Science & Technology · GS - III

Examine how export controls on advanced semiconductors, manufacturing equipment and computing infrastructure are emerging as instruments of geopolitical competition. Discuss their implications for global technology supply chains and India's strategic interests.

EXAM YEAR	PAPER	SUBJECT
DAILY PRACTICE 19/11/2026	GS - III	Science & Technology

MARKS	WORD LIMIT
15	~250 words

Answer Hint

Export controls, semiconductor geopolitics, Foreign Direct Product Rule, technological sovereignty, global supply chains, U.S.–China rivalry, India's semiconductor mission, strategic autonomy.

Model Answer

Introduction

Advanced semiconductors and computing infrastructure have become critical strategic assets. The United States uses export licensing, restrictions on manufacturing equipment, the Foreign Direct Product Rule and outbound investment controls to limit China's access to sensitive technologies.

Export Controls as Instruments of Geopolitical Competition

- **Technology denial:** Restrictions on advanced chips and chip-making equipment seek to constrain access to technologies relevant to artificial intelligence, supercomputing and advanced military applications.
- **Extraterritorial reach:** The Foreign Direct Product Rule extends certain U.S. controls to foreign-made products incorporating specified U.S. technology.

- **Control over compute:** Restrictions on remote cloud computing access and high-end chip shipments address possible circumvention through overseas facilities and third countries.
- **Investment screening:** Outbound investment restrictions seek to limit financial and technological support for sensitive sectors in countries of concern.

Implications for Global Technology Supply Chains

- **Fragmentation:** Technology ecosystems may increasingly divide into competing regulatory and production networks.
- **Supply-chain vulnerabilities:** Countries dependent on imported chips and equipment face higher costs and uncertainty.
- **Innovation constraints:** Restrictions can affect international research collaboration and technology diffusion.
- **Strategic realignment:** Semiconductor-producing economies may face pressure to align their trade and technology policies with competing blocs.

Implications for India

India has an opportunity to attract semiconductor investment, develop domestic manufacturing capabilities and strengthen its position in global supply chains. However, dependence on imported fabrication equipment, specialised materials and intellectual property remains a major constraint.

India must strengthen domestic R&D, skilled manpower, chip design, fabrication and international technology partnerships while preserving strategic autonomy.

Conclusion

Semiconductor export controls reflect the growing intersection of technology, national security and international trade. India should pursue technological self-reliance through global cooperation, resilient supply chains and sustained investment in indigenous capabilities.

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