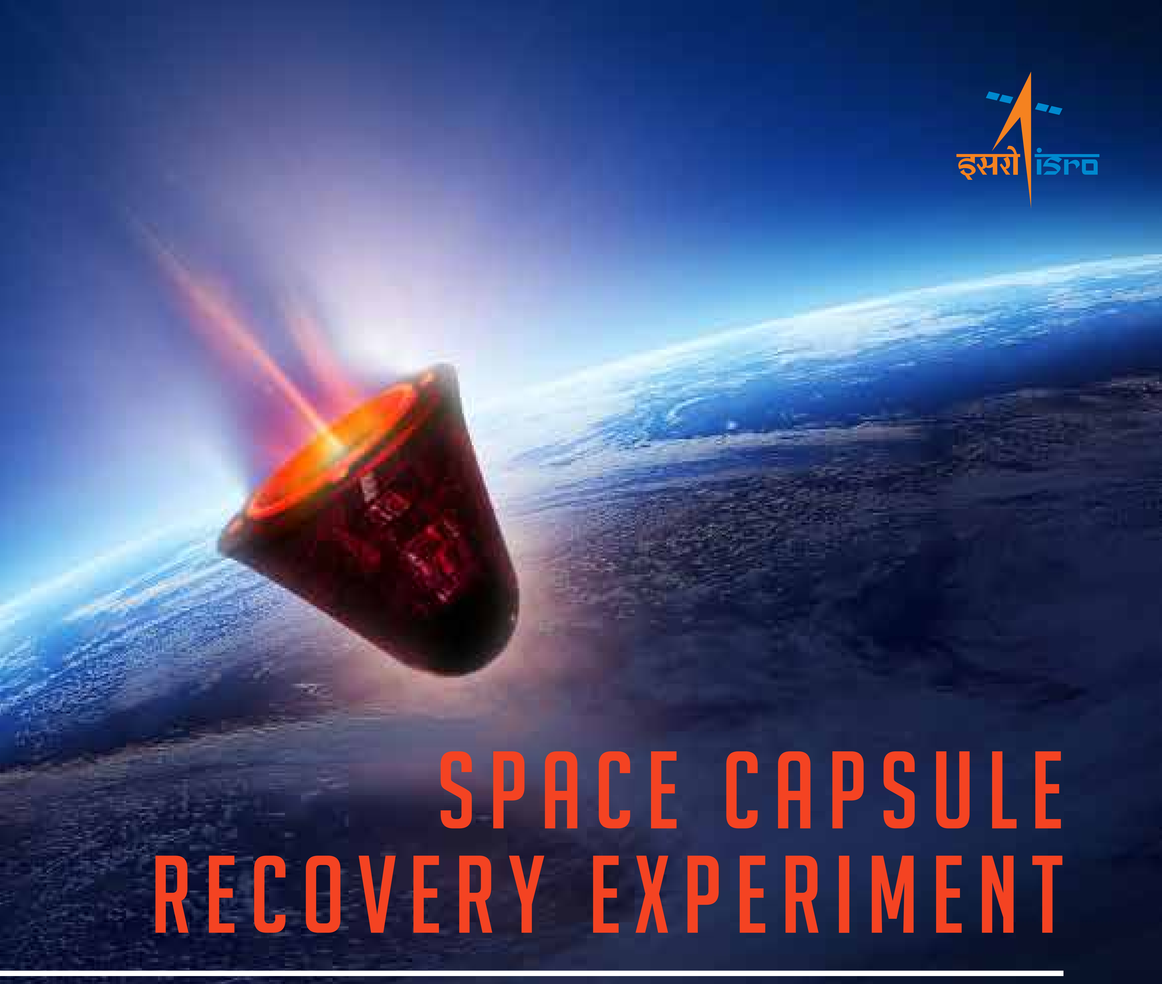
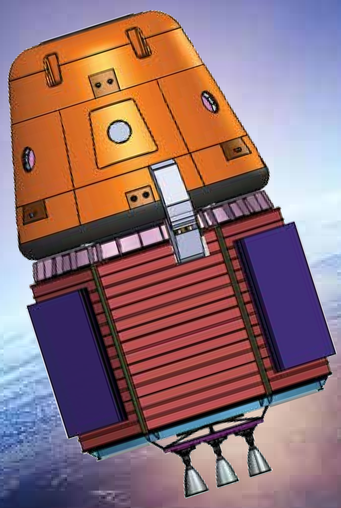


SPACE CAPSULE RECOVERY EXPERIMENT

Space Capsule Recovery Experiment (SRE) was a 550 kg recoverable orbital capsule intended to demonstrate the technology of an orbiting platform for performing experiments in microgravity conditions. The SRE was launched on 10th January, 2007 and after being in orbit for 10 days, it was de-boosted for re-entry and recovered successfully from Indian sea waters on 22nd January, 2007.

