Science & Technology · GS - III

Reusable launch vehicle technology has the potential to transform the economics of space exploration. Assess its significance for India's space programme and examine the technological and institutional challenges involved in achieving operational reusability.

EXAM YEAR	PAPER	SUBJECT
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MARKS	WORD LIMIT
15	~250 words

Answer Hint

Launch cost reduction, access to space, technological autonomy, space commercialisation, human spaceflight, RLV-TD, autonomous landing, thermal protection, propulsion, refurbishment, private sector participation, space sustainability.

Model Answer

Introduction

Reusable launch vehicles are designed to recover and reuse major rocket components instead of discarding them after a single mission. Recent advances in rocket recovery demonstrate the potential to reduce launch costs and improve access to space.

Significance for India's Space Programme

1. **Economic efficiency:** Reusability can reduce recurring launch expenditure and improve the competitiveness of Indian launch services.
2. **Strategic autonomy:** Indigenous reusable technology can strengthen India's independent access to space.

3. **Commercial opportunities:** Lower launch costs can attract satellite operators and expand India's share in the global space economy.
4. **Advanced missions:** Reusability can support future human spaceflight, lunar exploration and deep-space programmes.
5. **Innovation ecosystem:** It can encourage collaboration among ISRO, start-ups, research institutions and private industries.

Technological and Institutional Challenges

- **Thermal protection:** Returning vehicles must withstand extreme aerodynamic heating.
- **Precision recovery:** Autonomous guidance, navigation and landing systems require high reliability.
- **Propulsion:** Engines must support repeated operation and safe restart.
- **Refurbishment:** Inspection, maintenance and turnaround time determine actual economic viability.
- **Institutional capacity:** Advanced testing facilities, skilled manpower and sustained research investment are essential.

Way Forward

India should accelerate its Reusable Launch Vehicle programme, strengthen public-private partnerships, invest in advanced materials and autonomous systems, and establish reliable recovery and refurbishment infrastructure.

Conclusion

Reusable launch technology can reshape the global space economy. Its strategic value for India will depend on translating experimental demonstrations into safe, cost-effective and operationally reliable launch systems.