



2014 - 2023

# THE MODERN ERA OF INDIAN SPACE PROGRAMME



# The Modern Era of Indian Space Programme

Indian space sector was spreading its wings to a new, brighter, and eventful horizon since 2016, when **Honourable Prime Minister Shri Narendra Modi** interacted with **60 more ministries and mepartments to adopt space technology and applications to the economic growth of the country**. More than 270 projects were concluded with various ministries and departments.

Space reforms are announced by Government of India to participate more number of Non-Governmental Entities (NGEs) in the space domain. The space technologies and infrastructure of ISRO have been made available to all industries for scaling up and productionisation / commercialisation.

Space policy is in place to bring more uniform understanding. Over last 5 decades ISRO developed and qualified many MSMEs/ Corporate sectors/ PSUs for delivering the space grade systems. Now startups started pitching in and exploring the innovative practices in the space domain to build the cost effective solutions.

## Largest Missions Accomplished by ISRO

The noteworthy achievements are:



### LVM-3

Development, operationalisation & commercialisation of the LVM3 launch vehicle



### SSLV

Development of SSLV & transfer of technology to Industry



### PSLV

Productionisation of PSLV through industry



### CARE/RLV

Technology demonstrations like Space Capsule Recovery, Re-usable Launch Vehicle, scramjet



### SCIENCE MISSIONS

Started with sounding rockets, the saga is continuing with scientific missions like AstroSat, Mars Missions, Chandrayaan missions, Solar, and other planetary missions



### MISSION TO MANGAL

Mission to Mangal in the first attempt



### CHANDRAYAAN-3

Soft-landing of Chandrayaan3 on Moon near south pole



### NavIC

Commissioning of Indian Regional Navigation System NavIC



### SPACE POLICY

Space policy approved



### IN-SPACe

Institutionalising of IN-SPACe - a promotion, authorisation, and regulatory body for promoting NGEs in space domain



### NSIL

Institutionalizing of New Space India Ltd (NSIL), which is the commercial arm of ISRO.



### LAUNCH BY START-UP

First sub-orbital launch by a startup from ISRO's launch pad. Another startup building launch pad within ISRO's premises



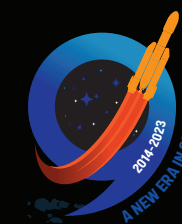
The Gaganyaan was announced by **Honourable Prime Minister Shri Narendra Modi** on 15th August 2019.

ISRO is now working with collaborative missions like **NISAR** with **NASA** and **Lupex** with **JAXA**.

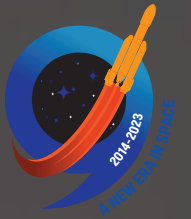
Commercial launches for foreign customers are also increasing progressively.

Setting of Bharathiya Antariksha Station (Indian Space Station) by 2035

Department of Space is developing a road map for moon exploration and has scheduled the first Indian landing on the Moon by 2040







Not only payloads, they carry the hopes  
and aspirations of our nation

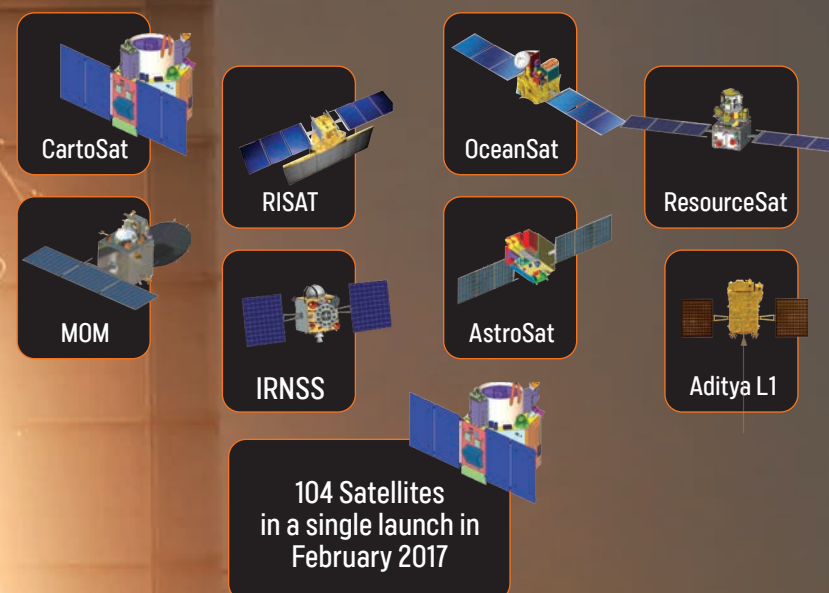
# Major Missions Accomplished

## PSLV

Since its first mission on 20th September 1993, PSLV has been performing as the most reliable and versatile workhorse launch vehicle of ISRO with a success rate of above 95%. It has accomplished out 59 missions.

Number of PSLV missions since 2014 **32**

### Major Missions



## LVM3

Launch Vehicle Mark3 is the 4th generation launch vehicle developed indigenously carry 4 ton class payloads to GEO and 6 ton class payloads to LEO.

Since its first mission on 18th December 2014 it's successfully launched high throughput satellite and Chandrayaan missions.

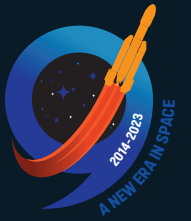
Number of LVM3 missions since 2014 **7**

### Major Missions





# Enabling the Indian Industry



## PSLV Commercialisation

Contract released to HAL Led consortium for producing 5 nos. of PSLV.



## Building Satellites

Building of small satellites through Indian Industry



### SSLV

#### Small Satellite Launch Vehicle



ISRO qualified the systems and launched two demonstration flights.



IN-SPACe released the EOI for inviting industries for technology transfer.

Empowering technologies to everyday industry

## Technologies Transferred to Industries

ISRO has **transferred over 400 technologies** to around **235 industries**. Starting in 80s, the technology transfer programme has gone from strength-to-strength, with industries engaged across various sectors and geographically covering the breadth of the nation.

