Mission Gaganyaan

Why in news?

Recently Prime Minister Narendra Modi publicised the final shortlist of candidates to be astronauts on board the maiden human spaceflight mission called Gaganyaan of the Indian Space Research Organisation (ISRO).

What is Gaganyaan?

- **Aim**- To send a team of astronauts into space on a ***Low Earth Orbit (LEO) of 400 km*** for 3 days and safely return them by landing in the Indian Ocean.
- **Objective**- To demonstrate indigenous capability to undertake human space flight mission to LEO.
- **Origin**- In 2006, India started work on an orbital vehicle mission that was later named Gaganyaan.
- **Mission program**- As a part of this program two unmanned missions and one manned mission are approved by Government of India.
- **Unmanned mission**- It will demonstrate the levels of technology preparedness before manned mission.
- **Demonstrator missions**- It includes Integrated Air Drop Test (IADT), Pad Abort Test (PAT) and Test Vehicle (TV) flights.

- **Space Capsule Recovery Experiment**- It was conducted in 2007 where a satellite previously placed in orbit descended from an altitude of 635 km and safely splashed down into Bay of Bengal.
- **CARE-** The Crew Module Atmospheric Re-entry Experiment was successfully conducted in 2014 where ISRO launched a prototype of the crew module onboard on LVM-3 rocket.
- **Domestic development and testing**- ISRO worked deligently to human rate various components ensuring their reliability met stringent standards for crewed spaceflight.
- **Second phase of unmanned mission**- A second unmanned flight is planned with a pressurized crew module, which will carry the robot ***Vyommitra*** to record all parameters to study the impact of the flight on humans.
- **Manned mission-** Group Captain Prasanth Balakrishnan Nair, Group Captain Ajit Krishnan, Group Captain Angad Pratap, and Wing Commander Shubhanshu Shukla are India's astronauts-designate for Gaganyaan.
- **Launch vehicle**- LVM-3, it is a well proven and reliable heavy lift launcher of ISRO.

Stages of LVM-3	Components

First stage	It comprises of two solid-fuel boosters strapped to the rocket core.
Second stage	It is powered by two liquid-fuelled and clustered Vikas 2 engines.
Third stage	It has the CE-20 indigenous cryogenic engine with liquid hydrogen and liquid oxygen as fuel and oxidiser, respectively.

LVM-3 was earlier called as GSLV Mk-III

- **HLVM 3-** All systems in LVM3 launch vehicle are re-configured to meet human rating requirements and christened Human Rated LVM3.
    - It will be capable of launching the Orbital Module to an intended Low Earth Orbit of 400 km.
- **Crew Escape System**- HLVM3 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.



- **Orbital module**- It will orbit the Earth which consists of
    - Crew module
    - Service module

Crew module	Service module
It is the habitable space with Earth like environment in space for the crew.	It will be used for providing necessary support to CM while in orbit.
It consists of *pressurized* metallic *inner structure* and *unpressurised external structure* with Thermal Protection System (TPS).	It is an *unpressurized structure* containing thermal system, propulsion system, power systems, avionics systems and deployment mechanisms.
Features- Parachute, Crew Escape System, Environmental Control and Life Support System	It is a regulated bi-propellant-based propulsion system that caters to the requirements of the Orbital Module,
It will also feature a gynoid (feminine robot) named 'Vyommitra' to perform critical tasks.	It performs orbit injection, circularisation, on-orbit control, de-boost manoeuvring and Service Module based abort (if any) during the ascent phase

- **Human space flight centre**- It was launched in 2019 in Bangalore with a primary mandate to spearhead ISRO's Gaganyaan programme, the crew training is provided here.

ISRO signed a Memorandum of Understanding (MoU) with Glavkosmos, a subsidiary of the Russian space agency Roscosmos, for the training of the crew.

What are the benefits of undertaking Gaganyaan Mission?

- **Future explorations-** It will make a progress towards a sustained and affordable human and robotic programme to explore the solar system and beyond.
- **Technology advancement-** Advanced technology capability for undertaking human space exploration, sample return missions and scientific exploration.
- **International collaboration**- To actively collaborate in global space station development & to carry out scientific experiments of interest to the nation.
- **Job creation-** It provides for an ample scope for employment generation and human resource development in advanced science and R&D activities.
- **Foster scientific temper**- It will provide unique opportunity to inspire and excite Indian youth and steer many students towards career in science and technology.
- **Global leader** -The programme will strengthen international partnerships and global security through the sharing of challenging and peaceful goals.

What are the challenges in Gaganyaan mission?

- **Space debris management**- The increasing amount of space debris poses a significant threat to spacecraft in LEO, it requires advanced tracking systems and collision avoidance maneuvers to prevent potential collisions with debris.
- **Cabin depressurization risk**- Robust spacecraft design with protective shielding and ealy warning systems are essential as collision with small debris can pose a risk of depressurization in the crew module.
- **Complexity-** Replicating earth like conditions in a confined space like crew module is challenging.
- **Resource management**- Lightweight and compact systems for life support, food production and waste recycling are essential to optimize the use of available payload capacity.
- **Technological innovations**- It is necessary continuously to overcome the challenges and complexities associated with the mission, research and development effort must focus on creating reliable, compact and energy efficient systems to sustain human life in the harsh conditions of space.

What lies ahead?

- Gaganyaan is a significant step for India, aiming to achieve self-sufficiency in human spaceflight.
- It will boost India to achieve its vision of an indigenous space station by 2035 and to land an Indian on the moon by 2040.

References

1. The Hindu- What will Gaganyaan change for India
2. ISRO- About Gaganyaan



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