Rectrix

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What's inside:

Department of Aeronautical Engineering

VISION

To provide excellent graduate education in Aeronautical Engineering and continuously support the community of aerospace professionals that will spearhead and strengthen the design and development of aerospace related industries and institutions in India.

MISSION

- To impart quality exposure in theory and practical with proficiency, skill and humane values with the best of teaching and industrial expertise.
- To continuously strengthen the laboratory learning of students in tune with the best industry processes and practices
- To ensure the updated knowledge and skill sets of students in emerging technologies
- To provide the students the right ambience and opportunities to develop into creative, talented and globally competent Aero professionals.
- To promote research and development activities in the sphere of aeronautics for the benefit of the society

CONCORDE : THE RISE WELCOME TO THE WORLD OF MACH!

-Danish Ahamed K IVth year

We all would have familiarized ourselves with the concept of supersonic travel. It says traveling at a speed greater than or equal to the speed of the sound. Here comes the interesting facts about the most famous and revolutionary plane CONCORDE.

Concorde was built in 1969 and operated by two major airline companies, British Airways and Air France. British Airways and Air France collaborated in Concorde, investing approximately 2.8 million dollars.

Concorde had stated that it would be capable of reachingMach 2 speeds. It was predicted that it would take 3 hours and 15 minutes to go from London to New York Concorde was one of the aircraft that made the air travel cozier and simultaneously the development of such a supersonic aircraft for passengers was challenging and faced many difficulties by concorde engineers.

Concorde engines are not compatible with these planes, unlike other airplane engines that fly at subsonic speeds. Current jet jets are powered by turbofan engines that can achieve speeds of roughly mach 0.8.

Fig.1 Concorde

Fig.2 Engine of Concorde

HEART OF THIS MONSTER

The Concorde's engines were derived from a British warplane known as the AVRO VULCAN. AVRO VULCAN is powered by the olympus 593 engine designed by ROLLSROYCE.

This particular type of engine in a warplane could generate around 49 KN of thrust.he Olympus 593 was the first two-spool engine in the world.

For Concorde, the Olympus 593 engine was slightly rebuilt and fitted with an afterburner or re heater. The thrust generated in Concorde was roughly 169kN.

It was discovered that a freshly installed afterburner increased thrust by 20%, causing more expansion and acceleration.

The engine's reheated capacity allowed the plane to reach Mach 2. It has two nozzles that may be controlled to control the amount of power output.

The control system for the primary nozzle actuallycame from the scraped BACTSR2 supersonic bomber. The primary nozzle forms the jet-pipe exit.

Whereas jet engines on all of the subsonic airlines have fixed area jet pipe, the Olympus 593 MK 610 may be varied over a small area. As the jet pipe exit is made smaller in area, the jet pipe pressure increases and has the effect of slowing down only the LP turbine and its

compressor – and vice versa for larger areas. By this means the speed of the LP spool will be controlled independently of the HP spool.
It is an extreme form of turning not available to fixed jet pipe aircraft, not even the latest Airbus and Boeings. Only high performance military engines have variable nozzles.

The secondary nozzles are called hinged buckets or clamshells in which the positions of these nozzles can be varied to control the jet exhaust during different stages of flight.

The secondary nozzle was one of the complex parts of the aircraft section. Its structure will be like an eyelid. By actuating these nozzles the plane was able to manipulate the exhaust velocity.

The olympus 593 engine was fitted with 7 compressor stages and was driven by a single stage turbine.
Hiduminium is the material used to build the entire structure of the concorde. Hiduminium is an aluminum alloy. Materials like titanium alloys were used in the compressor stages. Nickel alloys are used in the hotter stages.

Another challenging part of the aircraft was the cooling system, the cooling oil was enough to reduce the temperature of the drive shaft bearing .Earlier it has been discussed to remove the drive shaft bearing
But without drive shaft bearing we cannot expect the drive shaft to be as stiffer than earlier. In order to accommodate this change the diameter of the drive shaft has been increased to increase the stiffness.
The above wing structure is a delta shaped wing designed purposely to decrease the drag created on the airplane.
It is called OGIVAL DELTA wings where these kinds of wings are able to perform well in low speed and high speed flights. In ogival delta wings the forward section will have more sweep angle than the rear section.

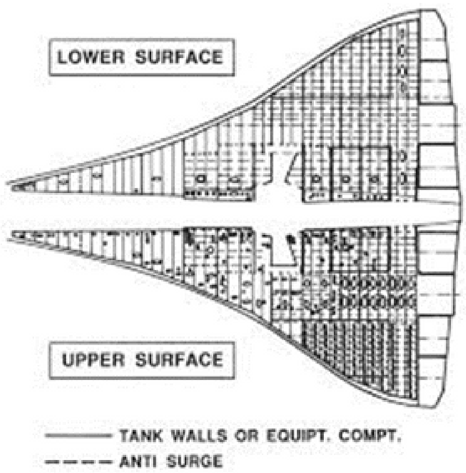

Fig.3 Wing Surface

RUNWAY MARKINGS AND LIGTHINGS

-Subasandhiya IInd Year

Fig.4 Runway markings

Runway markings and lighting are essential for the safe operation of aircraft. Airport pavement markings and signs provide information that is useful to a pilot during take-off, landing, and taxiing. The lighting is used during the night and low visibility operations. Both the markings and lighting on a runway are highly standardized.

Uniformity in airport markings and signs from one airport to another enhances safety and improves efficiency.