SRE carried two experiments, an Isothermal Heating Furnace (IHF) and a Biomimetric experiment. The SRE mission provided valuable experience in the fields of navigation, guidance and control during re-entry phase, hypersonic aerothermodynamic, development of reusable thermal protection system, recovery through deceleration and floatation, besides acquisition of basic technology for reusable launch vehicles.



GAGANYAAN ORBITAL MODULE

The Orbital Module consists of Crew Module and Service Module.

The Crew Module (CM) is the habitat where the crew resides. The crew module contains various subsystems like crew seat, display panels, life support system, storage racks, parachutes, propulsion and separation systems.

The Service Module (SM) has essential subsystems like solar panels, battery, propulsion systems, radiators and avionics.

The SM after de-boosting from CM will be separated prior to re-entry. The crew module is three axes controlled and will splash down in Indian sea waters using parachutes.

HUMAN SPACE PROGRAMME IN INDIA

Gaganyaan Project has the objective of demonstrating human space flight capability to Low Earth Orbit (LEO) with three crew members for seven days in the orbit and after re-entry, safely recover crew from Indian sea waters.

Gaganyaan has three major components, namely the Human Rated Launch Vehicle, Crew Escape System and Orbital Module. Associated ground segment will also be made ready. GSLV MKIII will be human rated and certified for undertaking human space flight mission. Gaganyaan mission is scheduled for launch in December 2021.

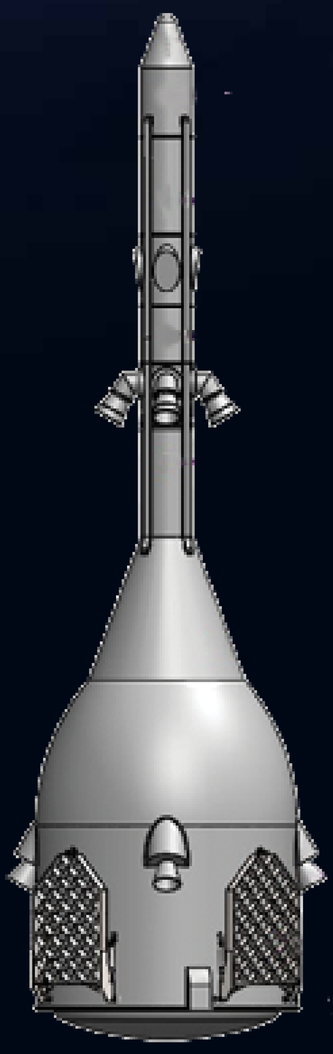
HUMAN RATED GSLV MKIII

Human Rated GSLV MkIII

Gaganyaan orbital module will be launched by human rated GSLV MKIII vehicle. The human rating of the launcher will be carried out for safely ferrying the crew to orbit. The vehicle is provided with escape provisions to bailout crew in case of contingency during the ascent phase.

The vehicle is equipped with an intelligent health management system to monitor the health of vehicle systems and to detect any anomaly that can lead to abort of the mission.

CREW ESCAPE SYSTEM



Crew Escape System

The Crew Escape System (CES) will be active from Launch Pad to about 70 km altitude. It is powered by a set of quick-acting, high burn rate solid motors. Depending upon the abort situation the vehicle health management system will select appropriate strategies to fire the required combination of motors to effect safe abort.

The development flight of the CES was carried out in 2018.

CREW MODULE FOR ATMOSPHERIC RE-ENTRY

Crew Module for Atmospheric Re-entry (CARE) mission was the first experimental suborbital flight launched by LVM-3X. It injected a module to an altitude of 126 km, which splashed down in the Bay of Bengal about twenty minutes after lift-off from Sriharikota.

After the re-entry, the vehicle performed descent and splashdown during which thermal protection, aerothermodynamics and parachute system performance was validated.