### Small Satellite Bus

The small satellite project is envisaged to provide a platform for stand-alone payloads for earth imaging and science missions within a quick turnaround time.

### Mini-SAR

A Miniaturised X-Band Airborne Synthetic Aperture Radar is a lightweight and compact SAR to fly in small aircraft and provides high resolution imagery for various applications.

### Li-ion Batteries

Li-ion cells have wider applications in electronic gadgets, telecommunication, industrial applications and in aerospace segment. Transferring this technology to Indian industries and startups will improve its production in large scale.

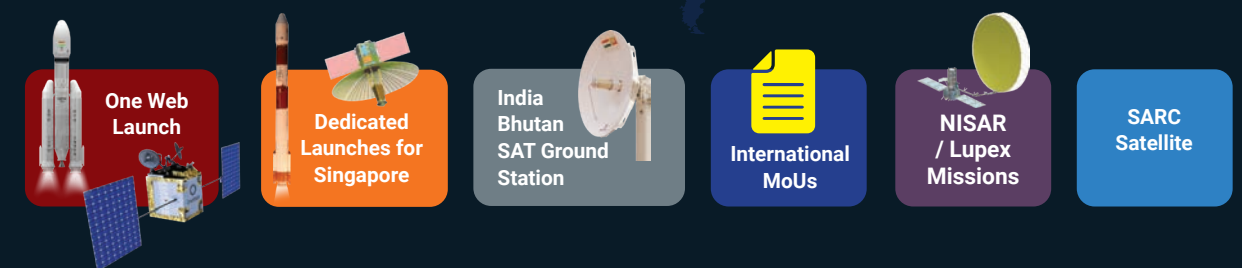
### Laser Guided Gyro

Missiles use gyroscopes to stabilise, track, and guide the rotational movement of their course.

## India – in the Global Map

### 389 International Satellites in 9 Years

Our nation is now a global hub for innovative space ventures and commercial space services by delivering reliability, cost effective services, and options on vehicles and technologies.





# Critical Technology Demonstration

## Scramjet Engine

### Technology demonstration- way forward

Scramjet is an air-breathing engine efficiently operated at hypersonic speeds and allows supersonic combustion. Technology Demonstrator of Scramjet Engine was successfully flight tested on 28th August 2016. India is the fourth country to demonstrate the flight testing of a Scramjet Engine.



## Quantum Communication

### Talk of the town

Quantum communication allows safe and distant transfer of data within India and between other nations. The Department of Space demonstrated entanglement-based quantum communication over 300m free space along with real-time cryptographic applications.



## RLV-LEX

### One rocket. Many missions.

ISRO successfully conducted the Reusable Launch Vehicle Autonomous Landing Mission (RLV LEX) on 2nd April 2023. The landing was carried out under the exact conditions of a space re-entry vehicle's landing "high speed, unmanned, precise landing from the same return path" as if the vehicle arrives from space.

With LEX, the dream of an Indian reusable launch vehicle arrives one step closer to reality.



## Crew Module Atmospheric Re-entry Experiment (CARE)

### Assured return ticket

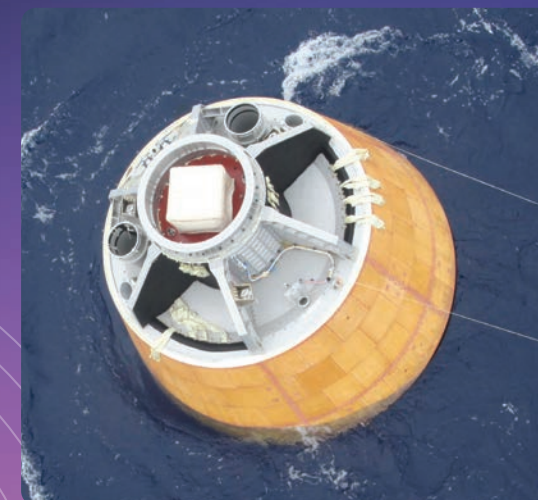
LVM3-X, the experimental flight of LVM3, will carry CARE mission as its payload. The mission would be used as a platform for testing the re-entry technologies envisaged for Crew Module.

Demonstration of re-entry flight of Crew Module

Demonstration of apex cover separation

End-to-end parachute system validation

Demonstration of parachute deployment



## Gaganyaan Test Vehicle TV-D1 Mission

TV-D1 mission was successfully launched on 21st October, 2023 and demonstrated the performance of crew escape system's sub-systems like high thrust solid motors, parachutes, etc. Crew module was safely recovered from Bay of Bengal.

## Pad Abort Test (PAT) of Crew Escape System

### Exploring new territories

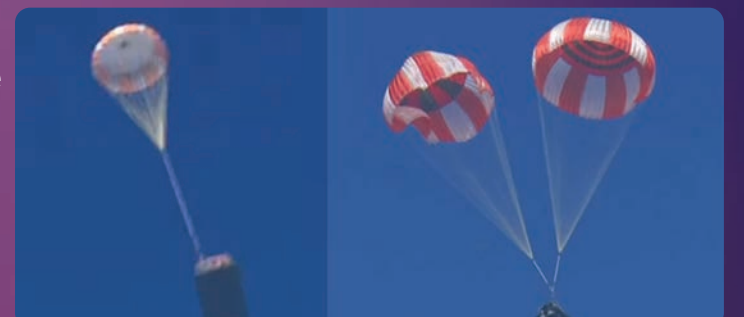
Gaganyaan project envisages demonstration of human spaceflight capability. Its Crew Escape System (CES) has a set of quick acting, high burn rate solid motors which ensure that Crew Module along with crew is taken to a safe distance in case of any emergency either at launch pad or during ascent phase. Human Rated LVM3 rocket is identified as the launch vehicle for Gaganyaan mission.



