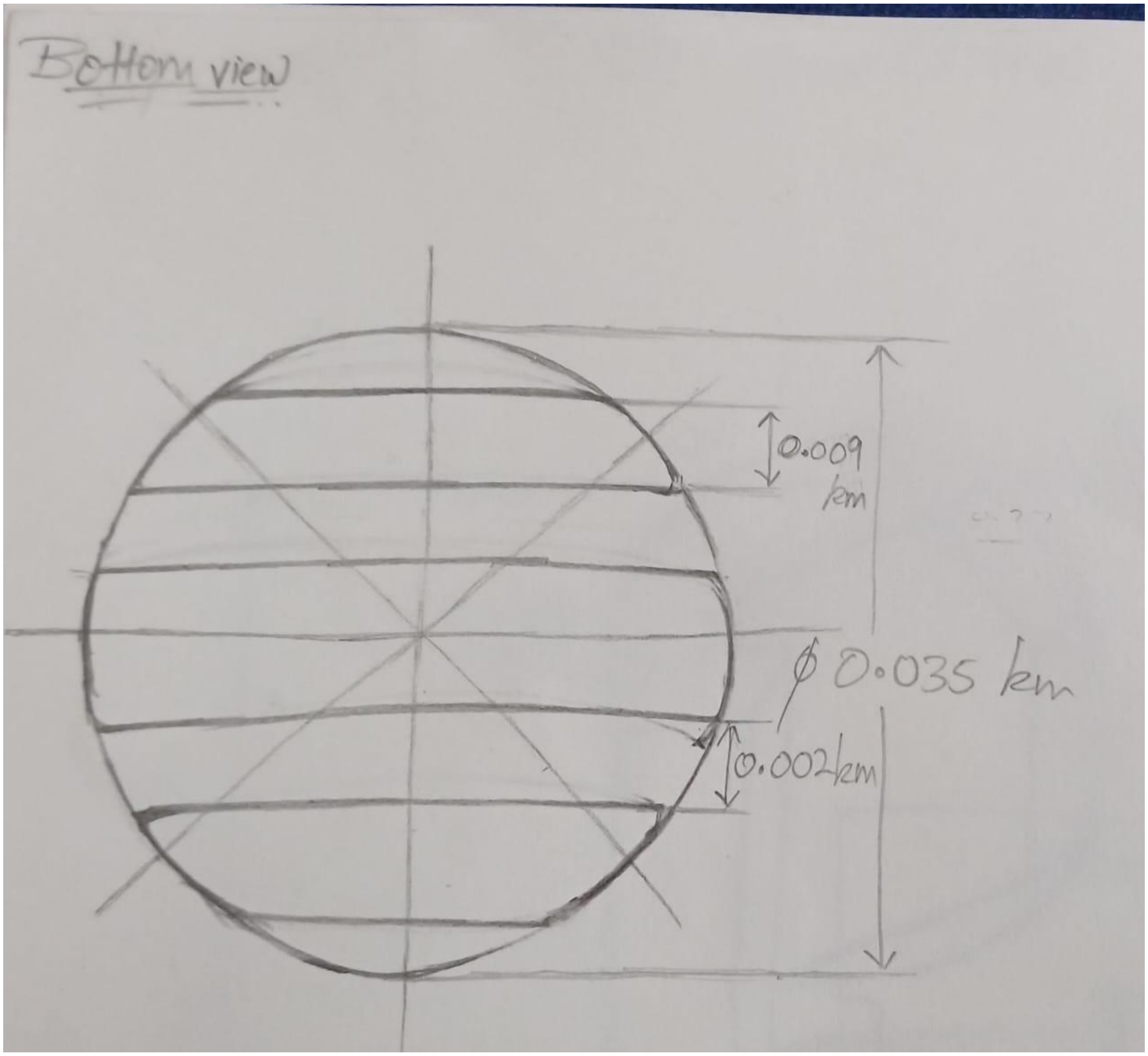
The radiation panel has three main dimensions (length, width, thickness). The length of the radiation panel is 2.6 km. The main reason for taking this dimension is that the radiation panel do not touch any other part of the spacecraft. Taking the dimensions of width and thickness also has the same reason as given above. The length and width of the cells, which are rectangular in shape, are 0.245 and 0.23. All cells have the same length. The main reason for selecting this length is that the overall energy output of the radiation panel is higher. The radiation panel is divided into four sections. All four parts are identical. There is a small gap between the sections. The length and width of the sections depend on the size of the cells.

