Science & Technology · GS - III

Examine how semiconductor export controls have emerged as instruments of geopolitical competition. What are their implications for global technology supply chains and India's semiconductor ambitions?

EXAM YEAR	PAPER	SUBJECT
DAILY PRACTICE 21/11/2026	GS - III	Science & Technology

MARKS	WORD LIMIT
15	~250 words

Answer Hint

Strategic technology, dual-use goods, US-China competition, export licensing, supply-chain vulnerabilities, technological sovereignty, India Semiconductor Mission, international cooperation.

Model Answer

Introduction

Semiconductors are critical components of modern economies, powering artificial intelligence, telecommunications, automobiles, defence systems and advanced computing. Their strategic importance has transformed semiconductor trade into an instrument of geopolitical competition.

Export Controls as Geopolitical Instruments

- **National security:** Advanced chips can support military applications, surveillance and sophisticated weapons systems.
- **Technological advantage:** Restrictions on high-end chips, manufacturing equipment and associated technologies can limit competitors' access to critical capabilities.
- **Strategic leverage:** Export licensing, restrictions on re-exports and controls on remote access can influence international technology flows.

- **US-China rivalry:** Restrictions on advanced computing chips and semiconductor technologies illustrate the growing securitisation of global technology trade.

Implications for Global Supply Chains

1. **Fragmentation:** Competing technology ecosystems may emerge, increasing production and compliance costs.
2. **Supply-chain vulnerability:** Dependence on a limited number of countries for advanced chips and manufacturing equipment creates strategic risks.
3. **Innovation constraints:** Restrictions can affect research collaboration, technology diffusion and commercial innovation.
4. **Third-country challenges:** Countries must navigate competing regulatory requirements while maintaining access to global markets.

Opportunities and Challenges for India

India can strengthen its semiconductor ecosystem through the India Semiconductor Mission, domestic fabrication, chip design, skilled manpower development and international partnerships. However, high capital requirements, technological dependence and infrastructure constraints remain significant challenges.

Conclusion

Semiconductor security requires a balance between legitimate national security concerns and open technological cooperation. India should pursue technological self-reliance while remaining integrated with global semiconductor supply chains.

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