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Pilots are encouraged to work with the operators of the airports they use to achieve the marking and sign standards described in this section. There are three types of markings for runways: visual, nonprecision instrument, and precision instrument.

Marking Colours: Markings for runways are white. Markings defining the landing area on a heliport are also white except for hospital heliports which use a red "H" on a white cross Markings for taxiways, areas not intended for use by aircraft (closed and hazardous areas) and holding positions (even if they are on a runway) are yellow. Runway Designators: Runway numbers and letters are determined from the approach direction.

The runway number is the whole number nearest one-tenth the magnetic

azimuth of the centreline of the runway, measured clockwise from the magnetic north.
For example, if the runway is labeled 36, then the bearing to that runway is 360 degrees. Conventionally, only two digits are used to mark a runway. As seen in the example, the zero in 360 is dropped. Similarly, if the heading to the runway is 90 degrees, the last zero is dropped.

The Runway Threshold Marking:
The runway threshold marks the start of the runway. It consists of stripes that are about 30m in length and about 1.8m in width. The number of stripes depends on the actual width of the runway.

In some airports, there exists are portion behind the runway threshold known as a displaced threshold. This area is marked with arrows pointing to the threshold. The displaced threshold is an area where it is prohibited to land an aircraft. However, take-offs can be conducted using the area.

The Runway Aiming Point and Touch-down Zone Marking The aiming point consists of two large white stripes marked on the runway. It is the point on the runway where the pilots aim to touch down during the approach. The length, width, and distance from the threshold where the aiming point must be painted depending on the runway length.

Runway Lighting system:
Runway Edge Lights:
Runway Edge lighting should be provided for a runway that is intended to be used for night operations. It should also be provided for day operations when the Runway Visual Range (RVR) falls below 800m.

The lights must be white lights. However, in case the runway has a displaced threshold, the lights between the start of the runway and the displaced threshold should be red lights for landing aircraft. Also, for the last 600m of the runway or one-third of the runway
length (whichever is less), the edge lights must be yellow.

Runway Threshold Lights
The runway threshold lights are provided to mark the start of the runway. If there is a displaced threshold, the lights should be placed in a row right angle to

the runway axis at the displaced threshold. It consists of at least six green lights, and the distance between the lights depends on the type of approach the runway is certified for.

Runway Threshold Lights

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Runway End Lights

The end lights are placed on a line right angle to the runway axis at the end of the runway. It should consist of at least six red lights. This is to show the end of the runway to the pilots.

Crucial for safe operations

Pilots are expected to pay attention to all the relevant runway markings and lights to ensure safe flight operations. Even a slight oversight can have disastrous consequences.

AIRBUS ZEROe

-Pawan P IVth Year

Fig.5 Airbus ZEROe

Airbus' aim of getting hydrogen-powered flight off the ground gets closer by the day thanks to exciting progress in the technology building blocks behind ZEROe, low-carbon emission aircraft concept.
Forging ahead with its decarbonization ambition, Airbus is maturing two hydrogen-based propulsion technologies in parallel.

Hydrogen combustion and hydrogen fuel cells are at the heart of ZEROe, our low-carbon emission aircraft concept. H2 fuel cells are also under study as a source of non-propulsive energy.

Hydrogen combustion (H2C)The cold heart that powers Airbus' ZEROe aircraft:
On 12 May this year ArianeGroup, a joint venture between Airbus and Safran, successfully completed a proof-of-concept of a hydrogen 'conditioning system' adapted to power an aircraft turbine engine.

Given that hydrogen has to be stored at a bone-numbing -253°C, it needs to be 'conditioned' to reach an acceptable temperature and pressure for combustion in the aircraft engine. That is the system's job.

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Hydrogen fuel cells

Airbus revealed its hydrogen fuel cell engine concept which has been put through its

Fig.5 Hydrogen Fuel cells in ZEROe

paces at E-Aircraft Systems test house near Munich. It's Europe's largest such facility. Over six months of ground testing, expert teams have joined forces to achieve the exciting milestone of running the fuel cell at full power: 1.2 megawatts (MW).

This is the most powerful fuel cell test ever achieved in aviation anywhere in the world to date, and a great platform to learn. Airbus is alone in the aviation industry in reaching such a power 'chain', coupling 12 fuel cells to reach the output needed for commercial use.

What is the significance of 1.2 Megawatts?

Airbus shared with the public a 100% fuel cell powered aircraft concept.

This concept was a 100-seat aircraft capable of 1,000 nautical miles and it had six engines. 1.2 megawatts is the power needed by one of

Fig.7 Airbus ZEROe

Non propulsive energy

Non-propulsive energy (NPE), the energy which powers cabin systems and aircraft control surfaces, for example. This power - generally around 5% of the aircraft's needs - traditionally comes from the kerosene-powered APU, or auxiliary power unit, located in the aircraft tail cone.

Airbus subsidiary UpNext's NPE demonstrator will use a fuel cell containing ten kilograms of gaseous hydrogen generated from renewable sources to produce electrical non-propulsive power. Within three years, the cell will be tested on board an Airbus A330 in standard operating conditions. The NPE project benefits from strong support of the Spanish government and its adoption will help reduce CO2, NOx and noise emissions.

Why do planes leave a white trail?

- Padmashree K IVth Year

Fig.8 Aircraft Exhaust Makrs

Technically known as contrails, these white trails are created from water vapour produced by the combustion of fuel in aircraft engines.

