Science & Technology · GS - III

Why is nanotechnology one of the key technologies of the 21st century? Describe the salient features of Indian Government's Mission on Nanoscience and Technology and the scope of its application in the development process of the country.

EXAM YEAR	PAPER	SUBJECT
2016	GS - III	Science & Technology

MARKS	WORD LIMIT
12.5	~200 words

Answer Hint

Nanotechnology; nanoscale materials; Nano Mission; scientific research; healthcare; agriculture; energy; environmental applications

Model Answer

Introduction

Nanotechnology involves designing, characterising and applying materials and structures at the nanoscale, where properties may differ substantially from those of bulk materials. It offers opportunities for innovation across multiple sectors.

Why It Is a Key Technology

- Nanoscale materials can exhibit distinctive optical, electrical, chemical and mechanical properties.
- They can improve the performance of sensors, coatings, catalysts, batteries and electronic components.
- Their applications span healthcare, energy, agriculture, water treatment and advanced manufacturing.

Indian Government's Nano Mission

India launched the Nano Mission in 2007 under the Department of Science and Technology. Its major objectives included:

- **Research capacity:** Supporting basic and applied nanoscience research.
- **Infrastructure:** Establishing facilities for synthesis, characterisation and testing of nanomaterials.
- **Human-resource development:** Training scientists and researchers in nanoscience and nanotechnology.
- **Collaborative research:** Encouraging interdisciplinary and international collaboration.
- **Industrial applications:** Promoting links between academic research and commercial innovation.
- **Safety and standards:** Encouraging assessment of the potential health and environmental impacts of nanomaterials.

Scope of Application

- **Healthcare:** Targeted drug delivery, diagnostics, imaging and medical materials.
- **Agriculture:** Potentially improved sensors, precision delivery of inputs and crop monitoring.
- **Water treatment:** Nanomaterials can support filtration and removal of certain contaminants.
- **Energy:** Applications include improved solar cells, batteries and catalysts.
- **Electronics:** Nanoscale components can enable smaller and more efficient devices.
- **Environment:** Sensors and remediation technologies may help detect or treat pollutants.

Challenges

High research costs, scale-up difficulties, uncertain toxicity and regulatory gaps require careful attention. Products must undergo suitable safety testing.

Conclusion

Nanotechnology can contribute to India's scientific and industrial development, provided that research excellence, commercialisation and responsible risk assessment advance together.