## Integrated Main Parachute Airdrop Test (IMAT)

### Secured landing for successful flights

Integrated Main Parachute Airdrop Test, the significant milestone towards Gaganyaan crew module deceleration system was successfully tested in Uttar Pradesh on 18th November 2022. The design and development of this deceleration system was a joint venture of ISRO and DRDO.





# Making India Proud

## Chandrayaan 2

Launched on 22nd July 2019, Chandrayaan 2 demonstrated successful satellite insertion into Moon orbit. The orbiter made a complete map of Moon for last five years and given an independent information on Moon.

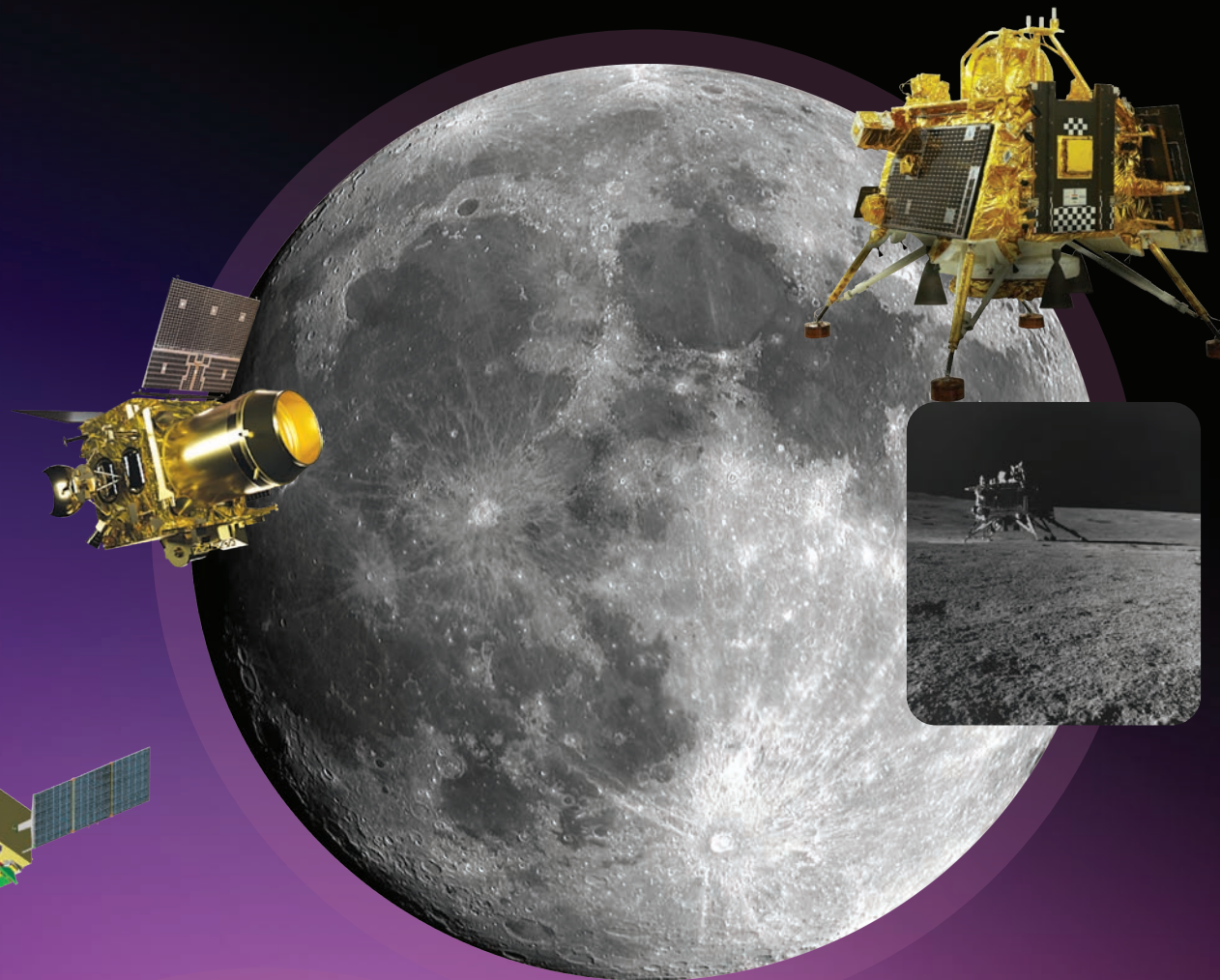
## AstroSat

The first dedicated Indian astronomy mission aimed to study celestial sources in X-ray, optical and UV spectral bands simultaneously. It enables the simultaneous multi-wavelength observations of various astronomical objects with a single satellite.

## Mangalyaan, Mars Orbiter Mission (MOM)

India's first inter-planetary mission to the planet Mars was launched onboard on 5th November 2013 and reached Martian land on 24th September 2014. With its launch, ISRO has become the fourth space agency to successfully send a spacecraft to Mars orbit.

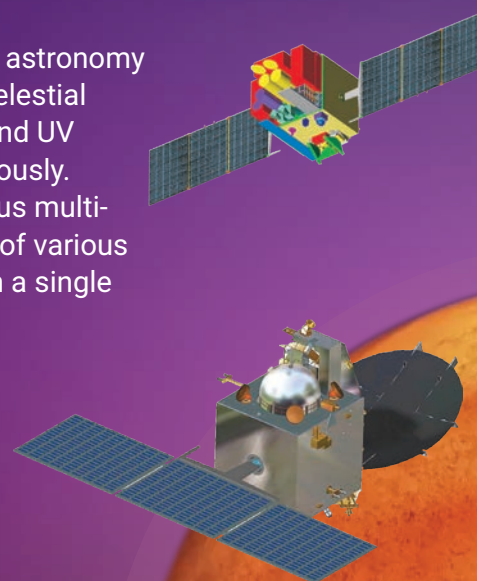
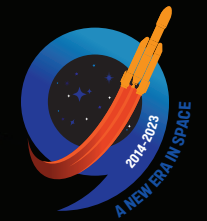
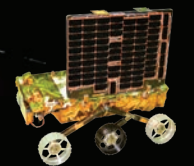
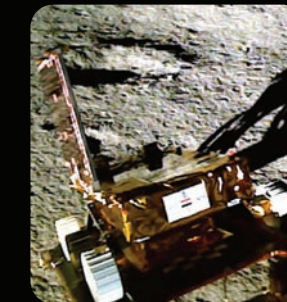
It aimed to study the Martian surface features, morphology, mineralogy, and Martian atmosphere.



