General S&T Concepts

1. Disruptive technologies
2. Emerging technologies
3. Digital public infrastructure (DPI)
4. Technology sovereignty
5. Responsible innovation
6. Innovation ecosystem
7. Technology transfer
8. Frugal innovation
9. Techno-ethics
10. National R&D expenditure

Information Technology & AI

11. Artificial General Intelligence (AGI)
12. Machine Learning (ML)
13. Deep Learning
14. Explainable AI (XAI)
15. Ethical AI
16. Natural Language Processing (NLP)
17. Edge Computing
18. Cloud Sovereignty
19. Big Data Analytics
20. Blockchain technology

Space Technology

Small Satellite Launch Vehicles (SSLV)

21. Gaganyaan Mission
22. Chandrayaan-3 & lunar south pole landing
23. Aditya L-1 Solar Mission
24. IN-SPACe (Indian National Space Promotion & Authorization Centre)
25. Indian Space Policy 2023
26. Space situational awareness (SSA)
27. Dual-use technology
28. Private space startups (Skyroot, Agnikul)
29. Satellite Internet constellations

Biotechnology & Health

30. CRISPR-Cas9 gene editing
31. Synthetic biology
32. Precision medicine
33. mRNA vaccine technology
34. Genome India Project
35. Stem cell therapy
36. Bioinformatics
37. Nanobiotechnology
38. Biopharming (GM crops for medicine)
39. Biopharmaceuticals

Nanotechnology, Robotics & Quantum

40. Quantum supremac
41. Quantum dots
42. Quantum key distribution (QKD)
43. Quantum sensors
44. Nano-medicine
45. Swarm robotics
46. Humanoid robotics
47. Internet of Things (IoT)
48. Industry 4.0
49. 3D printing (additive manufacturing)

1. Artificial Intelligence (AI) & Applications

Keywords: Machine

learning, deep learning, NLP,

Explainable AI (XAI), AI

ethics. Facts/Data

1. AI could add $967B to India's GDP by 2035 (NASSCOM).
2. India ranks 5th in AI research output globally (Stanford AI Index 2023).
3. China & US together account for ~70% of global AI patents; India ~3%.
4. Govt launched IndiaAI Mission (₹10,000 cr, 2024).
5. AI adoption rate in Indian firms ~60% vs global avg ~50%.

Examples: AI in agriculture (crop disease detection), health (NHA's Ayushman Bharat Digital Mission), disaster forecasting (IMD).

Conclusion: AI is India's "general-purpose technology" of the 21st century—scaling it with ethics is key.

2. Space Technology (ISRO & Private Sector)

Keywords: PSLV, GSLV Mk-III,

IN-SPACe, space situational

awareness.

Facts/Data

1. ISRO budget ~$1.6B (2023–24), vs NASA $25B, China CNSA $12B.
2. India has launched 400+ foreign satellites for 36 nations.
3. Chandrayaan-3 (2023) made India 1st nation to land on lunar south pole.
4. Space economy potential = $13B by 2025 (PwC).
5. Private players (Skyroot, Agnikul) backed by IN-SPACe; US private sector ~70% of space funding.

Examples: Gaganyaan human

spaceflight mission (planned 2025–26);

Aditya L1 solar mission. Conclusion:

Space is India's strategic frontier—

public-private synergy will define

leadership.

3. Biotechnology & Health Tech

Keywords: CRISPR,

Genome India Project,

synthetic biology, mRNA

vaccines. Facts/Data

1. India ranks 3rd in biotech start-ups (~6,000 in 2022).
2. Bioeconomy value = $130B in 2024, target $300B by 2030.
3. Genome India Project aims to sequence 10,000 genomes.

4. China has sequenced >1M genomes; US leads in CRISPR patents.
5. India produced 2B+ COVID vaccine doses, world's largest supplier.

Examples: Bharat Biotech (Covaxin), Zydus Cadila DNA vaccine, Serum Institute's Covishield.

Conclusion: Biotech is India's healing + innovation engine—scaling R&D is the bridge to Atmanirbhar health.

4. Nanotechnology

Keywords: Quantum dots, nano-medicine,

carbon nanotubes, nanofabrication.

