B.E/B.Tech- Internal Assessment – III

Academic Year 2024-2025 (Even Semester)

Eighth Semester

Mechanical Engineering

19MEZ407 – Smart Manufacturing Process

A

PART A

1. **Different technologies of Rapid Prototyping**

- Stereolithography (SLA)
- Selective Laser Sintering (SLS)
- Fused Deposition Modeling (FDM)
- Laminated Object Manufacturing (LOM)
- Digital Light Processing (DLP)
- Electron Beam Melting (EBM)
- Binder Jetting

2. **Hardware & Software involved in Rapid Prototyping**

- **Hardware:** RP machines (SLA, SLS, FDM printers), laser systems, extrusion heads, scanning devices.
- **Software:** CAD (Computer-Aided Design), CAM (Computer-Aided Manufacturing), slicing software, RP-specific software for model processing.

3. **What is NURBS surface model?**

- NURBS stands for Non-Uniform Rational B-Splines. It is a mathematical model used to represent curves and surfaces in CAD. It allows precise and flexible representation of complex shapes using control points and weights.

4. **Stages involved in additive manufacturing**

- 3D modeling (CAD design)
- Conversion to STL format
- Slicing the model into layers
- Building the layers using an AM process
- Post-processing (cleaning, curing, finishing)

5. **Advantages & disadvantages of Additive Manufacturing**

- **Advantages:** Complex geometry, less material waste, rapid prototyping, customization, reduced tooling cost.
- **Disadvantages:** Slow production speed, limited material choices, surface finish quality issues, higher cost for large volumes.

PART B (Detailed answers with split-up marks)

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6. (a) What are the key steps in rapid prototyping, and how do they enhance product development efficiency? (13 marks)

Content	Marks
Introduction to Rapid Prototyping (RP)	2
Step 1: CAD model preparation	2
Step 2: Conversion to STL format	2
Step 3: Slicing and tool path generation	2
Step 4: Building the prototype layer-by-layer	3
Step 5: Post-processing	2
Explanation of how these steps enhance efficiency	2

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6. (b) How do you select an appropriate reverse engineering system with suitable examples? (13 marks)

Content	Marks
Definition and purpose of reverse engineering	2
Criteria for selection (accuracy, complexity, cost, material)	3
Types of systems (contact, non-contact)	3
Examples of systems (Coordinate Measuring Machine (CMM), laser scanners, CT scanners)	3
Summary and conclusion	2

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7. (a) Illustrate the stages and components of additive manufacturing (13 marks)

Content	Marks
Introduction to AM stages	2
CAD modeling	2
Data conversion (STL file)	2
Slicing & tool path generation	2
Building process (layer deposition)	3
Post-processing	2

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7. (b) Explain various technologies of additive manufacturing in detail (13 marks)

Content	Marks
Introduction and classification of AM technologies	2
Stereolithography (SLA)	3
Selective Laser Sintering (SLS)	3
Fused Deposition Modeling (FDM)	3
Other technologies overview (LOM, DLP, EBM, Binder Jetting)	2

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8. (a) Describe the technologies of reverse engineering with suitable example (14 marks)

Content	Marks
Introduction to reverse engineering	2
Contact based technologies (CMM)	3
Non-contact technologies (laser scanning, structured light)	3
CT scanning and imaging techniques	3
Examples and applications	3

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8. (b) Illustrate the strength and weakness of additive manufacturing with suitable example (14 marks)

Content	Marks
Strengths of AM (complex geometry, customization)	5
Weaknesses of AM (speed, cost, material limits)	5
Example illustrating these points	4

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PART A

1. **Define Rapid Prototyping**

   • Techniques to quickly fabricate a physical prototype from 3D CAD data by layering material.

2. **What is point clouds and meshes in Rapid Prototyping?**

   • Point clouds: Set of data points representing the surface of an object.

   • Meshes: Network of vertices and faces defining the 3D surface geometry.

3. **Mention the role of reverse engineering in manufacturing process.**

   • Reverse engineering captures existing product geometry to create CAD models, enabling redesign or reproduction without original drawings.

4. **What is additive manufacturing?**

   • Process of building parts layer-by-layer directly from 3D CAD data by adding material.

5. **List the components of additive manufacturing**

   • CAD model, slicing software, AM machine hardware (print head, build platform), materials, control software.

PART B

6. (a) Describe the general methodology of rapid prototyping in detail. (13 marks)

Content	Marks
Introduction to Rapid Prototyping	2
CAD Model creation	3
Data conversion to STL file	2

Content	Marks
Slicing and tool path generation	2
Layer-by-layer fabrication	2
Post-processing	2

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6. (b) Explain the hardware and software involved in rapid prototyping. (13 marks)

Content	Marks
Hardware components	6
— RP machines (SLA, SLS, FDM)	
— Laser/extrusion heads	
— Build platform	
Software components	7
— CAD modeling software	
— Slicing software	
— RP machine control software	

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7. (a) Sketch on the principle involved in additive manufacturing with suitable applications. (13 marks)

Content	Marks
Principle of layer-wise material addition	5
Explanation of common AM processes (SLA, FDM, SLS)	5
Applications in aerospace, medical, automotive	3

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7. (b) Illustrate the challenges and limitations of additive manufacturing in detail. (13 marks)

Content	Marks
Material limitations	3
Surface finish and accuracy	3
Build size and speed limits	3

Content	Marks
Cost and post-processing	4

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8. (a) Differentiate reverse engineering and additive manufacturing. (14 marks)

Content	Marks
Definition of reverse engineering	3
Definition of additive manufacturing	3
Differences in purpose and process	5
Example use cases for both	3

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8. (b) How is additive manufacturing applied in real world applications? (14 marks)

Content	Marks
Medical applications: implants, prosthetics	4
Aerospace: lightweight parts, tooling	4
Automotive: prototypes, custom parts	3
Consumer products and customization	3