PAD ABORT TEST

Crew Escape System
Pad Abort Test

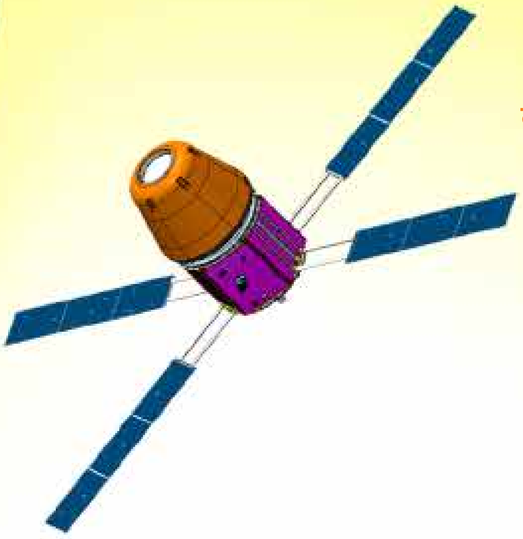
The Pad Abort Test (PAT) demonstrated the safe recovery of the crew module in case of any exigency at the launch pad. This is the first test in a series to qualify Crew Escape System (CES) technology for Gaganyaan mission in future.

A developmental flight of CES simulating PAD abort was conducted in 2018. The test demonstrated various subsystems like the functioning of quick-acting solid motors, grid fin and its deployment, various separation systems and deployment of parachute systems.

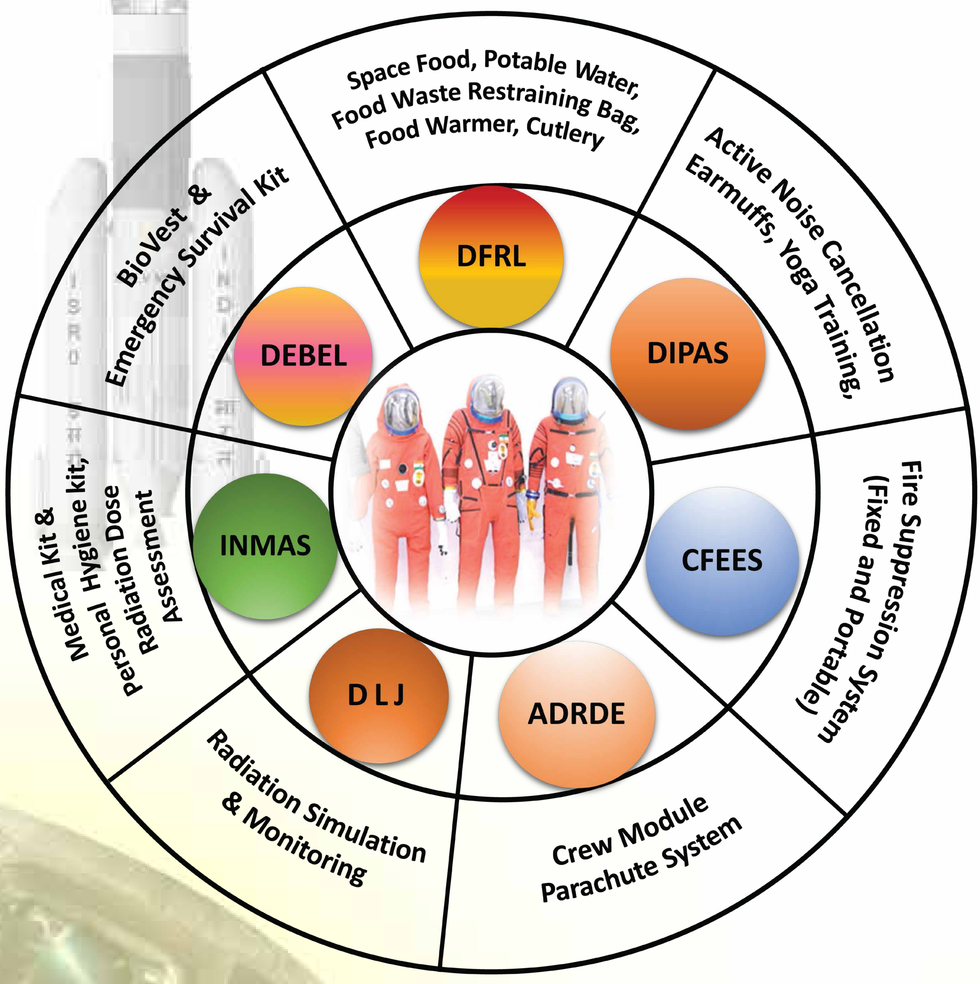
GAGANYAAN
EXPLORING NEW TERRITORIES

Indian Human Spaceflight Programme

enhances science and technology levels in the country, serves as a national project involving several institutes, academia and industry, improves industrial growth, inspires youth, develops technology for social benefits and improve international collaboration.