At their cruising altitude of 10,000m, temperatures are around -55°C. As it's so cold, the water turns to ice particles, but how long they remain visible depends on humidity. If the air is relatively humid, the contrails will grow Iand remain visible long after the aircraft has disappeared.

It's the water vapour. They create the white trails left by the aeroplanes we see in the sky.

However, when and why aircrafts leave vapour trails is fascinating.

When an aeroplane is in the air, the engines produce and release a sizable amount of water in the form of water vapour out the back. In the cool, high-altitude air, this hot, saturated water vapour from the plane's engine(s) condenses on other exhausting particles and freezes around them. The frigid temperatures at a high altitude causes water vapour to freeze as it condenses in the atmosphere behind the aircraft, leaving lengthy, white clouds in the sky.

depending on the aircraft and, the air conditions the plane is flying through, some flights will create vapour trails that are different from another planes. The duration of the contrails (condensation trails) until they disappear can be as short as a few minutes, depending on the humidity and temperature of the surrounding air. But not all aircraft produce vapour trails since it depends on the surrounding atmosphere. The air must be sufficiently chilly and humid for vapour trails to be left in the aircraft's wake. Insufficient moisture in the air prevents condensation from forming on engine exhaust particles. Additionally, the water vapour particles won't freeze and form the “clouds” if the air is not cold enough (i.e., the plane is not flying at a high enough altitude).

The main reason that all planes don't produce vapour trails, aside from the differing engine types, is the state of the air. Mostly, a personal single-engine aircraft won't produce vapour trails since it isn't high enough in the atmosphere for the air to be sufficiently cold and humid to create the tiny particles of frozen water vapour.

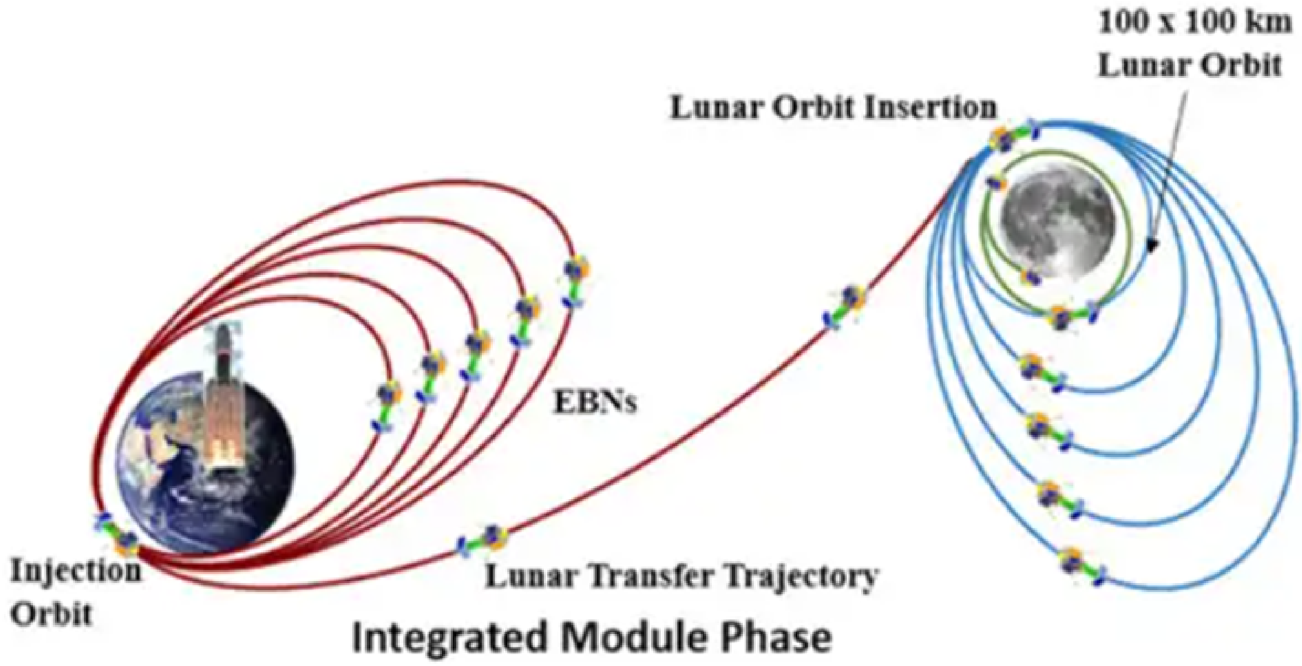
Indian Space Mission : Chandrayaan – 3

-Pragnya K S IVth Year & Srinaath K S IIIrd Year

Fig.9 Chandrayaan 3

With the aim of researching and showcasing new technology necessary for interplanetary missions, Chandrayaan-3 is made up of an indigenous Lander module (LM), Propulsion module (PM), and Rover. The Lander will be able to gently land at a chosen location on the moon and release the Rover, which will conduct in-situ chemical analysis of the lunar surface as it is moving. There are scientific payloads on the Lander and the Rover that will conduct lunar surface tests.

The main job of PM is to transport the LM from injection into the launch vehicle to the final 100 km circular polar orbit of the moon and then to release the LM from PM. Apart from this, the Propulsion Module also has one scientific payload as a value addition which will be operated post separation of Lander Module. The launcher identified for Chandrayaan-3 is LVM3 M4 which will place the integrated module in an Elliptic Parking Orbit (EPO) of size ~170 x 36500 km.