Facts/Data

1. India's nanotech patents = ~2,300 (2023), vs US 45,000+, China 70,000+.
2. India spends ~0.7% of GDP on R&D, OECD avg ~2.5%.
3. National Nanotech Mission = ₹1,000 cr+ since 2007.
4. Market size: global $125B (2021), India projected $20B by 2025.
5. Applications: medicine (targeted drug delivery), agriculture (nano-fertilisers).

Examples: Nano-fertiliser by IFFCO; Tata Memorial using gold nanoparticles in cancer treatment trials.

Conclusion: Nanotech is small in scale but huge in impact—India must turn pilot projects into scaled industries.

5. Quantum Technology

Keywords: Quantum computing, quantum

key distribution (QKD), quantum supremacy.

Facts/Data

1. Govt launched National Quantum Mission (₹6,000 cr, 2023).
2. Target: build 50–100 qubit systems by 2030.
3. US invested $1.2B (National Quantum Initiative Act, 2018).
4. China leads in quantum communication satellite (Micius, 2016).
5. India ranks 6th globally in quantum research papers.

Examples: Quantum Key Distribution trial by DRDO (2022); IBM quantum computer access to Indian institutes.

Conclusion: Quantum is India's tech leapfrog—investments today will define strategic autonomy tomorrow.

6. Digital Public Infrastructure (DPI)

Keywords: UPI, Aadhaar, ONDC,

digital stack, interoperability.

Facts/Data

1. India processed ~89.5B real-time digital payments in 2022 (more than US, China, EU combined).
2. DPI contribution = ~12% of GDP (2022), target 20% by 2026.
3. Aadhaar coverage = ~99% adults; US Social Security ~92%.
4. UPI accounts for 75% of India's retail digital transactions.
5. India exporting DPI models to 7+ nations (e.g., UPI in Singapore, RuPay in UAE).

Examples: Aadhaar-enabled DBT for 500+ schemes; ONDC for digital commerce.

Conclusion: DPI is India's soft power tool—democratising access to finance and services globally.

7. Cyber Security Technologies

Keywords: Critical Information Infrastructure (CII), encryption, zero-trust architecture, deepfake detection.

Facts/Data

1. India faced 13.9 lakh cyber incidents in 2022 (CERT-In).
2. Average cost of data breach in India = ₹17.9 crore (IBM 2023).
3. US has >1M cyber workforce; India ~3 lakh (capacity gap).
4. China deploys 50,000+ cyber soldiers in PLA-linked units.
5. BRICS set up a working group on cybercrime in 2022.

Examples: AIIMS ransomware attack (2022); NATGRID for data integration.

Conclusion: Cyber resilience must evolve from firewalls to AI-driven adaptive defence.

8. Robotics & Automation

Keywords: Humanoids, swarm robotics, Industry 4.0, collaborative robots (cobots). Facts/Data

1. Global robotics market = $45B (2022), India <1% share.
2. India has 3 robots per 10,000 workers, China 140, Korea 900 (IFR 2021).
3. PLI schemes boosting electronics & auto robotics adoption.
4. Defence: DRDO developing robotic mules, UGVs for border.
5. Japan leads in eldercare robotics; India in warehouse/delivery automation.

Examples: Asimov Robotics in Kerala; DRDO Daksh bomb-disposal robot.

Conclusion: Robotics can transform India's productivity—but needs skilling and cost reduction.

9. Industry 4.0 & Emerging Tech

Keywords: IoT, 3D printing, cloud-

edge integration, AR/VR.

Facts/Data

1. Industry 4.0 adoption in Indian manufacturing still <15% of firms (CII 2022).3D printing global market = $17B (2022), India ~1% share.
2. IoT devices globally ~14B (2022), India projected 2B by 2025.
3. China leads smart factories; India lagging in automation.
4. US has advanced additive manufacturing clusters (GE, Boeing).

Examples: IIT Madras 3D printed houses; Hero MotoCorp smart factory.

Conclusion: India's Industry 4.0 must focus on SMEs + MSMEs or risk widening productivity gaps.