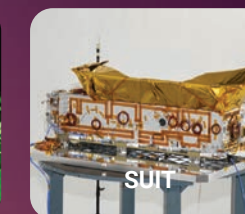
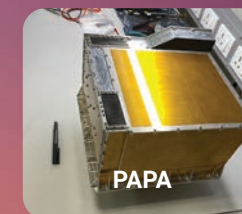
## Chandrayaan 3

Launched on 14th July 2023, Chandrayaan 3 has reached greater heights by demonstrating the safe and soft landing on the lunar surface and by exhibiting rover mobility on the Moon.

It has conducted in-situ experiments on: The surface and environment of the Moon at the landing site, Thermo-physical properties, Plasma environment, Seismicity, Elemental Composition.



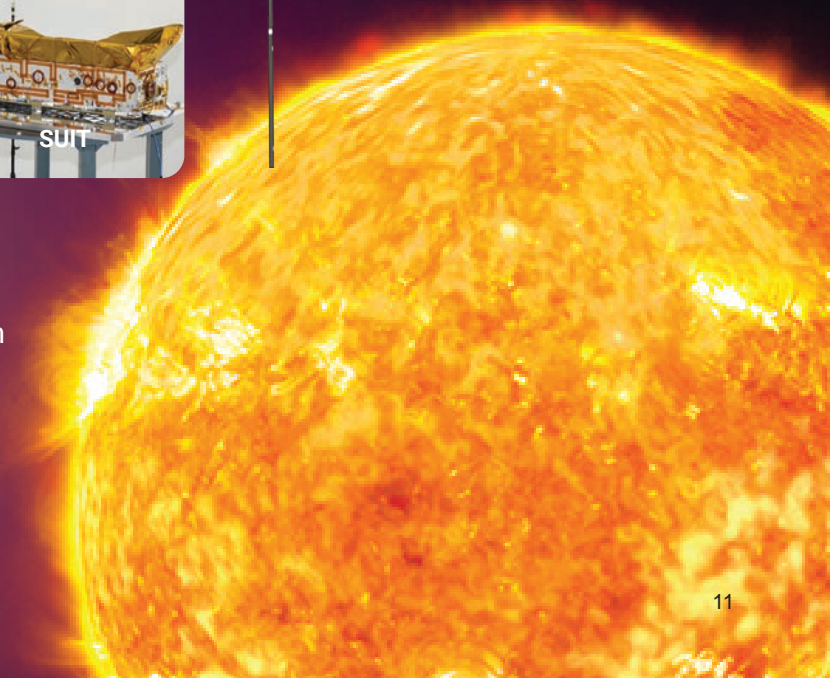
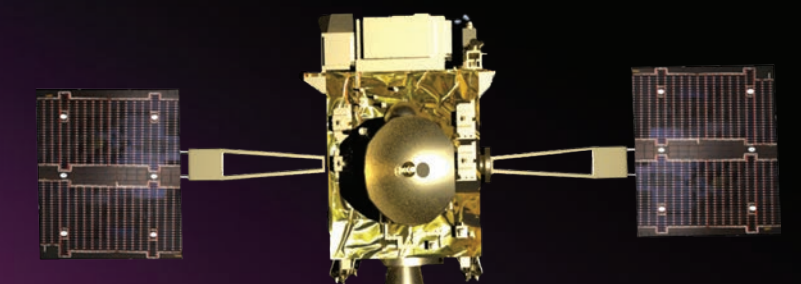
## Aditya - L1 Payloads



Aditya-L1 spacecraft in a highly eccentric Earth bound orbit. The spacecraft will perform orbital maneuvers by using its LAM to reach Sun-Earth Lagrange point L1

## ADITYA L1

Aditya - L1 is the first Indian solar observatory launched by PSLV-C57 on 2nd September 2023.



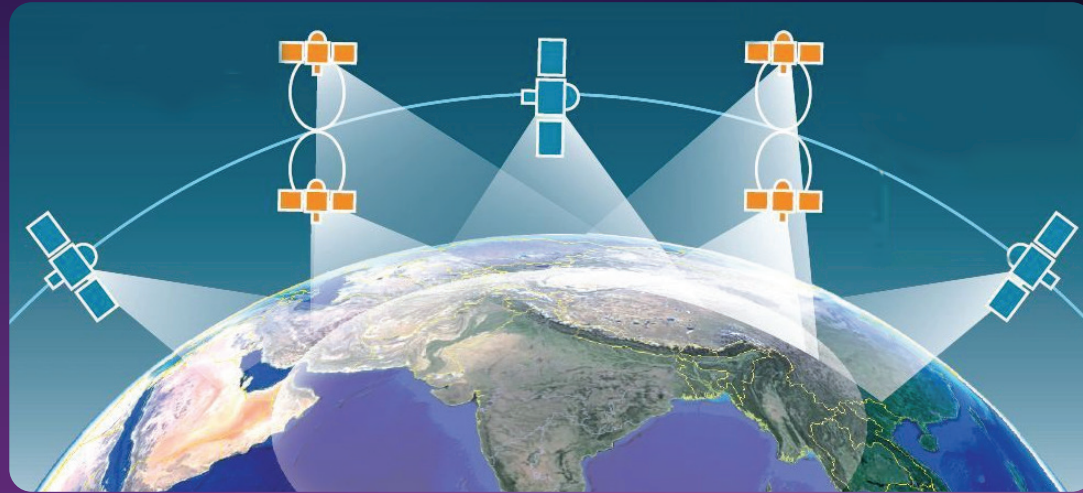




## NavIC - Operationalisation

By launching NavIC, India became the 4th country to offer Space-based Satellite Navigation Services.