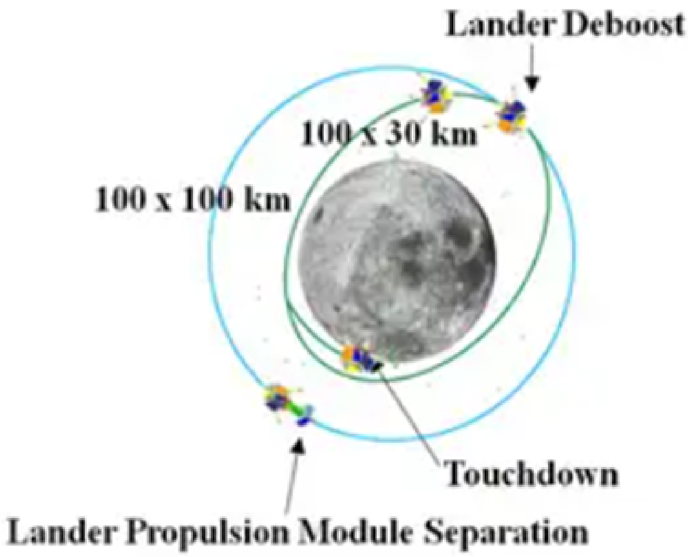


Fig.10 Chandrayaan 3 Mission Profile

The mission objectives of Chandrayaan-3 are:

1. To demonstrate Safe and Soft Landing on Lunar Surface
2. To demonstrate Rover roving on the moon and
3. To conduct in-situ scientific experiments.

To achieve the mission objectives, several advanced technologies are present in Lander such as,

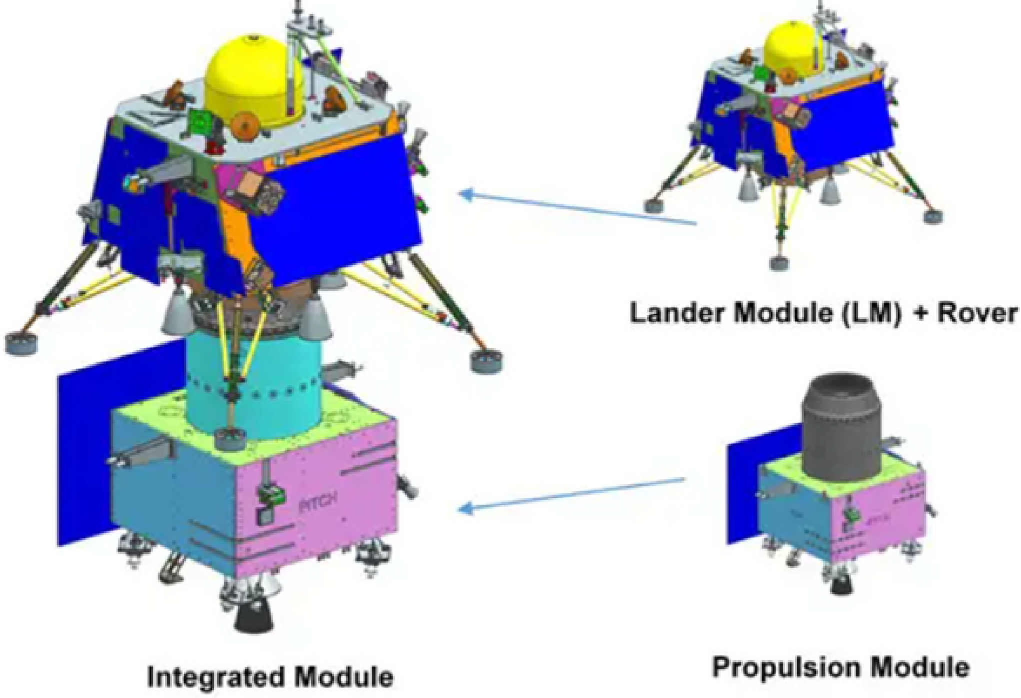


Fig.11 Chandrayaan 3 Modules

1. Altimeters: Laser & RF based Altimeters
2. Velocimeters: Laser Doppler Velocimeter & Lander Horizontal Velocity Camera
3. Inertial Measurement: Laser Gyro based Inertial referencing and Accelerometer package
4. Propulsion System: 800N Throttleable Liquid Engines, 58N attitude thrusters & Throttleable Engine Control Electronics
5. Navigation, Guidance & Control (NGC): Powered Descent Trajectory design and associate software elements
6. Hazard Detection and Avoidance: Lander Hazard Detection & Avoidance Camera and Processing Algorithm
7. Landing Leg Mechanism.

To demonstrate the above said advanced technologies in earth condition, several Lander special tests have been planned and carried out successfully viz.

1. Integrated Cold Test - For the demonstration of Integrated Sensors & Navigation performance test using helicopter as test platform
2. Integrated Hot test – For the demonstration of closed loop performance test with sensors, actuators and NGC using Tower crane as test platform
3. Lander Leg mechanism performance test on a lunar simulant test bed simulating different touch down conditions.

Operation Timeline of Chandrayaan 3

7th Jul 2023 – Vehicle electrical test completed.

11th Jul 2023 – 'Launch Rehearsal' simulating the entire launch preparation and process lasting 24 hours has been concluded.

14th Jul 2023 – LVM3 M4 successfully launched Chandrayaan 3 into its orbit. It has begun its journey to the Moon. Health of the space craft is normal.

