



3D PRINTING - GS III MAINS

Q. What is 3D printing and how is it done? Explain with an example how it promises to transform different sectors. (15 marks, 250 words)

News: *World's biggest 3D printer whirs into action*

What's in the news?

- A giant 3D printer, which is big enough to make a house, has been unveiled at the University of Maine.
- The university says it has beaten its own record for the world's largest polymer 3D printer - with the new printer four times bigger than the previous machine.

3D Printing:

- Three-dimensional (3D) printing is an additive manufacturing process in which a physical object is created from a digital design by printing thin layers of material and then fusing them together.
- 3D printing technology is a fast-emerging technology.

Significance of 3D Printing:

1. Ease of Access:

- 3D printers are becoming more and more accessible with more local service providers offering outsourcing services for manufacturing work.

2. Advanced Healthcare:

- It is being used in the medical sector to help save lives by printing organs for the human body such as livers, kidneys, and hearts.
- Further advances and uses are being developed in the healthcare sector providing some of the biggest advances in using the technology.

3. Environmentally Friendly:

- As this technology reduces the amount of material wastage used this process is inherently environmentally friendly.

4. Cost Effective:

- Customise desired products in a short time and therefore costs associated with using different machines for the manufacture.

5. Rapid Prototyping:

- It can manufacture parts within hours, which speeds up the prototyping process.



6. Fast Design and Production

7. Strong and Lightweight Parts

8. Create complex objects and shapes that otherwise might be impossible to create through any conventional method.

Applications of 3D Printing:

1. Defence and Aerospace:

- At present, AM technology in the aerospace and defence sector is broadly used for prototyping, repair of small parts and component manufacturing.
- Examples - The UK Royal Air Force and Navy use AM for repairing spare parts.

2. Health:

- **Hearing aids** have been made using 3D printing technology.
- **Bio Printers** - Organ printing or body part printing is being printed and some parts being used as implants of actual body parts. Example: Titanium pelvic, plastic tracheal splint, titanium jaws.
- **Tissue Engineering** - Tissue engineering made remarkable progress with printing of 3D blood vessels. This was achieved by 3D bio-printing technology and biomaterials through vascularisation of hydrogel constructs.
- **Dentistry** - Dental Implants are being made on a commercial level using 3D printing technology.
- **Prosthetics** - 3D printing is being used to make surrogate body parts.
- **Artificial Organ** - Additive manufacturing of stem cells has also led to various possibilities in printing artificial organs, although most of the work is still in the experimental stage.

3. Manufacturing:

- 3D printing can be used to manufacture varied forms of products - from car or plane parts to sport goods, toys etc.
- Customised products are able to be manufactured as customers can edit the digital design file and send it to the manufacturer for production.

4. Domestic Usage:

- 3D printers can be used in the home to make small objects such as ornamental objects, small toys etc.



5. Architecture and Housing:

- The technology can be used for a variety of housing projects with application in custom luxury designer homes, large scale development projects, to temporary housing projects.
- It could also enable engineers to design and build stiffer and safer geometries for houses. Further, can also help engineers to rebuild and restore old heritage designs quickly yet accurately.

6. Food:

- 3D printing enables fast automated and repeatable processes, freedom in design, as well as allowing large and easy variability of the cooking process which can be customized.

7. Education:

- Affordable 3D printers in schools may be used for a variety of applications which can aid students with learning better.

Challenges of 3D Printing:

1. Design Inaccuracies:

- A potential problem with 3D printing is directly related to the type of machine or process used, with some printers having lower tolerances, meaning that final parts may differ from the original design.

2. Copyright Issues:

- As 3D printing is becoming more popular and accessible there is a greater possibility for people to create fake and counterfeit products and it will almost be impossible to tell the difference.
- This has evident issues around copyright as well as for quality control.

3. Reduction in Manufacturing Jobs:

- Another of the disadvantages of 3D technology is the potential reduction in human labour, since most of the production is automated and done by printers.
- However, many third world countries rely on low skill jobs to keep their economies running, and this technology could put these manufacturing jobs at risk by cutting out the need for production abroad.

4. Restricted Build Size:

- 3D printers currently have small print chambers which restrict the size of parts that can be printed.
- Anything bigger will need to be printed in separate parts and joined together after production.
- This can increase costs and time for larger parts due to the printer needing to print more parts before manual labour is used to join the parts together.

5. Limited Materials:



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- 3D Printing can create items in a selection of plastics and metals the available selection of raw materials is not exhaustive.

Government Initiatives:

National Strategy for Additive Manufacturing, 2025:

- National Strategy for Additive Manufacturing aims to increase India's share in global additive manufacturing to 5 per cent by 2025, with the hope to likely add \$1 billion to the gross domestic product by that time.
- India will aim to achieve certain targets such as 50 India-specific technologies for material, machine and software, 100 new startups for additive manufacturing, and 500 new products and employ at least 1 lakh new skilled workers over the next three years.

Way Forward:

- There is a need for strong support from the government and business houses for AM-related studies and R&D for the growth of the technology in India
- Research in India with regard to AM technology needs to be significantly scaled up if it is to emerge as a competitive player in this field.
- It is important to create an environment that is conducive for industry to form collaborations with foreign firms to co-create the technology
- Training and skilling is another important aspect which requires considerable attention. There is huge scope under the 'Skill India' initiative to reach out to the many technical institutes in the country to sensitise them regarding the opportunities in 3D printing.