It provides accurate position information service to users in India and the region extending up to 1500km from its boundary with an accuracy of better than 20m. The system has five satellites in the geosynchronous orbit and three in the geostationary orbit.



## 104 Satellites

The launch of 104 satellites in a single rocket, PSLV-C37, marked a significant milestone in India's space programme. Except the **two Indian nano satellites**, the remaining **101 were from USA (96)** and one each from the **Netherlands, Switzerland, Israel, Kazakhstan, and UAE**.



## SSA Inauguration

ISRO SSA Control Centre, "NETRA", is set up within the ISTRAC campus, Bangalore. Space Situation Awareness focuses on tracking objects in space, identifying them, establishing their orbits, safeguarding India's space assets, predicting their future positions and threats to their operations.

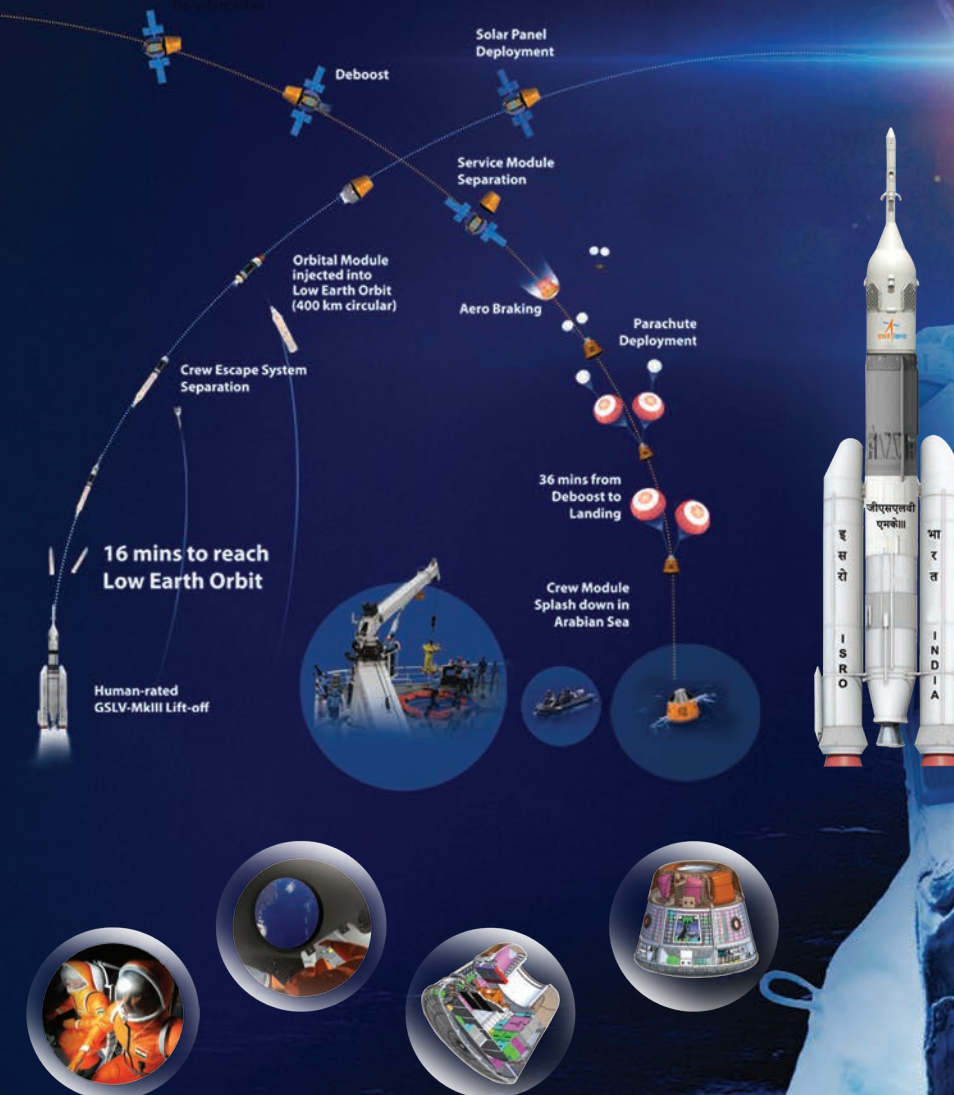
# Gaganyaan

## Indian Human Spaceflight Programme

Gaganyaan project envisages demonstration of human spaceflight capability by launching crew of 3 members to an orbit of 400 km for a 3-day mission and bring them back safely to earth, by landing in Indian sea waters.

HLVM3 rocket, human-rated LVM3 launch vehicle, is identified as the launch vehicle for Gaganyaan mission.

It consists of Crew Escape System (CES) powered by a set of quick acting, high burn rate solid motors which ensures that Crew Module along with crew is taken to a safe distance in case of any emergency either at launch pad or during ascent phase.