Name - Sai Gawali

Roll no - 23110114

13.Maneuvering thruster





Reason for choosing dimension (maneuvering thrusters):

The dimensions of maneuvering thrusters are not dependent on any other component. As we know, as creatures increase in size, their mobility, flexibility, and maneuverability tend to decrease significantly. For example, the movements of insects cannot be mimicked by larger animals, and the agility of a cat is not seen in an elephant, even though both are quadrupled. Similarly, the main thrusters can provide powerful forward propulsion, but owing to their vast size, altering the course or rotation with them is both impractical and energy-inefficient. Thus, these maneuvering thrusters have a dimension of 0.035

km as diameter, with propellants of diameter 0.009km placed at intervals of 0.002km, to fulfill this critical role

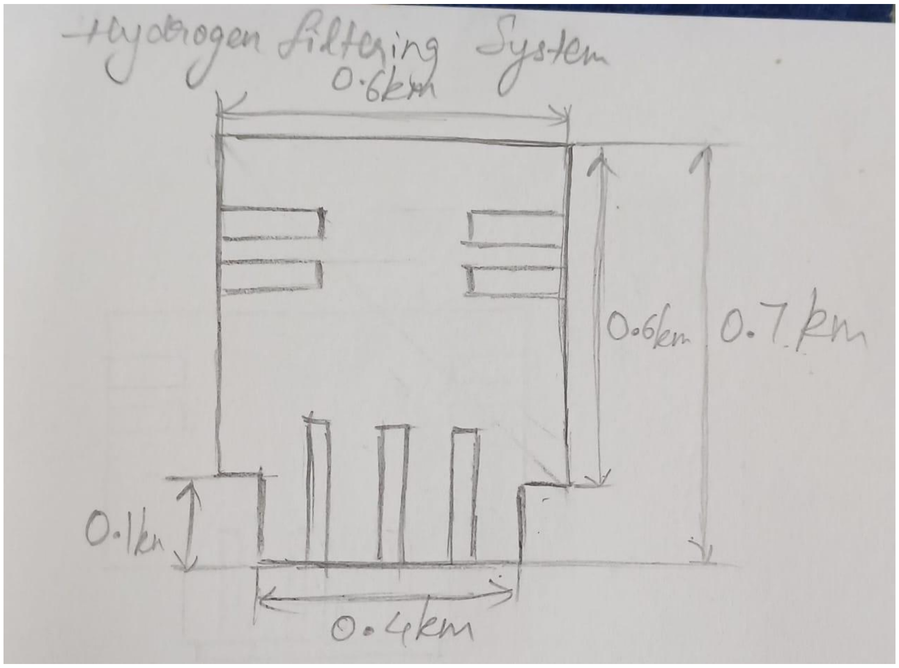
Materials

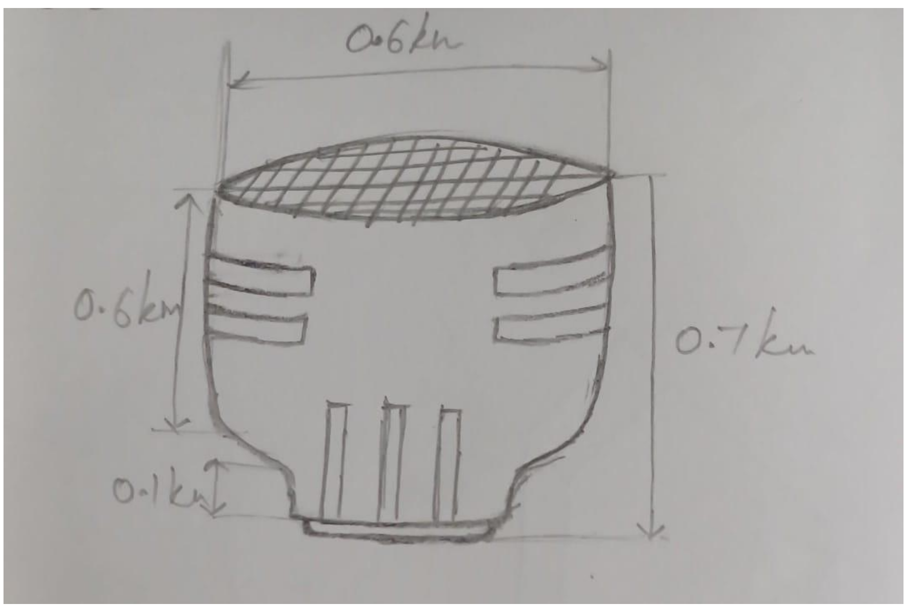
The outermost part of these thrusters will be the same as that material used to shield the Skeleton Hulls, ensuring uniformity in design and function. For the interior of thrusters the material that can be used is PEEK(Polyetheretherketone). Since the gases used in manoevering thrusters is helium and other nuclear wastes PEEK is selected due to its harsh chemical resistance and good thermal performance. It also has excellent mechanical strength and good dimensional stability ensuring that it does not expand when subjected to high temperatures.