HUMAN CENTRIC SYSTEMS FROM DRDO FOR GAGANYAAN



HUMAN CENTRIC PRODUCTS FROM DRDO

BIOVEST
DEBEL

PARACHUTE SYSTEMS
ARDE

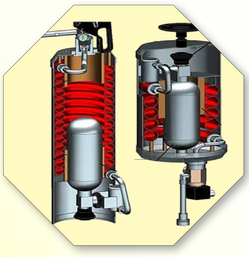
EMERGENCY SURVIVAL KIT
DEBEL

EARMUFF
WITH NOISE CANCELLATION
DIPAS

MEDICAL KIT
INMAS

SPACE FOOD
DFRL

FIRE SUPPRESSION SYSTEM
CFEES



RADIATION DOSIMETER
DLJ

GSLV

Geosynchronous Satellite Launch Vehicle

GSLV is the fourth generation launch vehicle of India and is the tallest launch vehicle of ISRO. This launch vehicle demonstrated India's Geosynchronous launch capability.

Cryogenic stage and technologies were indigenously developed for the first time and flown in GSLV. It is a three stage vehicle with solid, liquid and cryogenic stages and 4 liquid strap-ons.

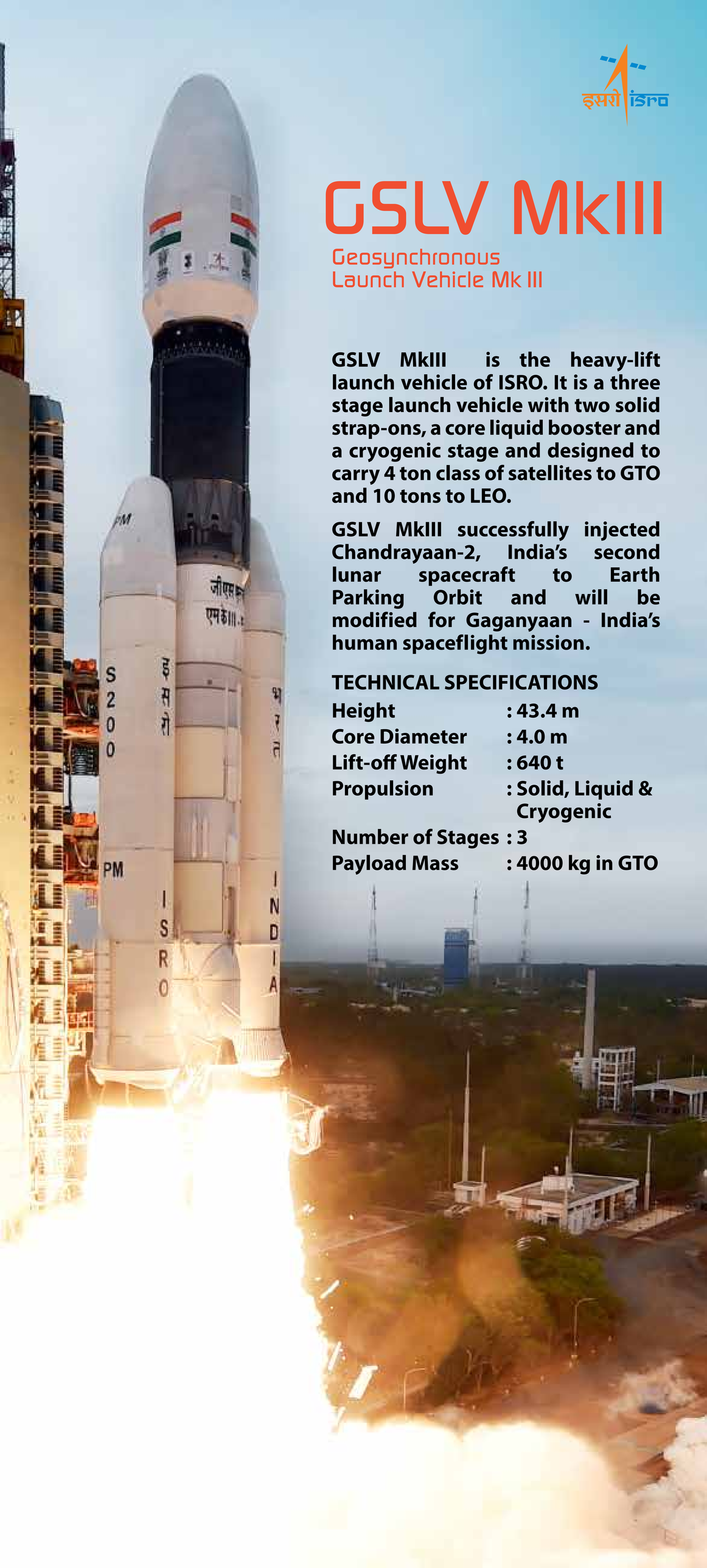
The vehicle got enhanced payload capability with high thrust liquid engines and improved cryogenic stages. GLSV can launch satellites into a wide range of Earth orbits.

