Science & Technology · GS - III

Assess the effectiveness of technology export controls as an instrument of geopolitical competition, particularly in the field of advanced semiconductors and artificial intelligence.

EXAM YEAR	PAPER	SUBJECT
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MARKS	WORD LIMIT
15	~250 words

Answer Hint

Strategic technologies, semiconductor supply chains, dual-use applications, export restrictions, technology smuggling, technological self-reliance

Model Answer

Advanced semiconductors are critical inputs for artificial intelligence, supercomputing, defence systems and emerging technologies. Consequently, export controls have become an important instrument of geopolitical and national security policy.

Strategic significance of export controls:

1. **Restricting access:** Controls on advanced chips and manufacturing equipment can limit access to strategically sensitive computing capabilities.
2. **National security:** Restrictions seek to prevent technologies with military applications from reaching unauthorised end users.
3. **Geopolitical leverage:** Technological dependencies can be used as instruments of economic and strategic influence.
4. **Supply-chain security:** Export regulations encourage countries to assess vulnerabilities in critical technology supply chains.

Limitations and challenges:

- Smuggling and intermediary companies can bypass restrictions.
- Complex international supply chains make end-user verification difficult.
- Restrictions may accelerate indigenous technological development in targeted countries.
- Unilateral controls can create trade tensions and encourage fragmentation of global technology markets.

India's priorities:

India should strengthen domestic semiconductor manufacturing, research and development, technology partnerships and strategic export-control compliance. Effective coordination between customs, intelligence and industry is also essential.

Conclusion: Export controls can slow the diffusion of sensitive technologies, but cannot independently guarantee technological superiority. Their effectiveness depends on international cooperation, enforcement capacity and sustained domestic innovation.

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