15th Jul 2023 – The 1st orbit raising maneuver (Earthbound firing 1) is successfully performed. Space craft is now in 41762 x 173 Km orbit.

25th Jul 2023 – Orbit raising maneuver is performed.

1st Aug 2023 – Space craft is injected to the translunar orbit. The orbit is achieved 164 x 18074 Km as intended.

14th Aug 2023 – The space craft is in 151 x 179 Km orbit, that is orbit circulation phase.

17th Aug 2023 – Lander module is successfully separated from the propulsion module. 1st deboosting planned for 18th August 2023.

19th Aug 2023 – Lander module is in 113 x 157 Km orbit around the moon. 2nd deboosting is planned for 20th August 2023.

20th Aug 2023 – Lander module is in 25 x 134 Km orbit. Power descent is expected to commence on 23rd August 2023 around 17:45 Hrs (IST).

23rd Aug 2023 – Chandrayaan 3 had successfully soft landed on the moon surface! India reached a stepped a great milestone.

24th Aug 22023 – India took a walk on the moon by the Indian made Rover!

27th Aug 2023 – 1st observation from ChaSTE payload onboard Vikram Lander.

28th Aug 2023 – LIBS confirms the presence of Sulphur (S) on the lunar surface through unambiguous insitu measurements.

30th Aug 2023 – APXS onboard rover detects the presence of minor elements.

31st Aug 2023 – ILSA listens to the movement around the landing site. And RAMBHA – LP onboard measures near surface plasma content.

4th Sep 2023 – Lander and Rover are gets into the sleep mode.

22nd Sep 2023 – Lander and Rover gets awaken.

Sensors of Lander Module

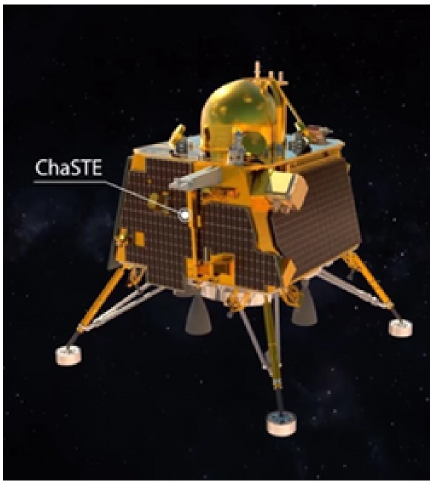


Fig.12 ChaSTE Sensor

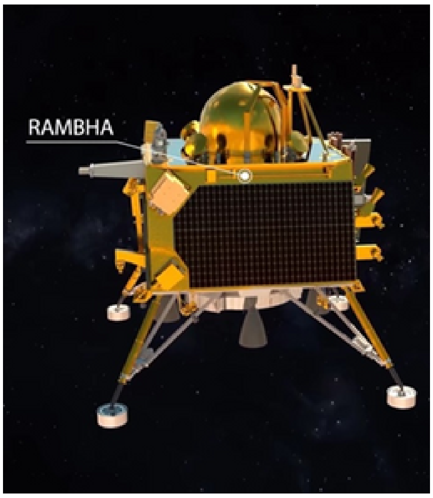


Fig.13 RAMBHA sensor

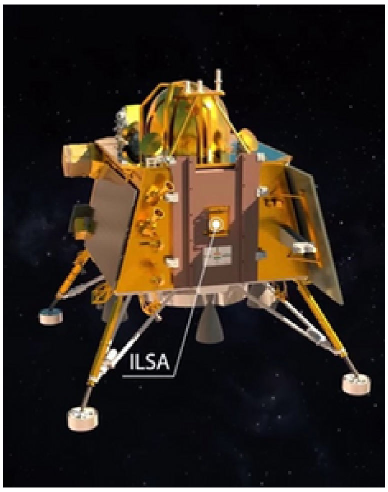


Fig.14 ILSA

The lander module has contains 3 sensors in it.
They are:
1.ChaSTE
2.RAMBHA
3.ILSA
Here you can see about that sensors in detail.

1. ChaSTE

ChaSTE (Chandra's Surface Thermo-physical Experiment) aims at in-situ measurements of thermal conductivity and temperature profile on the lunar surface to derive the vertical temperature gradient up to a depth of 100 mm at the site of landing. This is carried out by means of inserting a probe consisting of thermal sensors in to the lunar regolith using a motor based mechanism. ChaSTE provides thermophysical properties of a igh latitude region on the Moon for the first time. This instrument is being developed jointly by the Physical Research Laboratory(PRL), Ahmedabad and the Space Physics Laboratory(SPL),
VSSC, Trivandrum.

