All about 3D Printing

Why in news?

Recently India inaugurated its first 3D-printed post office in Bengaluru.

What is 3D Printing?

- **Additive Manufacturing (AM) –** It is the industrial production name for 3D printing.
- It is a process that uses computer-created design to make 3-dimensional objects layer by layer.
- It is an additive process, in which layers of a material like plastic, composites or bio-materials are built up to construct objects that range in shape, size, rigidity and colour.
- It ***differs from the traditional subtractive manufacturing*** techniques involving cutting large blocks of material to form the desired object.
- The addition of material can happen in multiple ways, namely powder deposition, resin curing and filament fusing.
- The deposition and solidification are controlled by computer to create a 3D object.
- **Potential of India**- India has an excellent opportunity as the world begins to adopt AM techniques.
- Additive manufacturing development and adoption can help India in become a leading manufacturing hub.
- To achieve this, the Ministry of Electronics and Information Technology (MeitY) formulated the *'National Strategy on Additive Manufacturing'.*
- The strategy aims to increase India's share in global AM to 5% with a target to add nearly US 1$bn to the GDP by 2025.

What are the advantages of 3D printing?

- **Simplified Supply Chains**- It is likely to simplify supply chains as semi-fabricated products substitute raw materials and suppliers consolidate.
- **Cost effective**-Procurements and labour costs will decrease.
- This will help Make in India campaign and the Atmanirbhar Bharat Abhiyan as successful.
- **Gross Value Addition Growth**- It can lead to *democratisation in innovation* by empowering individuals to create and actively participate in the global value chain.
- Many product designs are freely available and individuals can purchase a 3D printer and start manufacturing and selling products.
- **Employment Opportunities**- It is expected to increase productivity which may lead to reduction in employment.
- However, higher productivity and new products create new employment opportunities.

- Workers may need to be provided upskilling opportunities to ensure they remain competent.
- **Sustainable Development**- It would lead to significant reduction in raw material due to
    - Material-efficient designs
    - Reduced wastage and
    - Less need for manufacturing tools, moulds and dies.
- **Energy efficient**- The products will be more energy-efficient. This will help India reduce its carbon footprint and lead to eco-friendly environment.
- **Flexibility-**It allow manufacturers the ease to redesign their products.
- This reduces design constraints and associated costs.
- **Foster innovation**-Flexibility in AM will allow small businesses to innovate and experiment, thus making their products more efficient and enabling product differentiation.

What are the applications of 3D printing?

- **Prosthetics-** It has revolutionized how prosthetics are created. As 3D printing processes and techniques are refined, the creation of custom, tailored prosthetics becomes more straightforward.
- **Replacement Parts-** It has the ability to fabricate replacement parts easily. 3D printing enables consumers and businesses to maximize the value of their purchases.
- **Implants-** It allows the construction of more specialized products for patients.
- Patient outcomes are improved when parts with complex geometries can be fabricated quickly.
- Example- Tooth implants, heart valves, knee replacements etc.,
- **Pharmaceuticals-** 3D-printed drugs to have special delivery profiles that can be tailored to patients' specific needs.
- **Emergency structures-** 3D printing can help alleviate the hardships of affected families by building houses, hospitals, and other structures much faster than by traditional means.
- **Automotive-** Testing and production of lightweight, high strength parts.
- **Electronics-** Production of light weight, impact resistant structures with multiple functionality.
- **Example-** Wearable devices, soft robots etc.,
- **Consumer goods-** Fabrication of complex internal and external structures compels innovative product design.
- **Aerospace**- Relativity Space launched a test rocket made entirely from 3D-printed parts, measuring 100 feet tall and 7.5 feet wide.
- **Healthcare industry**- During Covid-19 pandemic the healthcare industry used 3D printers to make much-needed medical equipment, like swabs, face shields, and masks.

What are the concerns of 3D printing?

- **Scalability-** In conventional techniques, once a design has been set, multiple copies can be made much faster. But 3d printing is slow.

- **High cost-** The initial set up of 3d printing and pre and post processing in healthcare is costly.
- **Job loss-** Due to automation it may have impact on employment opportunities.
- **Limited materials-** Raw materials is not exhaustive in 3d printing, it poses a serious challenge.
- **Skilled labour-** It needs talented individuals to work with additive manufacturing.

What are the initiatives taken to promote 3D printing?

- **Atal Innovation Mission (AIM)-** It is a flagship initiative to create and promote entrepreneurship and innovation across the country.
- **Atal Tinkering Labs -** It is launched under AIM which aims to foster creativity and innovation in young minds.
- It focuses on Science, Technology, Engineering and Math (STEM) concepts.
- Dedicated workspaces have been set up with do-it-yourself (DIY) kits including 3D printers, robotics and miniaturised electronics are installed.
- **National Strategy on Additive Manufacturing**- The strategy aims to increase India's share in global AM to 5% with a target to add nearly US 1$bn to the GDP by 2025.

What lies ahead?

- **Private Partnership Model-** Establish National Additive Manufacturing Centre as a dedicated agency to promote the adoption of AM technologies.
- **Strengthening Technology Leadership-**There is a need to address the skilled workforce.
- **Research-** There is a need to promote Research and Development in AM, encourage competition, and create a next generation workforce.
- **Supply Chain Development**- The government can provide incentives to small businesses aligned with the AM Technology Advancement Plan and include AM in various schemes and incentives.

References

1. Indian Express- How does 3D printing work
2. MEITY- National Strategy on Additive Manufacturing

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