# Science & Technology · GS - III

**Analyse how export controls on advanced semiconductor technology are reshaping the relationship between national security, technological competition and global supply chains.**

| EXAM YEAR | PAPER | SUBJECT |
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| MARKS | WORD LIMIT |
|---|---|
| 15 | ~250 words |

## Answer Hint

**Semiconductor ecosystem, dual-use technology, export controls, strategic competition, technology denial, supply-chain fragmentation, technological self-reliance**

## Model Answer

Semiconductors, particularly advanced AI processors, have become strategic assets because they underpin artificial intelligence, defence systems, telecommunications and high-performance computing. Their control has consequently emerged as an instrument of economic and national security policy.

**National Security and Technology Controls**

1. **Dual-use concerns:** Advanced chips have both civilian and military applications, including autonomous systems, intelligence processing and sophisticated weapons development.
2. **Technology denial:** Export restrictions seek to limit the technological capabilities of strategic competitors by restricting access to critical processors and manufacturing technologies.
3. **Third-country diversion:** Recent restrictions affecting shipments through Southeast Asian markets illustrate growing concerns about re-exports, intermediaries and remote access to computing infrastructure.

**Consequences for Global Supply Chains**

1. **Fragmentation:** Competing technology ecosystems may emerge, increasing costs and reducing interoperability.
2. **Investment uncertainty:** Manufacturers, cloud providers and data-centre operators face licensing uncertainty and compliance expenses.
3. **Indigenous innovation:** Restrictions can encourage targeted countries to accelerate domestic semiconductor research and manufacturing.
4. **Strategic dependencies:** Countries dependent on imported chips may face disruptions in critical digital and industrial sectors.

**Implications for India**

India must strengthen semiconductor manufacturing, advanced packaging, research and development, and skilled human resources. Its semiconductor initiatives should be complemented by reliable international partnerships and diversification of technology suppliers.

India must also develop robust export-control compliance systems, particularly for dual-use goods and sensitive technologies.

Ultimately, technology controls may address legitimate security concerns, but excessive unilateral restrictions risk fragmenting global innovation networks. Transparent rules and multilateral cooperation are essential to balancing security with technological progress.

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