## Major milestones achieved so far



Demonstration of Thermal and Humidity Control System



Human Rating Test of Cryogenic Engine



Service Module Propulsion System Test



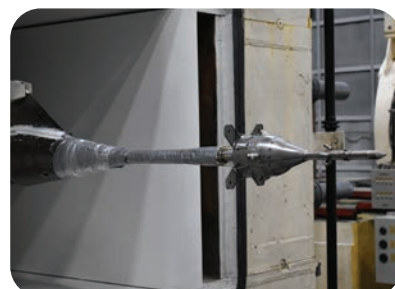
Human Rated Solid Booster Test



Human Rating Test of Liquid Engine



TV-D1 Launch



Wind Tunnel Test

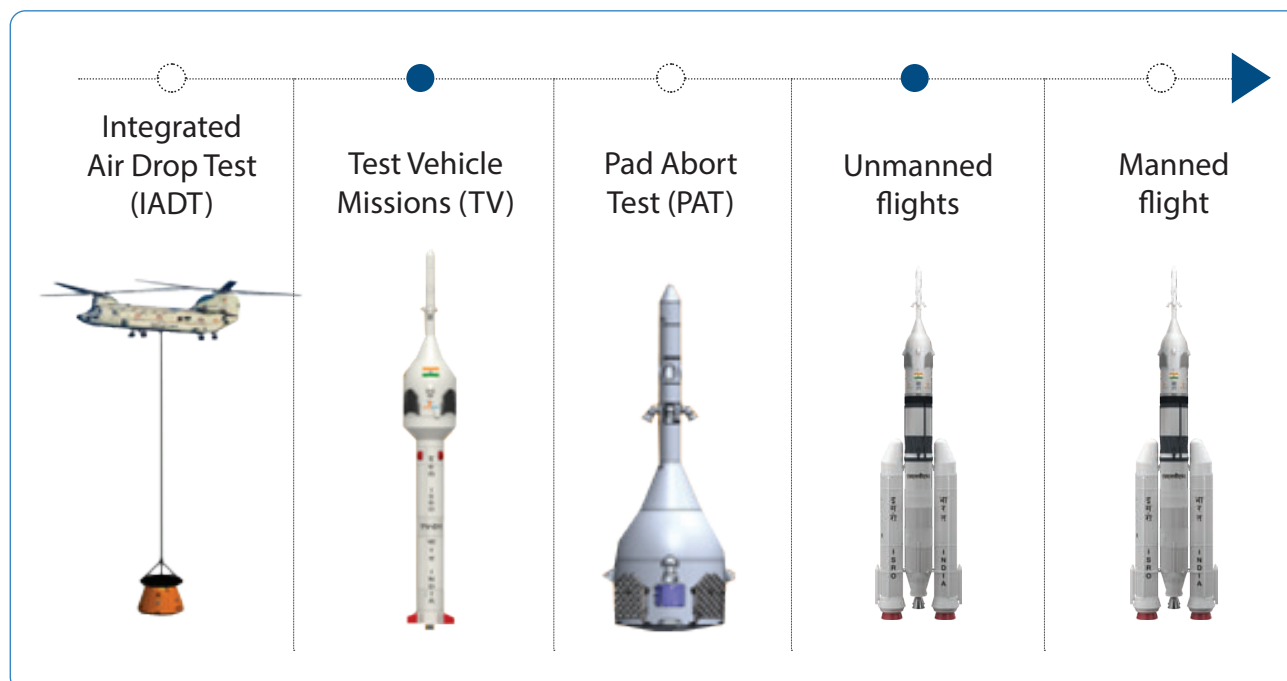


CES Motor Static Test



PAD Abort Test

## Gaganyaan Milestone Missions



## From textbooks to rocket launches

# Research through Academia

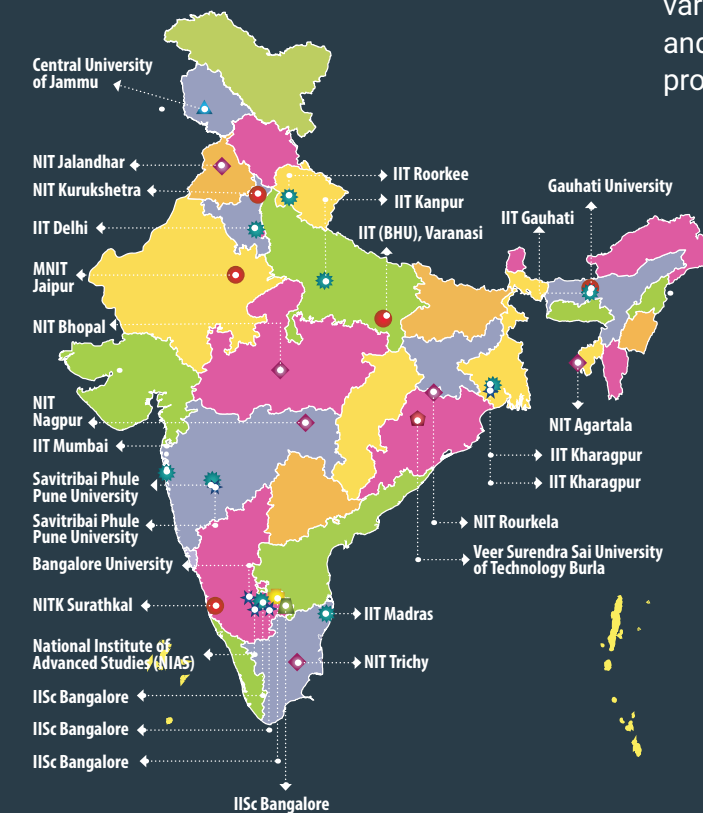
ISRO encourages research activities at Academia. Interested institutions can be engaged with ISRO centres out R&D activities in the ISRO focussed areas. Some of such programmes are:

## Sponsored Research

ISRO publishes focussed areas for research in the space domain and seeks proposals from qualified academic institutions for joint research. PI will be identified by the institution, where as Co-PI will be joining from ISRO for carrying out the projects. The project including timeline and budget will be mutually agreed upon and reviewed thoroughly by joint management committees / technical committees with in ISRO centres, before the project is approved.

