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Chandrayaan-3 and its launch vehicle LVM3

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Why in News: The Indian Space Research Organisation (ISRO) recently announced that it had successfully integrated the Chandrayaan-3 spacecraft with the launch vehicle, Launch Vehicle Mark-III (LVM3), at the Satish Dhawan Space Centre in Andhra Pradesh's Sriharikota

About Chandrayaan 3

INDIA'S THIRD lunar mission Chandrayaan-3 will be launched from the country's only spaceport Sriharikota on July 13. The spacecraft will travel just over a month and likely land on the surface of the moon around August 23.

The landing site for the integrated Vikram lander and Pragyan rover will remain the same as the previous mission: near the south pole of the moon at 70 degrees latitude. If successful, Chandrayaan-3 will become the first mission to soft land near the southern pole of the moon.

The site was selected as it has several craters that remain permanently in shadows, increasing the chances of examining water ice. Chandrayaan 1, which also carried NASA payloads, was instrumental in confirming the presence of water and hydroxyl (OH) molecules on the moon.

The mission will also make India the fourth country in the world to achieve soft landing on the moon after the US, Russia and China.

The position remains open for India as the lander missions by Israel and Japan that were launched since the previous Chandrayaan mission also failed.

The current mission will follow a similar trajectory to what was planned for the previous mission, with the orbit of the spacecraft being raised several times till its slingshots out of Earth's gravity.

Once the spacecraft reaches the moon and is captured in its gravity, the orbit will be lowered to a 100×100 km circular orbit before making the descent.

The descent phase of the vehicle had been described as "15 minutes of terror" by the previous ISRO chairperson K Sivan.

With the orbiter from the previous mission already in place around the moon, the spacecraft will fly only the lander-rover configuration sitting atop a propulsion module.

The lander-rover configuration has remained more or less the same; more sensors have been added to ensure the mission goes as planned. Several tests were also conducted to ensure that the mission is a success

Chandrayaan 2, which was planned to demonstrate soft landing and roving, crash landed 2.1 km from the surface of the moon.

About LVM3

LVM3 is India's heaviest rocket, with a gross lift-off weight of 640 tonnes, an overall length of 43.5m and 5m-diameter payload fairing (nose-shaped equipment to protect the rocket from aerodynamic forces).

The launch vehicle can carry up to 8 tonnes of payload to the lower earth orbits (LEO), which is about 200 km from the Earth's surface. But when it comes to the geostationary transfer orbits (GTO), which lie much further ahead, up to about 35,000 km from the Earth, it can carry much less, only about four tonnes

This, however, does not mean that LVM3 is weak compared to rockets used by other countries or space companies for similar jobs.

For instance, the European Space Agency's (ESA) Ariane5 rocket has a lift-off mass of 780 tonnes and can carry 20 tonnes of payloads to LEO and 10 tonnes to GTO.

LVM3 made its first journey into space in 2014 and also carried the Chandrayaan-2 in 2019. Most recently, in March this year, it placed 36 OneWeb satellites, weighing about 6,000kg, in LEO, showing its capabilities to deliver multiple satellites into space.

This was the second time that LVM3 made a commercial launch — the first one came in October 2022 when it delivered the OneWeb India-1 mission.

Various components of LVM3

Rockets have several detachable energy-providing parts. They burn different kinds of fuels to power the rocket.

PSLV was developed for Low Earth Orbit satellites into Polar and Sun Synchronous Orbits, and GSLV for heavier INSAT class of Geosynchronous satellites into orbit.