10. Green & Clean Technologies

Keywords: Hydrogen economy, EVs, CCUS (Carbon Capture, Utilisation & Storage), circular economy.

Facts/Data

1. India launched National Hydrogen Mission (2021); target 5 MMT by 2030.
2. EV sales ~1.2M in 2022–23; target 30% fleet electrification by 2030.
3. Global EV penetration: China ~30%, EU 20%, India <2%.
4. Carbon capture capacity: US ~25M tonnes, India pilot scale <1M.
5. Renewable energy target: 500 GW by 2030.

Examples: Reliance & Adani hydrogen projects; Tata EVs leading domestic sales.

Conclusion: Green tech is not just about climate—it is India's industrial opportunity for global leadership.

11. Defence Technology & Strategic Tech

Keywords: Indigenous defence, dual-use tech, drone warfare, hypersonics.

Facts/Data

1. India = 4th largest military spender ($81B, SIPRI 2023); US $877B, China $292B.
2. Defence imports fell from 46% (2017) to 36% (2023) due to indigenisation.
3. India exports defence items to 85+ nations; exports = ₹16,000 cr in 2022–23.
4. DRDO testing hypersonic technology demonstrator vehicle (HSTDV).
5. US pioneered stealth + drones; China mass-producing UAVs (Wing Loong, CH-4).

Examples: Tejas Mk1A fighter jets, INS Vikrant aircraft carrier, Pinaka rocket system.

Conclusion: Defence tech is not just about sovereignty—it is also India's path to high-tech leadership.

12. Digital Health & Med-Tech

Keywords: Telemedicine, e-Sanjeevani, digital health ID, wearable health tech.

Facts/Data

1. India's telemedicine consultations crossed 140M by 2022 (MoHFW).
2. Global digital health market = $200B (2022), India ~$6B.
3. Ayushman Bharat Digital Mission (ABDM) aims for digital health ID for all.
4. US spends 18% of GDP on healthcare; India ~2%.
5. China leads in AI radiology; India catching up with start-ups.

Examples: e-Sanjeevani OPD; Aarogya Setu app during COVID.

Conclusion: Digital health can democratise care but requires bridging digital divide and privacy gaps.

13. Agri-Biotech & Food Tech

Keywords: GM crops, biofortification, CRISPR-edited crops, climate-smart agri. Facts/Data

1. India approved GM mustard hybrid DMH-11 (2022) for commercial trials.
2. Biofortified crops = 17 released varieties (ICAR).
3. India = largest producer of Bt cotton (12.5M hectares).
4. China leads in CRISPR-edited rice & wheat; US dominates GM soybean.
5. Global agri-biotech market ~$95B (2022).

Examples: Golden rice debate; ICAR biofortified wheat.

Conclusion: Agri-biotech balances food security with ecological concerns—public trust is key.

14. India Semiconductor Mission (ISM)

Keywords: Fabless design, chip fab, supply chain security, strategic autonomy.

Facts/Data

1. India launched ISM (2021) with ₹76,000 cr outlay.
2. Global chip market ~$600B; India's share <1%.
3. India imports 100% semiconductors (~$24B annually).
4. US CHIPS Act = $52B support; China invested $150B since 2014.
5. Vedanta–Foxconn's $19B fab project planned in Gujarat (delayed).

Examples: ISM partnerships with Micron (US); design start-ups under C-DAC.

Conclusion: Chips are the oil of the digital age—India must capture this supply chain or risk dependency.

15. 5G & 6G Technology

Keywords: Low latency, IoT, spectrum allocation, indigenous 6G.

Facts/Data

1. India launched 5G in Oct 2022; coverage reached 600+ districts in 1 year.
2. Target: 100M 5G users by 2025.
3. US & South Korea pioneered 5G in 2019; China has 2.3M 5G base stations.
4. India's 6G Vision Document (2022) aims rollout by 2030.
5. 5G may add $450B to India's GDP by 2040 (GSMA).

Examples: Reliance Jio & Airtel rolling out indigenous 5G tech; IIT Madras working on 6G R&D. Conclusion: 5G bridges digital divide today; 6G can place India in the tech vanguard tomorrow.