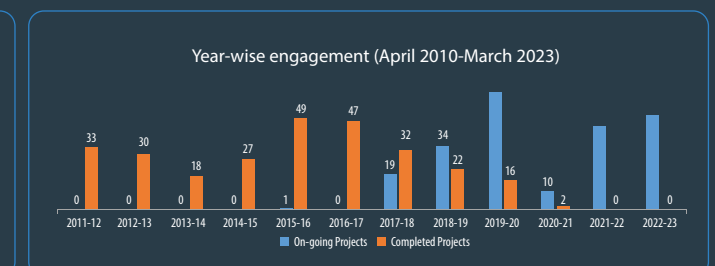
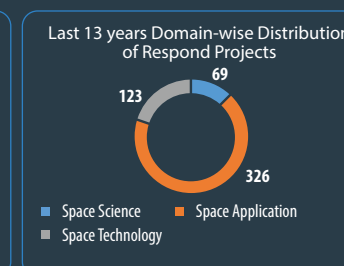
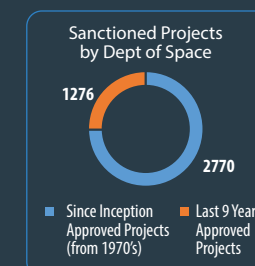
## ISRO cells

ISRO also established cells at various premier engineering institutions for carrying out joint research. Space Technology Cells (STC) are instituted at IITs and IISc for advanced research with the respective institution. Space Technology Innovation Centre (STIC) at NITs in various regions to focus on entrepreneurial oriented projects and Regional Academia Centres for Space (RAC-S) are instituted at NITs in the different regions to encourage the collaborative projects in space in that regions. Additionally, various centre of excellences, innovation centres and space science centres are also instituted to promote the research in space.



## Space Research Cells

- Regional Academic Centres for Space (RAC-S)
- Space Technology Incubation Centres (STIC)
- Space Innovation Centre
- Satish Dhawan Centre for Space Science
- Space Technology Cells (STCs)
- Centre of Excellence on Advanced Mechanics of Materials
- ISRO Chairs
- Centre for Nano Science & Engineering (CeNSE)





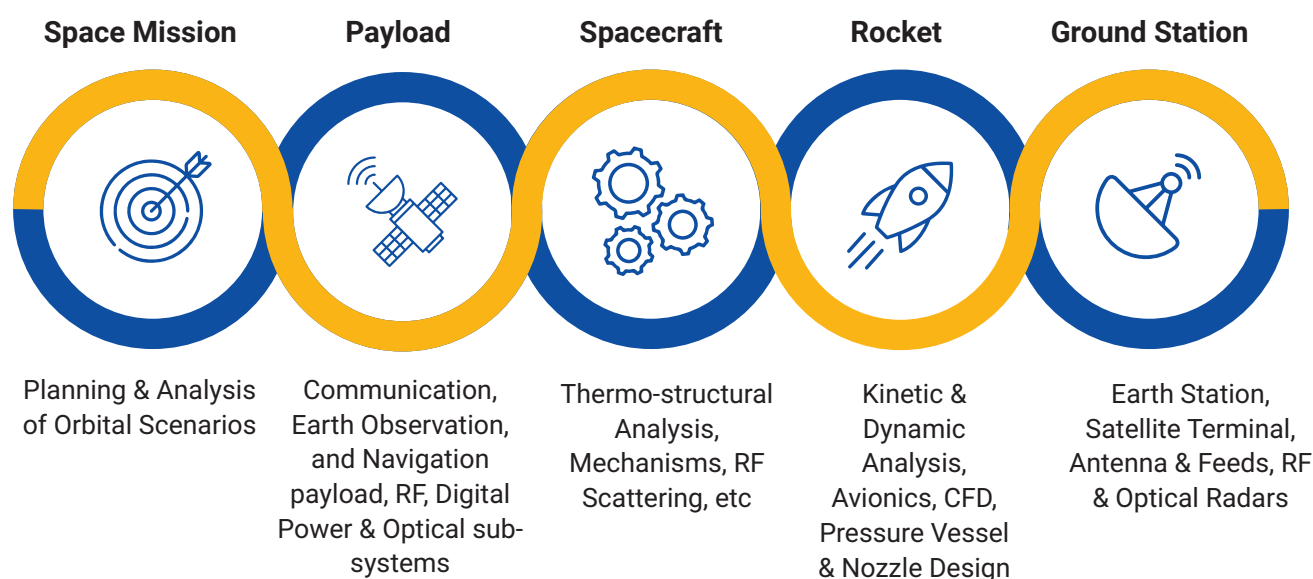
# Space Reforms



## The touch point

IN-SPACE, established as a single window agency for all space sector activities of Non-Governmental Entities (NGEs), plays an important role in boosting the private space sector economy in India. It acts as a promoter- enabler- authoriser- and supervisor for the programme.

### Role of In-Space



Space programme in India has been developed over a period of more than five decades with a strong focus on application driven programmes and bringing space to the services of the common man. In the process, it has become one of the six largest space agencies in the world. ISRO maintains one of the largest fleets of GEO communication and LEO remote sensing satellites, that cater to the ever-growing demand for fast and reliable communication and earth observation respectively.

To enable private sector participation in space activities, boost space economy within the country and develop space force frontiers, for a resurgent, AatmaNirbhar Bharat (आत्मनिर्भर भारत)



## ISRO's Commercial Arm

It has the responsibility of enabling Indian industries to scale up a high technology manufacturing base for space programme through technology transfer mechanisms. It also stands to catering to the emerging global

commercial small satellite launch service market, satellite services for various domestic and international application needs. It enables space technology spin-offs for the betterment of mankind through industry interface.

### Self Reliant Space Ecosystem

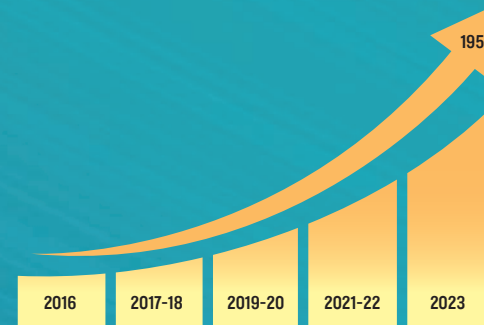


"Handling end-to-end Space related services"



# Space Startups

Indian space entrepreneurs and their startups explore the limitless space of opportunities and inspire the youths to find a career and business in space technology. This new business segment is identified as the future of Indian space industry as they are boosting the nation's pride and economy.