	SLV-3	ASLV	PSLV-XL	GSLV MK-II	GSLV MK-III
Height	22.7 m	23.5 m	44 m	49 m	43.43 m
Liftoff weight	17 t	39 t	320 t	414 t	640 t
Propulsion	All solid	All solid	Solid and liquid	Solid, liquid, and cryogenic	Solid, liquid, and cryogenic
Payload mass	40 kg	150 kg	1860 kg	2200 kg	4000 kg
Orbit	Low Earth Orbit	Low Earth Orbit	475 km Sun Synchronous Polar Orbit*	Geosynchronous Transfer Orbit	Geosynchronous Transfer Orbit

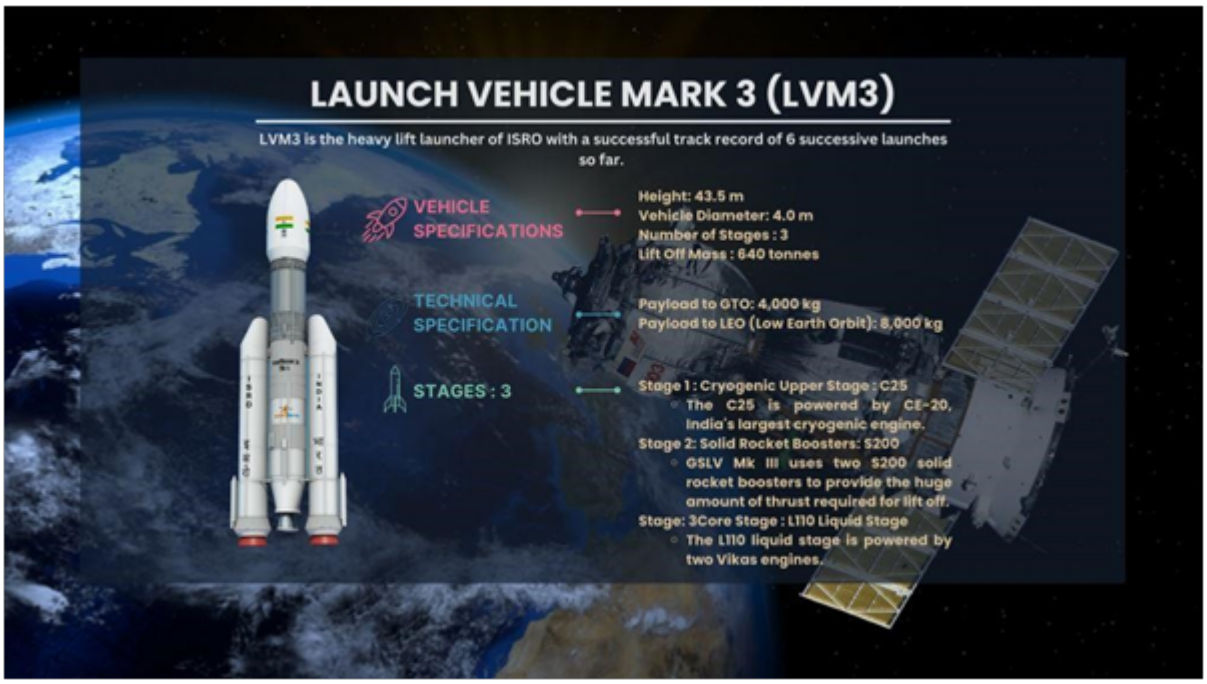
*1300 kg in Geosynchronous Transfer Orbit

All information and images: ISRO

Once their fuel is exhausted, they detach from the rocket and fall off, often burning off in the atmosphere due to air friction, and getting destroyed. Only a small part of the original rocket goes to the intended destination of the satellite, like Chandrayaan-3.

Once the satellite is finally ejected, this last part of the rocket either becomes part of space debris or once again burns off after falling into the atmosphere.

LVM3 is essentially a three-stage launch vehicle, including two solid boosters (S200), the core liquid fuel-based stage (L110), and the cryogenic upper stage (C25)



Chandrayaan-3 been integrated with LVM3

The Chandrayaan-3, which consists of a lander, rover and propulsion module, can’t travel to space on its own. It needs to be attached — like any satellite — to launch vehicles or rockets, like the LVM3 in this case.

Rockets have powerful propulsion systems that generate the huge amount of energy required to lift heavy objects like satellites into space, overcoming the gravitational pull of the Earth.