TECHNICAL SPECIFICATIONS

Height	:	**51.7 m**
Core Diameter	:	**2.8 m**
Lift-off Weight	:	**420 t**
Propulsion	:	**Solid, Liquid & Cryogenic**
Number of Stages	:	**3**
Payload Mass	:	**2500 kg in GTO**

Payload Capability

Orbit	GTO	SSPO	LEO
Payload (kg)	2500	3000	6000



GSLV MkIII

Geosynchronous Launch Vehicle Mk III

GSLV MkIII is the heavy-lift launch vehicle of ISRO. It is a three stage launch vehicle with two solid strap-ons, a core liquid booster and a cryogenic stage and designed to carry 4 ton class of satellites to GTO and 10 tons to LEO.

GSLV MkIII successfully injected Chandrayaan-2, India's second lunar spacecraft to Earth Parking Orbit and will be modified for Gaganyaan - India's human spaceflight mission.

TECHNICAL SPECIFICATIONS

Height	**: 43.4 m**
Core Diameter	**: 4.0 m**
Lift-off Weight	**: 640 t**
Propulsion	**: Solid, Liquid & Cryogenic**
Number of Stages	**: 3**
Payload Mass	**: 4000 kg in GTO**

PSLV

Polar Satellite Launch Vehicle

PSLV is the third generation launch vehicle of India and is one of the most reliable launch vehicles in the world. It is a proven launch vehicle to meet international customer needs.

This workhorse launch vehicle of ISRO has 4 stages (2 solid and 2 liquid). The vehicle has different variants which can cater to the various customer needs. It has the capability to launch satellites into a wide range of Earth orbits.

Historic Launches

- Chandrayaan-1 India's first lunar mission
- Mars Orbiter Mission
- Record launch of 104 satellites in a single mission
- Space Capsule re-entry and recovery experiment

TECHNICAL SPECIFICATIONS

Height	:	44 m
Lift-off Weight	:	320 t
Propulsion	:	Solid & Liquid
Number of Stages	:	4
Payload Mass	:	1750 kg in SSPO 1425 kg in GTO

NavIC

INDIAN REGIONAL NAVIGATION SATELLITE SYSTEM (IRNSS)

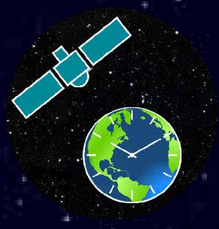
Provides India with assured navigation service for vital civilian applications without having to depend on another country.

Indian Regional Navigation Satellite System (IRNSS) constellation consists of 8 satellites in Geostationary and inclined Geosynchronous orbit. NavIC provides accurate position, velocity and time information in real-time to a variety of users, with a position accuracy better than 20 meters. The IRNSS data has a good accuracy for single frequency user with ionospheric correction. It provides services during all weather conditions on a 24 hour basis with coverage over India and about 1500 km around it.