ELLON SPACE PVT. LTD.

RANGSONS AEROSPACE PVT. LTD.

GRAHA SPACE

CALICHE

EON SPACE LABS

ABYOM SPACETECH & DEFENCE PVT. LTD.

SPACE AURA

DIVIZIRA

UPAGRAHA SPACE

SPACETECH ORBITAL PVT. LTD.

HARPY AEROSPACE

ASTROGATES

GALAX@E

MAPMY INDIA

QL SPACE

KAWA SPACE

PLANET EARTH

MAXER

GNIKUL

SATSURE

DHRUVA SPACE



# Students



## Student Programme Initiatives for Differently Abled Children

As a part of women's day celebration, the employees of ISRO & DOS have visited the following schools and interacted with the students.

- Jyoti Seva Home for Blind, Bengaluru
- Mathru Educational Trust for Blind, Bengaluru

Rockets and satellite models of appropriate material and size were taken to the students. So that they can touch and sense the overall configuration of rockets and satellites. A script was given before the lecture for conversion in Braille, so that the students can refer to what was explained during the session.



## Space Outreach

ISRO has launched several projects to promote space science in young minds. Through the events like workshops, quizzes, and challenges, ISRO encourages scientific curiosity and innovation among enthusiasts. Some of the significant programmes are:

### World Space Week

This initiative involves all centres of ISRO to reach out to the students in a big way to promote space science, technology and applications. Exhibitions are conducted at various places across the country. Quiz, elocution, expert talks and other competitions are conducted for the local students. The programme is run from 04th to 10th October, every year.





# Student Development Programmes (Initiatives & Schemes)

## YUVIKA (YUva Vignanik KAryakram)

ISRO sponsored residential student training programme for 2 weeks including classroom teaching and hands-on activities as per guidelines of NEP 2020. The intake is for the 9th completed students to pursue careers in STEM areas. Selection is done through a structured process with a weightage to rural children. Additional weightage is given to participation in NCC, sports, science fairs, Olympiad etc. and competitive students from all states and UTs.



The three batches of YUVIKA completed so far since 2019 (2020 & 2021 suspended due to pandemic)	Batch -1	2019	111
	Batch -2	2022	153
	Batch -3	2023	350

## UNNATI (UNispace Nanosatellite Assembly & Training by ISRO)

It aims to provide theoretical and hands-on experience to the participants from various countries on assembly, integration and testing of nano-satellites. India announced this capacity building programme as part of the UNISPACE +50, a UN Conference held in Vienna in 2018 and had proposed to conduct three programmes. U R Rao Satellite Centre (URSC), Bengaluru, the lead centre of ISRO for design, development and realisation of satellites conducts the programme. And competitive students from all states and UTs participate.

Batch -1	January-March 2019	29 Participants from 17 Countries
Batch -2	October-December 2019	30 Participants from 16 Countries
Batch -3	December- 2022 to Feb-2023	31 participants from 19 countries



# Global Collaborations

ISRO collaborate with space entities of both space faring and space aspiring countries. Space cooperative documents at country level and space agency level are with 59 countries and 5 multilateral bodies till June 2021. It strengthens diplomatic relations and supports formulating global guidelines on space.



# Women Power of ISRO



In ISRO, Women Scientists are playing key role in the Launch vehicle development, Launch vehicle Integration & Launch, Solid Motor Production, Mission Management, Satellite payload development, Satellite integration & assembly, etc.,







वसुधैव कुटुम्बकम्  
ONE EARTH • ONE FAMILY • ONE FUTURE

# Towards a New Space Era

India hosted The G20 summit with its unparalleled project, Space Economic Leaders' Meet. The theme of 2023 SELM, **"Towards a new space ERA (Economy, Responsibility, Alliance)"**, was decided in line with India's G20 Summit's theme, **'One Earth, One Space, and One Future'**. It points out the idea that we need vital alliance of responsible space actors to enhance the contribution of Space economy in global economy.



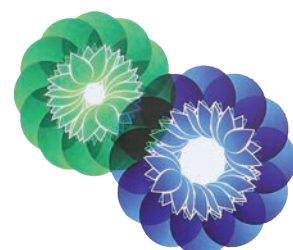
## Event highlights

The event was organised in two phases, beginning with the Precursor event during 17th -18th April 2023, at Shillong, Meghalaya. High officials from 16 countries participated in the event and deliberated on the efforts of their respective governments on improving the space economy.



The Main events in Bangalore during 6th-7th of July 2023, was significant with the presence of space agency heads and senior representatives from space agencies of 18 G20 countries, 8 invited countries, and one international organisation (ITU). Additionally, 32 space industries from abroad and 53 Indian space industries actively participated.

SELM has provided a good platform for Indian space industries to interact with foreign space agencies and industries, through side meetings and space exhibition. The deliberations reiterated the key contribution of space products and services in fuelling global economic growth.



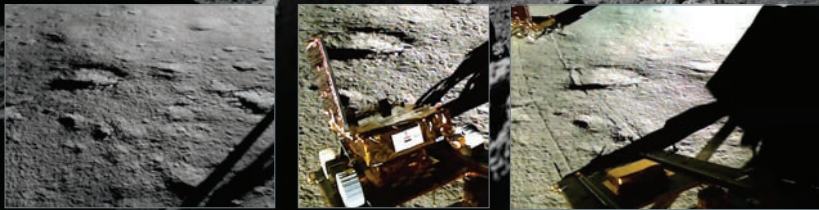




# CHANDRAYAAN-3



Moon as viewed by Chandrayaan-3 LI-4 Camera



Pre and Post Hop Ramp images captured by Lander Imager-1 Camera



The path retraced by the Chandrayaan-3 Rover on August 27, 2023, as viewed by Navigation Camera onboard Rover.

Vikram as seen by Pragyan on August 30, 2023, 07:35 Hrs. IST

Anaglyph (3D) View of Chandrayaan-3 Vikram Lander on the Moon



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