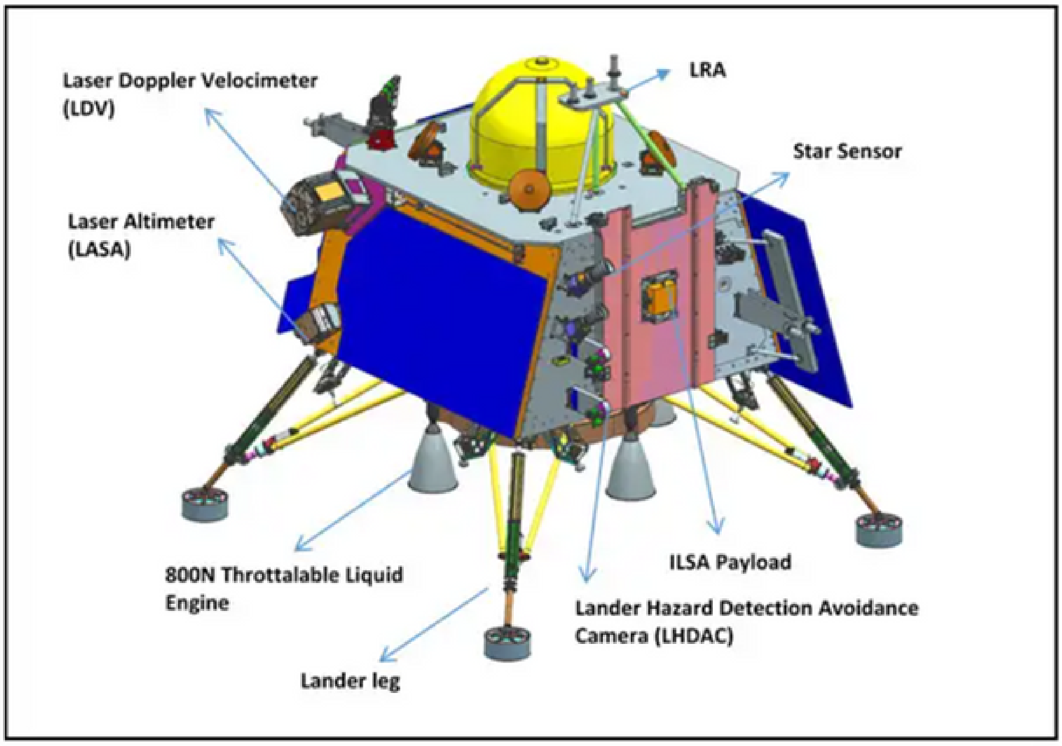


Fig.15 Landing Module

2. RAMBHA

- ·Radio Anatomy of Moon Bound Hypersensitive Ionosphere and Atmosphere (RAMBHA).
- ·The lunar ionosphere is a highly dynamic plasma environment.
- ·Langmuir probes, such as RAMBHA, have proven to be an effective diagnostic tool to gain information in such conditions.
- ·Its primary objective is to measure factors such as:
- i.Ambient electron density/temperature near the lunar surface.
- ii.Temporal evolution of lunar plasma density for the first time near the surface under varying solar conditions.

3.ILSA

- · ILSA stands for Instrument for Lunar Seismic Activity.
- · ILSA is a triple axis, MEMS-based seismometer that can detect minute ground displacement,velocity, or acceleration caused by lunar quakes.
- · Its primary objective is to characterise the seismicity around the landing site.
- · ILSA has been designed to identify acceleration as low as 100 ng /√Hz with a dynamic range of ±0.5 g and a bandwidth of 40 Hz.
- · The dynamic range is met by using two sensors — a coarse-range sensor and a fine-range sensor.

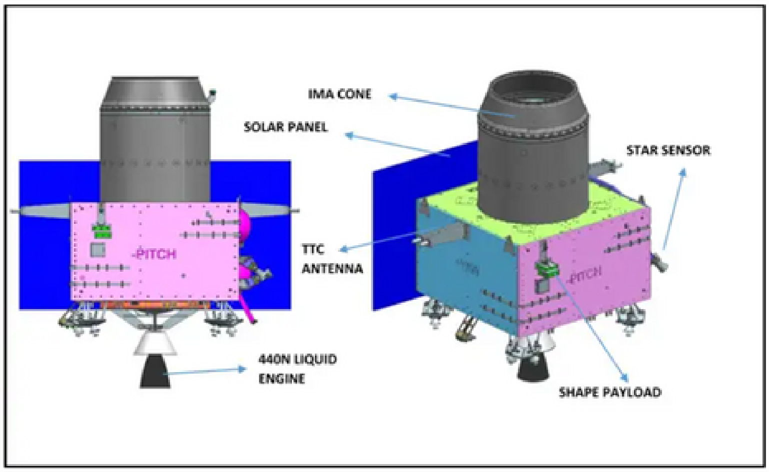


Fig.16 Propulsion Module

Propulsion module:

the propulsion module, also called the orbiter, that would circle the moon. It would observe the light coming from the Earth and help in understanding the nature of the distant planet that circles stars other than the Sun.

SHAPE (Spectro-polarimetry of Habitable Planet Earth): This is the only payload in propulsion that would help in studying the spectro-polarimetric signatures of the habitable planet Earth in the near-infrared (NIR) wavelength range (1-1.7 µm).

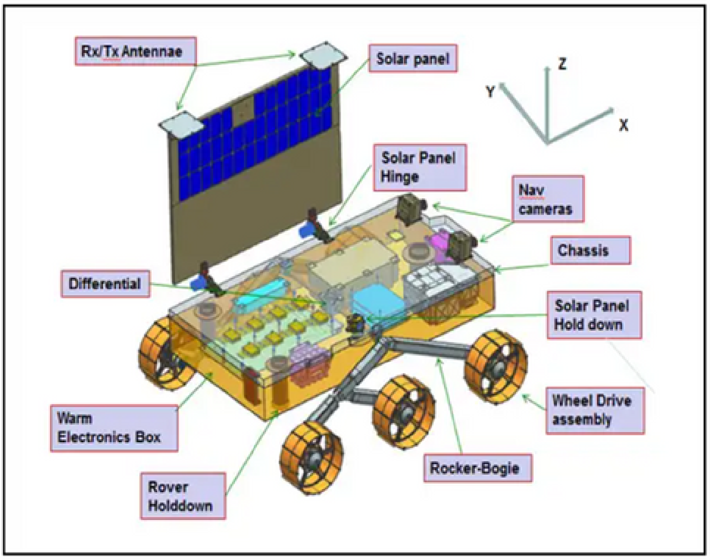


Fig.17 Rover

Rover and its role:

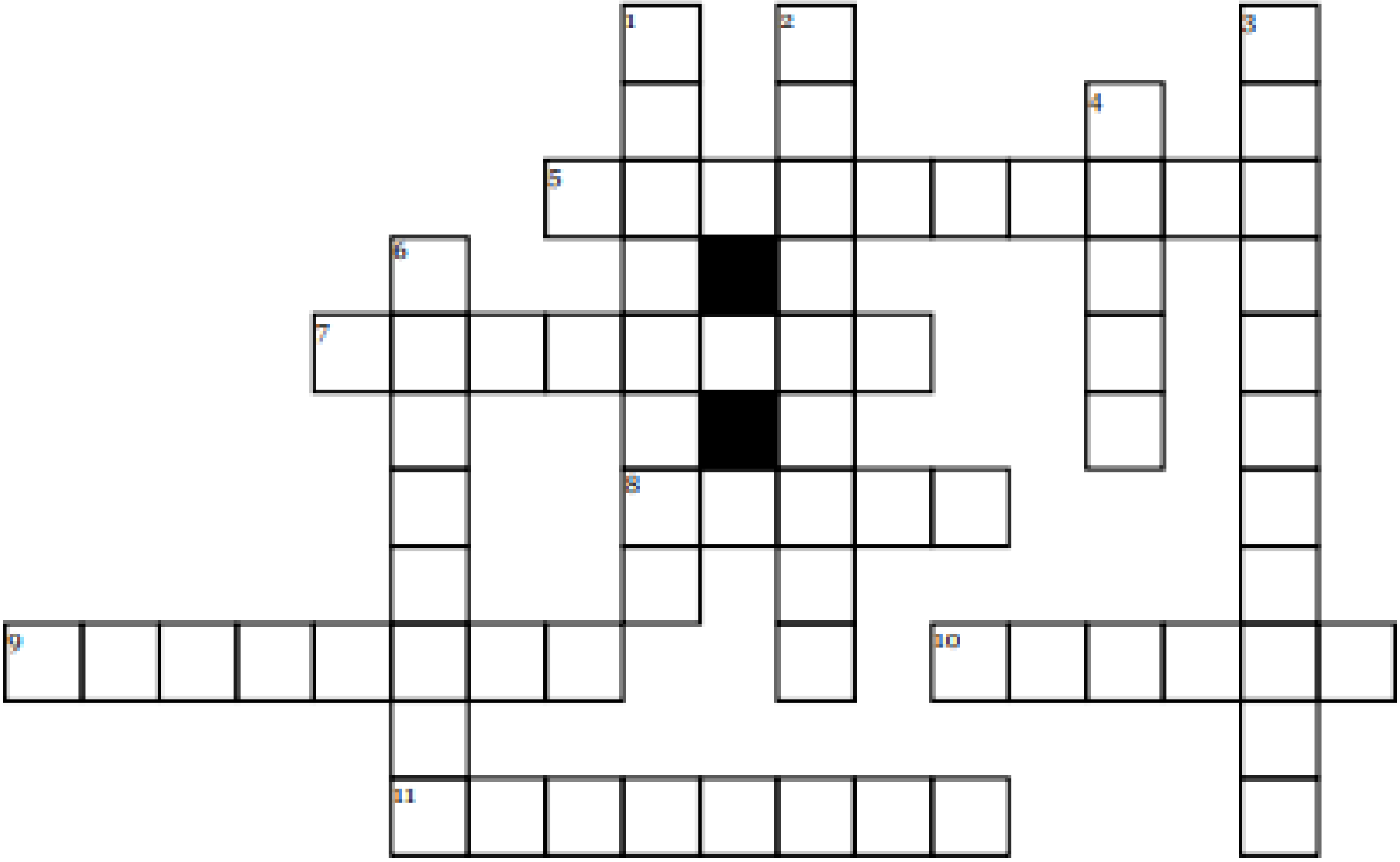
As per details, provided by ISRO, the rover has 2 payloads.

a) APXS (Alpha Particle X-Ray Spectrometer): This instrument will help in deriving the chemical composition and inferring mineralogical composition, which would further enhance understanding of the moon's surface.

b) LIBS (Laser-Induced Breakdown Spectroscope): This payload would help in determining the elemental composition (Mg, Al, Si, K, Ca, Ti, Fe) of the moon's soil and rocks around the landing site.

Name: ____ Date: _______

Main Parts of an Airplane



Across

5. Created by a propeller or a jet engine.

7. Controls the roll.

8. Moveable surface used during landing and take off.

9. The body of the aircraft, used to carry crew, passengers, and cargo.

10. Attached to the fin, controls the side-to-side movement of an aircraft (yaw).

11. Controls the up and down movement of the aircraft's nose (pitch).

Down

1. A device used for flight in the air

2. Refers to the entire tail section of an airplane, and has 3 parts.

3. Like the tires on a car it supports the landing of the aircraft and used to maneuver.

4. Used to support the aircraft in flight by producing lift.

6. A powered flying vehicle with fixed wings and a weight greater than that of air.

Seminar on
Flight maintenance and safety of aircraft

Fig.18 Felicitation of the Guest

Fig.19 The Speakers of the Seminar

Fig.20 The Seminar

The event was a national level seminar held by the department of aeronautical in association with aeronautical society of India. The speakers were all dignitaries with a lot of experience in the aviation field. The speakers were Air marshall S Vardhaman, Group captain M Murugan, Wg Cdr VR Sampath, Wg Cdr Manoharan.