NavIC Applications

Terrestrial, Aerial and Marine Navigation

Precise Timing

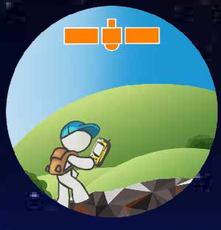


Integration with Mobile Phones

Disaster Management

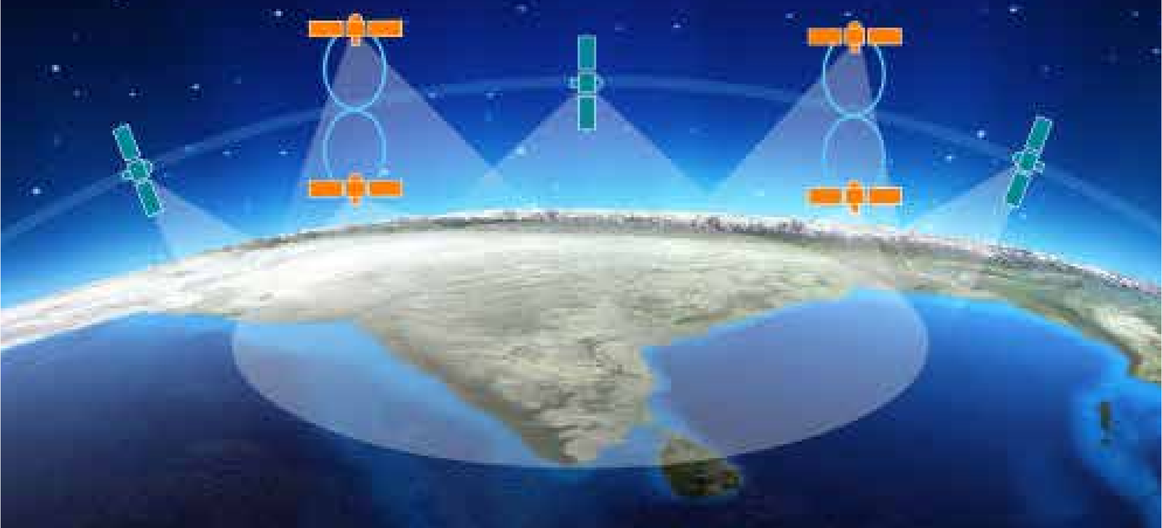
Mapping and Geodetic Data Capture

Vehicle Tracking and Fleet Management



Terrestrial Navigation Aid for Hikers and Travellers

Visual and Voice Navigation for Drivers



Resourcesat-2A

RESOURCESAT-2A is a Remote Sensing satellite intended for resource monitoring. RESOURCESAT-2A is a follow on mission to RESOURCESAT-1 and RESOURCESAT-2, launched in 2003 and 2011 respectively. RESOURCESAT-2A is intended to continue the remote sensing data services to global users. RESOURCESAT-2A was successfully launched by PSLV-C36 on December 07, 2016 from SDSC SHAR, Sriharikota.

The mission objectives of RESOURCESAT-2A are to provide remote sensing data services for integrated land and water resources management and carry out studies in advanced areas of crop discrimination, crop yield, crop stress, pest/disease surveillance, disaster management etc.

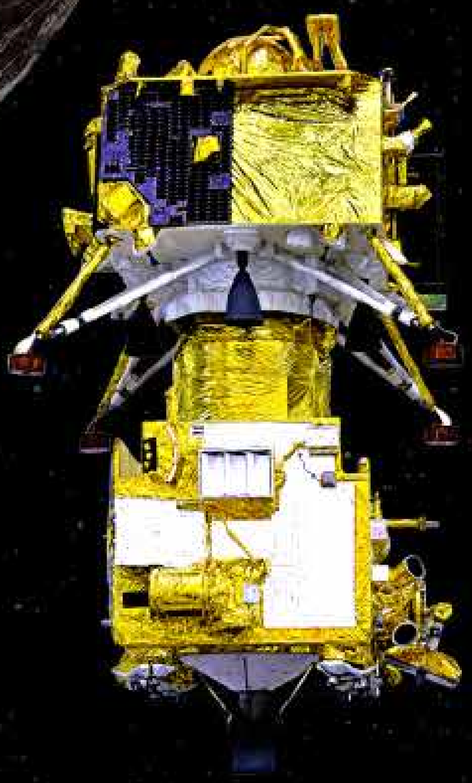
The satellite has three optical remote sensing cameras and one solid state C Band Transponder. The three optical payloads are LISS-4 (5.8 m resolution in three bands with 70 km swath), LISS-3 (23.5 m resolution in four bands with 140 km swath) and AWiFS (a spatial resolution of 56 m in four bands with 740 km swath). Resourcesat-2A will cater to several applications in the areas of natural resources monitoring and management.

