Roll. No. | | | | | | | | | | | | |

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E. / B. Tech / B. Arch (Full Time) - END SEMESTER EXAMINATIONS, Nov / Dec 2024

MANUFACTURING ENGINEERING

MF5652 - ADDITIVE MANUFACTURING

(Regulation 2019)

Time: 3 hrs Max. Marks: 100

CO 1	Understand the development of AM technology and how AM technology propagated into various businesses, while remembering the emerging opportunities it presented.
CO 2	Evaluate the process of transforming a concept into the final product in AM technology, and apply that knowledge to acquire a comprehensive understanding.
CO 3	Understand the vat polymerization and material extrusion processes in additive manufacturing, remember the key details and characteristics, and apply this knowledge to elaborate on their various applications.
CO 4	Understand the processes of powder bed fusion and direct energy deposition in additive manufacturing, remember the key aspects and details, and apply this knowledge to explore their various applications.
CO 5	Evaluate the advantages, limitations, and applications of additive manufacturing processes.

BL – Bloom's Taxonomy Levels

(L1 - Remembering, L2 - Understanding, L3 - Applying, L4 - Analyzing, L5 - Evaluating, L6 - Creating)

PART- A (10 x 2 = 20 Marks)
(Answer all Questions)

Q. No	**Questions**	**Marks**	**CO**	**BL**
1.	What is the primary difference between Rapid Prototyping and Rapid Manufacturing in Additive Manufacturing (AM)?	2	CO 1	L1
2.	Mention two benefits of Additive Manufacturing over traditional manufacturing methods.	2	CO 1	L1
3.	What is Part Consolidation in the context of Additive Manufacturing?	2	CO 2	L2
4.	Explain the importance of Part Orientation in Additive Manufacturing.	2	CO 2	L2
5.	What limitations are associated with Fused Deposition Modeling (FDM)?	2	CO 3	L2
6.	Which material is commonly used in Fused Deposition Modeling (FDM)? a) Photopolymer b) Metal powders c) Thermoplastic polymers d) Concrete	2	CO 3	L3
7.	What materials are typically used in Electron Beam Melting (EBM) for additive manufacturing?	2	CO 4	L1
8.	How does Laser Engineered Net Shaping (LENS) differ from traditional laser welding processes?	2	CO 4	L2
9.	What is a primary advantage of Binder Jetting over other 3D printing methods? a) Higher resolution b) Faster production speeds c) Use of metal materials only d) Requires high-temperature sintering	2	CO 5	L3
10.	What is the basic principles of thermal bonding?	2	CO 5	L2

PART - B (5 × 13 = 65 Marks)

Q. No.	Questions	Marks	CO	BL
11 (a)	Describe the AM process chain and its classification. What are the key benefits of following a structured process chain in additive manufacturing?	13	CO1	L2
	OR			
11 (b)	What are the business opportunities associated with additive manufacturing in sectors such as printing electronics and bioprinting? How does intellectual property play a critical role in this context?	13	CO1	L2
12 (a)	Explain the concept of topology optimization in additive manufacturing and discuss how it contributes to lightweight structures and part consolidation.	13	CO2	L2
	OR			
12 (b)	Describe the steps involved in data processing for additive manufacturing, including CAD model preparation, part orientation, support structure generation, model slicing, and tool path generation. How are these steps critical for achieving part quality improvement in medical applications?	13	CO2	L2
13 (a)	Explain the Fused Deposition Modeling (FDM) process in an extrusion-based system. Discuss the materials used, key applications, and limitations of this technology.	13	CO3	L2
	OR			
13 (b)	Describe the process of Digital Light Processing (DLP) and explain how it differs from SLA in terms of precision and speed. What are the typical applications where DLP is preferred over SLA?	13	CO3	L2
14 (a)	Explain the powder fusion mechanism in Selective Laser Sintering (SLS) and describe the key process parameters that influence the quality of the fabricated parts	13	CO4	L2
	OR			
14 (b)	Explain the role of process parameters in Electron Beam Melting (EBM). How do they influence the part quality and material properties in aerospace and biomedical applications?	13	CO4	L2
15 (a)	Analyze the differences between Binder Jetting and Material Jetting technologies in terms of their processes, materials, and applications. Apply this knowledge to determine the distinct advantages of each method in specific manufacturing scenarios.	13	CO5	L4
	OR			
15 (b)	Analyze the basic principle and mechanism of the Laminated Object Manufacturing (LOM) process in sheet lamination. Compare how gluing or adhesive bonding and thermal bonding differ in their applications.	13	CO5	L4

PART- C (1 x 15 = 15 Marks)

(Q.No.16 is compulsory)

16	An aerospace company uses Selective Laser Melting (SLM) to produce lightweight engine components. However, issues with material selection, part orientation, and support structures have led to defects in the final parts, affecting performance. Evaluate how material selection, part orientation, and support structures affect the quality of SLM-produced aerospace components. What challenges do these factors present in achieving precision and functionality? Suggest potential solutions to optimize material properties, improve part orientation for reduced defects, and design effective support structures to enhance the overall quality and efficiency of the SLM process for aerospace applications.	**15**	**CO4**	**L5**