Name- Faayza Vora

Roll no- 23110109

14. Filtering System

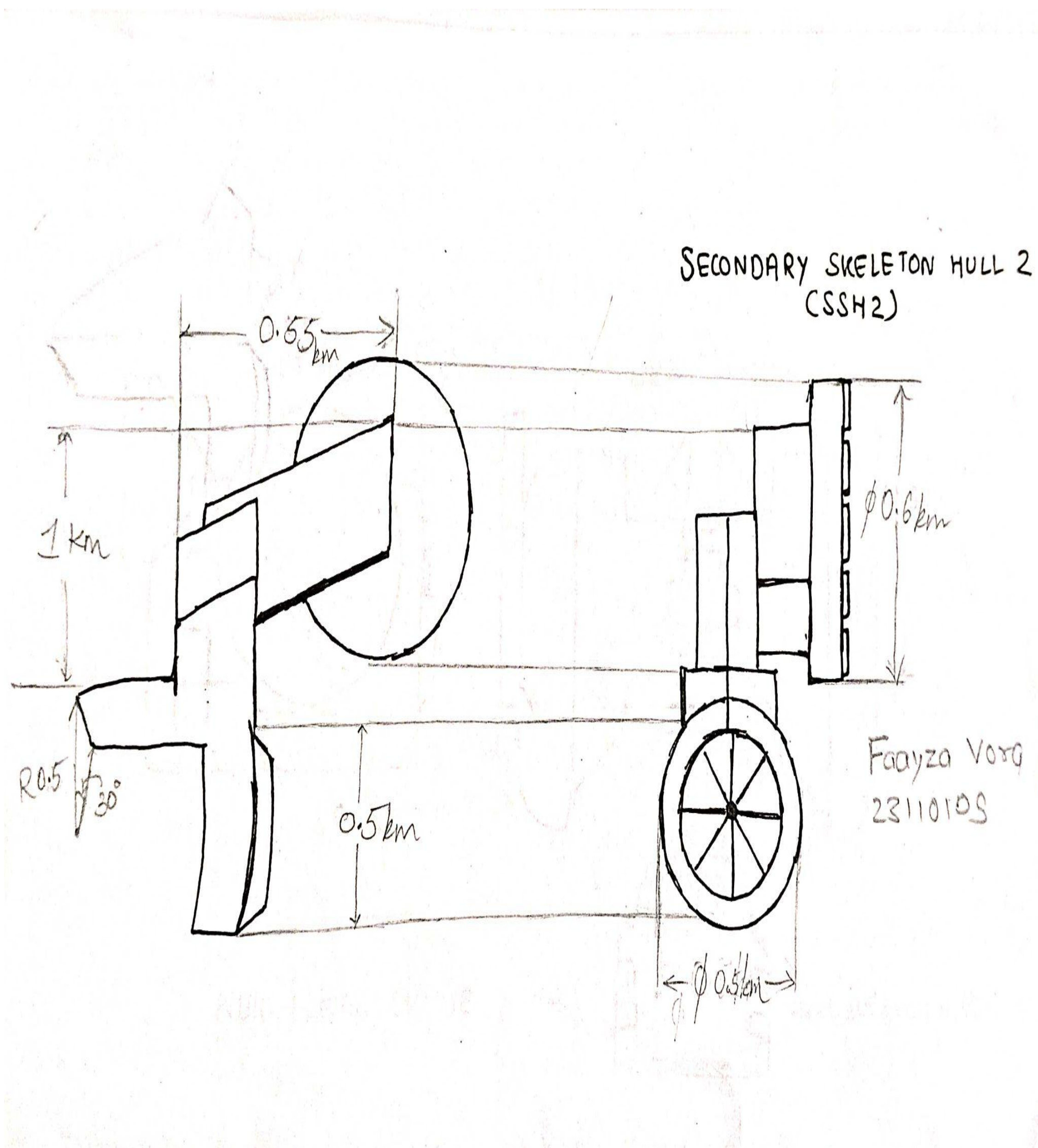




Name- Gadiparthi Abhinav

Roll no- 23110109

15. SSH 2



Reason for choosing dimentions (SSH 2)

Secondary skeleton hull 2 has two circles whose planes are perpendicular to each other . They are located within the equator ring in the spacecdiameter. Thus diameter circles are taken to be 0.5 km and 0.6 km so that it does not disturb the structure of equator ring . The height of the Secondary skeleton hull 2 is taken in accordance with Secondary skeleton hull 1 and with respect to the entire ship.

Materials

The material used to make Secondary skeleton hull 2 is same as that used for hull 1. They are Aluminum alloy which is due to the fact that it is lightweight and is used in most of the satellites that are sent to space. Since the main function of Secondary skeleton hull2 is to provide strength and rigidity to the entire model the material used in the making of same should have high tensile strength. Thus we are using Graphite-epoxy, the Graphite fibres provide strength and rigidity to the spacecraft .

Name- Faayza Vora

Roll no- 2311010

Bibliography:

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MEETING DETAILS:

Meeting 1:
Date: 1st Sept 2023
Time: 2 pm (60 mins)
Absent: 1)Abhinav
Topic:
Introduction
Brainstorming Ideas
Meeting 2:
Date:4th Sept 2023
Time: 10 pm (45 mins)
Absent: 1)Anil
2)Rahul
3)Jayaram
4)Abhinav
Topic:
Searching and creating model sketch.
Distribution of work
Meeting 3:
Date:7th Sept 2023
Time: 10 pm (30 mins)
Absent: 1)Anil
2)Rahul
3)Abhinav

Topic:
Collecting and understanding information from various articles available on the internet.
Meeting 4:
Date:9th Sept 2023
Time: 11 pm (45 mins)
Absent: 1)Anil
2)Rahul
3)Abhinav
Topic:

Making some minor changes in the model sketch.

Meeting 5:

Date:13th Sept 2023

Time: 10:30 pm (90 mins)

Absent: 1) Abhinav

Topic:

Collecting write-ups and compiling proposal.

Meeting 6:

Date:14th Sept 2023

Time: 10:30 pm (60 mins)

Absent:

Topic:

Final Edit and submission of the proposal.

Meeting 7:

Date:20th Sept 2023

Time: 10 pm (45 mins)

Absent:

Topic:

Discussion about sketching of models and dimensioning.

Meeting 8:

Date:27th Sept 2023

Time: 10 pm (45 mins)

Absent: 1)Anil

2)Rahul

Topic:

Collecting sketches and write-ups.

Compiling all the sketches and write-ups.

Meeting 9:

Date:28th Sept 2023

Time: 10 pm (45 mins)

Absent:

Topic: Final editing of the model sketches.