SSLV

Small Satellite Launch Vehicle

To cater to emerging global small satellite launch services market, ISRO has taken up the development of Small Satellite Launch Vehicle (SSLV), which is an all solid three stage vehicle, with a capability to launch on demand.

SSLV is designed with launch capability of putting a satellite weighing around 500 kg into Low Earth Orbit and 330 kg satellite into Sun-synchronous Orbit. The vehicle has a reduced turnaround time for realisation with multiple satellite mounting options for Nano, Micro and Small Satellites. SSLV will commence its small satellite launch services operation from 2020 onwards.

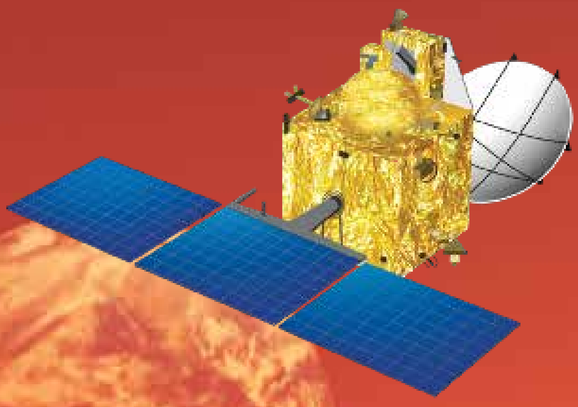


CHANDRAYAAN-2

Chandrayaan-2 is India's second mission to Moon, which was successfully launched on-board India's Geosynchronous Satellite Launch Vehicle, GSLV MkIII-M1, on July 22, 2019 into its planned orbit from Satish Dhawan Space Centre, Sriharikota. Chandrayaan-2 mission is a highly complex mission, which represents a significant technological leap compared to the previous missions of ISRO. It comprised an Orbiter, Lander and Rover to explore the unexplored South Pole of the Moon. The mission is designed to expand the lunar scientific knowledge leading to a new understanding of the origin and evolution of the Moon.

On August 20, 2019, Chandrayaan-2 was successfully inserted into lunar orbit. While orbiting the moon in a 100 km lunar polar orbit, on September 02, 2019, Vikram Lander was separated from the Orbiter in preparation for landing. Subsequently, two de-orbit maneuvers were performed on Vikram Lander so as to change its orbit and begin circling the moon. Later, Vikram Lander descent was as planned and normal performance was observed upto an altitude of 2.1 km. Subsequently communication from Lander to the ground stations was lost.

The Orbiter placed in its intended orbit around the Moon will enrich our understanding of the moon's evolution and mapping of the minerals and water molecules in Polar regions, using its eight state-of-the-art scientific instruments.



MARS ORBITER MISSION

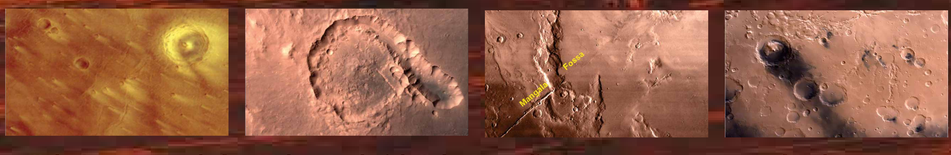
Mars Orbiter Mission (MOM) is India's first interplanetary mission to planet Mars with an orbiter designed to orbit Mars in an elliptical orbit. MOM is primarily a technological mission considering the critical mission operations and stringent requirements on propulsion and other bus systems of spacecraft. It has been configured to carry out observation of physical features of Mars and study the Martian atmosphere with following five payloads:

- Mars Colour Camera (MCC)
- Thermal Infrared Imaging Spectrometer (TIS)
- Methane Sensor for Mars (MSM)
- Mars Exospheric Neutral Composition Analyser (MENCA)
- Lyman Alpha Photometer (LAP)

The un-manned spacecraft to planet Mars was launched onboard PSLV-C25 on November 05, 2013 and successfully inserted into an orbit around Mars on September 24, 2014 using LAM engines. Subsequently the imaging and science data collection phase commenced. The five scientific instruments (MCC, TIS, MSM, LAP and MENCA) on-board MOM are being used to study the atmosphere, surface mineralogy and topography of the planet. The data from the satellite is made available to the national and international scientific community for analysis and research. The Mars Orbiter Mission is still operational and providing invaluable data.

