Science & Technology · GS - III

India has achieved remarkable successes in unmanned space missions including the Chandrayaan and Mars Orbitter Mission, but has not ventured into manned space mission, both in terms of technology and logistics? Explain critically

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MARKS	WORD LIMIT
10	~150 words

Answer Hint

Unmanned missions; human spaceflight; life-support systems; crew safety; launch capability; mission logistics; Gaganyaan

Model Answer

Introduction

India has demonstrated significant capabilities through Chandrayaan and the Mars Orbiter Mission. Human spaceflight, however, requires substantially more complex technology, safety systems and operational arrangements than unmanned missions.

Why Human Spaceflight Is More Difficult

- **Life-support systems:** Crewed spacecraft must maintain oxygen, pressure, temperature, water and waste management.
- **Crew safety:** Launch escape systems, radiation protection and emergency procedures are essential.
- **Human-rated launch vehicles:** Rockets must meet stringent reliability and safety standards.
- **Re-entry and recovery:** Spacecraft must safely withstand atmospheric re-entry and recover astronauts.

- **Training and logistics:** Astronaut selection, medical support, mission control and recovery operations require extensive preparation.
- **Cost and testing:** Human missions require rigorous validation, redundant systems and sustained funding.

India's Progress and Potential

- Chandrayaan and the Mars Orbiter Mission demonstrated navigation, propulsion, deep-space communication and autonomous operations.
- India's human-spaceflight programme, Gaganyaan, has advanced preparations involving crew training, testing and development of human-rated systems.
- Human spaceflight can strengthen domestic technology, scientific research, industrial capacity and international cooperation.

Critical Assessment

Unmanned missions are less risky and often more cost-effective for scientific exploration. Crewed missions have distinct benefits but require a strong safety culture and clear scientific and strategic objectives.

Conclusion

India's delayed entry into human spaceflight reflects its technical complexity and safety requirements rather than a lack of space capability. A phased, rigorously tested programme can build sustainable human-spaceflight capacity.

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