Chandrayaan-2: India’s Orbiter-Lander-Rover Mission

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Introduction

- On July 22, the Indian Space Research Organisation (ISRO) launched Chandrayaan-2 on-board its powerful rocket GSLV MkIII-M1 from the spaceport of Sriharikota in Andhra Pradesh.

About Chandrayaan-2: India’s second mission to the Moon

- The Chandrayaan-2 is India’s second lunar mission, after the previously successful Chandrayaan-1 mission that was launched in 2008.
Chandrayaan-2 mission has three parts: **an orbiter, a Lander (named Vikram) and a Rover (named Pragyan).**

- The orbiter will perform mapping of moon from an altitude of 100 kilometers, while the lander will make a soft landing in a high plain between two craters **Manzinus C and Simpelius N** and send out the rover on the moon surface.
- The mission life of **Orbiter will be one year** whereas the mission life of lander and rover will be **one Lunar day** (14 earth days).
- The mission will also carry **Laser retroreflector arrays** (a passive experimental instrument of NASA) to calculate exact distance between moon and earth.
The daring Chandrayaan-2 lunar mission

India’s Chandrayaan-2 spacecraft will attempt to land a briefcase-sized rover onto the Moon’s surface, 600km from the lunar south pole, while an orbiter above searches for water — vital to future manned missions.

Lander Craft (LC)
Orbiter Craft (OC)
Payload fairing

Mission cost: $150m

LANDER
Equipped with seismometer to detect moon-quakes and Langmuir probe to measure plasma fluctuations.

ROVER
Will move around near landing site in semi-autonomous mode observing lunar surface and analysing soil.

Sources: Science, Futurism, Spaceflight Insider, Planetary Society, ISRO, NASA

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Objectives of the mission

- To study Moon’s **topography, mineralogy, exosphere** along with study of **seismic activities**.
- To study the density of the electrons in the **Moon’s ionosphere** (the uppermost part of the atmosphere ionized by radiation).
- To demonstrate the ability to have a **soft landing** on the lunar surface and operate a robotic rover on moon.
- To study the **water distribution** using infrared spectroscopy, synthetic aperture radiometry & polarimetry and mass spectroscopy techniques.

Significance of the mission:
• It is first Indian expedition to attempt a **soft landing** on the lunar surface with **indigenous technology**.
• It will make **India fourth country** ever to soft land on the lunar surface after the US, Russia and China.
• It is the **second mission to land close to the Moon’s South Pole**. China’s Chang’e 4 was the first to land in the south pole in January 2019.
Due to the moon’s low angular tilted axis, few regions on the south pole of moon remains forever dark (sunlight cannot reach there or reached very few). In other words, the lunar south pole remains in shadow than north pole.

Hence, it is more likely that water, in the form of ice, and some other volatile elements could be found in the south pole region.

In addition, South Pole region has craters that are cold traps and contain a fossil record of the early Solar System.

Key Scientific instruments used in Chandrayaan-2

- **Terrain Mapping Camera 2** (TMC-2), map the lunar surface in three dimensions
- **Collimated Large Array Soft X-ray Spectrometer** (CLASS): Map the abundance of minerals on the surface.
- **Solar X-ray Monitor** (XSM): Looks at emissions of solar X-rays.
- **Chandra’s Atmospheric Composition Explorer** (ChACE-2): Neutral mass spectrometer.
- **Synthetic Aperture Radar** (SAR): map the surface in radio waves.
- **Imaging Infra-Red Spectrometer** (IIRS): Measure the abundance of water on the surface.
• **Orbiter High Resolution Camera (OHRC):** Examine the surface, particularly the landing site of the lander and rover.

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**Technological challenges of the mission:**

- The propulsion system consisting of throttleable engines to ensure **landing at low touch down velocity**.
- **Mission management** – propellant management at various stages.
- **Lander Development** – Navigation, guidance and control, sensors for navigation and hazard avoidance etc.
- **Rover Development** – Roll down (from the lander) mechanism, roving mechanism (on the lunar surface), development and testing of power systems, thermal systems etc.

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**What is Chandrayaan 1 mission?**

- It was the first moon mission of India conducted by ISRO.
- It was launched in October 2008 and was active in operations until August 2009.
- The mission included a lunar orbiter and an impactor named Moon Impact Probe (MIP).
Discoveries of Chandrayaan-1 mission

- It discovered **traces of water** on the Moon which was a path-breaking discovery.
- It also discovered **water ice in the north polar** region of the Moon.
- It also detected **magnesium, aluminum and silicon** on the lunar surface.
- **Global imaging of the Moon** is another achievement of Chandrayaan-1 mission.

Difference between Chandrayaan-1 and Chandrayaan-2 mission

- Unlike Chandrayaan-1, which consisted **only of an orbiter**, Chandrayaan-2 includes an **orbiter, a lander, and a rover**.
- Chandrayaan-1 was launched by India’s Polar Satellite Launch Vehicle (**PSLV-C11**) while Chandrayaan-2 was launched by the Geosynchronous Satellite Launch Vehicle (**GSLV**) Mk-III.
- Chandrayaan-1 carried five ISRO **payloads** and six payloads from other international space agencies while Chandrayaan-2 has 13 payloads including three from the Europe, two from the US and one Bulgaria.
- Chandrayaan-1 sent one of its instruments, known as Moon Impact Probe, in order to **crash land** on the lunar surface while Chandrayaan-2 aims for **soft moon landing**.

Key Facts:

- The lander has been named ‘Vikram’ after Vikram Sarabhai who is regarded as the father of India’s space programme.
- So far, a total number of 38 soft landing attempts on moon have been made worldwide, with the success rate of only 52%.
- NASA will also send astronauts on the south polar region of moon in 2024 as part of its Artemis
programme.

Way Ahead

- The study of moon can help us understand the development of our entire solar system.
- The moon is 3.5 billion years’ old and its craters were formed and have remained unchanged over time because it has no environment and no other internal movement that erase its features.
- With these missions, ISRO has also been signalling a distinct change in its priorities by engaging mainly in space and inter-planetary exploration, while other ventures like commercial satellite launches would only be secondary activities. Much would, however, depend on the success of Chandrayaan-2 mission.