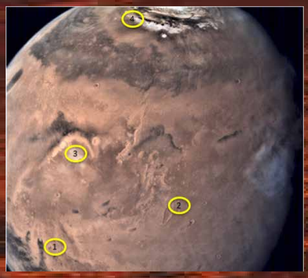
Images From Mars Mission

India's Mars Orbiter Mission delivered a series of photos of the Red Planet during its planned mission. Using its five instruments, MOM studied Mars and its atmosphere closely when passing the nearest point of its orbit (less than 400 km) and gets a global picture when at its farthest point.



Gale Crater named after Walter Frederick Gale, Australian amateur astronomer of 19th century

Natural Satellites of Mars



PYRO DEVICES FOR GAGANYAAAN

Mortar

The Mortar is a pyro device used for ejecting parachutes at required velocity. For Gaganyaan missions, Mortar will be used to deploy ACS and Drogue parachutes.

Head-end Mounted Safe Arm (HMSA) is a safe & arm device mounted on igniter / motor head-end. This is used for ignition system of Solid Motors in Crew Escape System in Gaganyaan. Compared to RMSA, it has no high explosive detonation transfer across bulkheads. The system complexity is reduced by eliminating pyro circuit elements.

Head-end Mounted Safe Arm

Reefing Line Cutter

Reefing line cutter is used for dis-reefing of Ø 31 m Main parachutes in Crew Module deceleration system and the device initiation is through percussion based system. It was successfully used in CARE and PAT missions.

Parachute Releaser Unit (PRU) is used for release of drogue and main parachutes after functioning and it employs piston pulling for release of clamp. It was successfully used in CARE and PAT missions.

Parachute Releaser Unit

THRUSTERS FOR GAGANYAAN

440 N Thruster with flow control valve

440 N Thruster for Orbital Module is designed for orbit raising and de-boost maneuvers. The Flow Control Valve (FCV) is designed for continuous long duration operation with redundant coils.

100 N Thruster with flow control valve

100 N Thruster for Orbital Module is designed for 3-axis attitude, orbit and re-entry maneuvers. It is available in both ablative (Crew Module) and radiative cooled (Service Module) versions. The Flow Control Valve (FCV) is charecterised by high cyclic life, fast response and all welded construction.

HALF-HUMANOID

Half-humanoid has anthropomorphic proportions with two arms, head and torso to mimic crew activity inside crew module for Gaganyaan.

Attaining launch and orbital postures

Responding to CM environment
Generate warnings
CO_2 canister replacement

VYOMMITRA

Operating switches
Visual monitoring of crew module

Receive voice commands
Respond via speech (Bilingual)
Expressive face ,
Lip-sync to Speech

Indian Communication Satellites

Reaching the Unreached

The Indian National Satellite (INSAT) system is one of the largest domestic communication satellite systems in Asia-Pacific region with nine operational communication satellites placed in Geostationary orbit. Established in 1983 with commissioning of INSAT-1B, it initiated a major revolution in India's communications sector and sustained the same later. The INSAT system provides services to Telecommunications, Television Broadcasting, Satellite News-Gathering, Societal Applications, Weather Forecasting, Disaster Warning and Search and Rescue Operations. 18 operational satellites are available in Geostationary orbit.

GSAT-30
January 17, 2020

GSAT-31
February 06, 2019

GSAT-11
December 05, 2018

GSAT-29
November 14, 2018

GSAT-17
June 29, 2017

GSAT-19
June 5, 2017

GSAT-9
May 5, 2017

GSAT-18
October 6, 2016

GSAT-15
November 11, 2015

GSAT-6
August 8, 2015

GSAT-16
December 7, 2014

GSAT-14
January 5, 2014

GSAT-10
September 29, 2012

GSAT-12
July 15, 2012

GSAT-8
May 21, 2011

INSAT-4B
March 12, 2007

INSAT-4A
December 22, 2005

Banking

Tele-education

Weather Forecast & Cyclone Warning Service

Telemedicine

Radio Broadcasting

Search & Rescue

Direct-To-Home (DTH) Service

Maitri, Antarctica

News Broadcasting