The event was started with felicitating the chief guests by our head of the department Dr. Suresh Chandra Khandai and Wg Cdr Dr. N. Muthuswamy. The 1st lecture was given by Air Marshall S Vardhaman, veteran Indian Air Force. the lecture was on the Indian Airforce's development over the days and about the current and future developments.

He also shared about his flying period and his experience fuelled the interest some students already had about being a part the Airforce. He mentioned about the types of unique welding that only a few people are trained and are allowed to do. He shared his critical moments during his service kept everyone on the edge of their seats. After Air Marshall S vardhaman Wg Cdr V R Sampath, Ex captain Indigo Airlines. 1st we got a peak at the aviation of our countries military then we got to know about the commercial aviation. As Sampath sir mentioned becoming a pilot has become a addition to the holy trinity of "Doctor Teacher Engineer" 's list and more kids are learning about aviation and are really interested to learn about it.

He didn't only share his experience with flying he also shared his interest in technological development in the field of aviation and his recent consultations in government research works.

The next lecture was by Group Captian M Murugan and his lecture was on Importance of non technical skills for aircraft maintenance. He started his lecture by stating Murphy's law "IF THERE ARE TWO OR MORE WAYS TO DO SOMETHING AND ONE OF THOSE WAYS CAN RESULT IN CATASTROPHE, THEN SOMEONE WILL DO IT THAT WAY".

Then he talked about types of errors and big losses occurred in aviation industry. There are intentional and unintentional errors for which he gave so many examples and gave us some great insights about the aviation industry. He talked about the human factor playing a vital roll in errors occurred in aviation field.

Next came Wg Cdr K Manoharan General Manager – CAMO & Continuing Airworthiness Manager Blue Dart Aviation Ltd spoke about the aircraft maintenance and sections in maintenance. He talked about new technologies in aircraft maintenance that saves a lot of money and reduces human labor which reduces the chance of human errors. Then he enlightened us about the flight safety hazards.

There our seminar came to a conclusion. The interactions between the students and the guests during the Q&A sessions were as interesting and informative as the lecture.

ROCKETRY WORKSHOP AT IIST

-Yamini IIIrd Year

Fig.21 Rocket Model

IIST-Indian Institute of Space Science and Technology is a government-aided institute and deemed university for the study and research of space science, located in Thiruvananthapuram, Kerala, India. IIST was set up in 2007 by the Indian Space Research Organization under the Department of Space, Government of India and Conscientia is the annual technology and astronomy festival of IIST.

In that festival we participated in rocketry workshop. There we designed and launched model rockets using the kit provided. Also learned to check the stability of the designed rockets using Open rocket software. Model rocket-A model rocket is a small solid fuel (Black Powder/APCP) powered rocket that is designed to reach low altitudes (100 to 500 meters) and can be effectively recovered by a variety of means. It allows young people to safely make flying rocket models without having to construct dangerous motor units or directly handle explosive propellants.

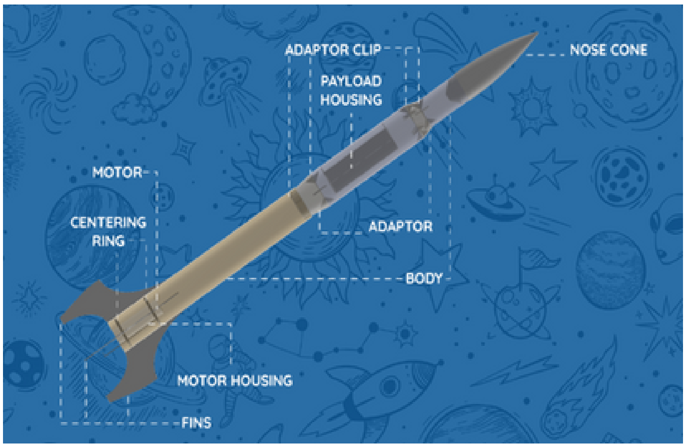


Fig.22 Rocket model Component

Components used for model rocket:

Centring rings-Model Rocket Centering Rings are used to center a smaller tube (or tubes, often an engine mount tube) inside a larger diameter one.

Ignitors-igniter is used to initiate the burning of a solid rocket motor at the end of the propellant facing the nozzle. As the propellant burns, hot exhaust gas is produced which is used to propel the rocket.

Fins-They provide stability during flight that is they allow the rocket to maintain its orientation and intended flight path.

Body tube-The body tube is the airframe of the model rocket. Body tubes are typically made from paper, fiberglass, or plastic

Nose cone -The nose cone is the forward-most part of the rocket. The purpose of the nose is to reduce the aerodynamic drag on the model.

Fuel cartridges-These are made of blackpowder. Black powder rocket propellants consist of charcoal, sulfur, and potassium nitrate.

Attending the rocketry workshop at the IIST Conscientia Festival 2023 in Kerala was an enriching and exhilarating experience. Over the course of three days, we gained valuable insights into the world of rocket science and learned practical skills in designing, building, and launching rockets. This provided profound understanding of aerospace technology.

Fig.23 Stuents testing the Model

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