Science & Technology · GS - III

The global semiconductor supply chain has emerged as a strategic arena of technological competition, with export-control circumvention posing challenges to national security and economic governance. Analyse the limitations of unilateral export controls and suggest measures to strengthen international technology governance.

EXAM YEAR	PAPER	SUBJECT
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MARKS	WORD LIMIT
10	~150 words

Answer Hint

Semiconductor geopolitics, advanced AI chips, export-control regimes, third-country intermediaries, end-user verification, re-export restrictions, supply-chain transparency, multilateral cooperation, technological sovereignty, strategic autonomy.

Model Answer

Introduction

Advanced semiconductors are critical to artificial intelligence, defence, telecommunications and high-performance computing. Their strategic importance has made technology trade an instrument of geopolitical competition.

Limitations of Unilateral Export Controls

- **Third-country routing:** Intermediaries and complex supply chains can obscure the final destination of restricted technologies.
- **End-user opacity:** Verifying the actual users and intended applications of advanced chips remains difficult.
- **Enforcement gaps:** Differences in national regulations create opportunities for regulatory arbitrage.

- **Economic consequences:** Restrictions can disrupt legitimate trade, research collaboration and global innovation.
- **Technological fragmentation:** Competing technology ecosystems may weaken international cooperation.

Measures to Strengthen Governance

1. **International coordination:** Harmonise controls and strengthen cooperation among technology-producing countries.
2. **End-use monitoring:** Improve verification, licensing and post-shipment compliance mechanisms.
3. **Supply-chain transparency:** Strengthen reporting requirements for manufacturers, distributors and intermediaries.
4. **Domestic capabilities:** Invest in semiconductor research, manufacturing and skilled human resources.
5. **Balanced regulation:** Ensure security restrictions remain proportionate and clearly defined.

Conclusion

Effective semiconductor governance requires coordinated enforcement, transparent supply chains and technological resilience. India must strengthen domestic capabilities while maintaining strategic international partnerships.

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