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UG Mechanical 2024-25 PYQP

UG Mech Even sem 2024-25 QP

2025-05-05

LASER-BASED AM

Department of Mechanical Engineering – SEAS

SRM UNIVERSITY A.P

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SRM UNIVERSITY – AP, ANDHRA PRADESH

End Term Examination, May 2025

[Question Paper ID: 008852]

Subject : LASER-BASED AM
Title
Batch : 2022
Degree : B.Tech.
Branch : ME

Subject : MCE 462
Code
Max Marks : 100
Duration : 3 hours
QP Set : ---

A (5 × 6 Marks = 30 Marks)		Marks BL CO			
Answer any 5 Questions					
1.	Explain the concept of population inversion and its significance in generating a laser beam.	6	6	2	1,2
2.	List the stages involved in the disintegration of a liquid stream during water atomization in metal powder production process.	6	6	1	3,4
3.	Explain the role of shielding gases and defocused position of laser beam in laser beam welding process and how they affect weld quality.	6	6	4	2,3,4
4.	What are the main difficulties encountered when using metals in laser based additive manufacturing process?	6	6	4	3,4
5.	How does powder particle size and shape affect the outcome of laser-based additive manufacturing process?	6	6	4	2,3
6.	Classify the powder-based additive manufacturing processes and explain how they differ in terms of material delivery and energy source.	6	6	5	3,4
7.	What is the sintering process, and why is it important? Discuss the three stages of sintering process.	6	6	6	2,3
8.	Why is a laser used in the laser cladding process? Discuss the benefits and drawbacks of the laser cladding technique.	6	6	6	1,2,3
B (7 × 10 Marks = 70 Marks)		Marks BL CO			
Answer any 7 Questions					
9.	List and explain the key process parameters that influence the Directed Energy Deposition (DED) process. Discuss how these parameter affects the quality and accuracy of the printed components.	10	10	6	2,3
10.	Select a real-world application of Laser Based Additive Manufacturing in the automobile or medical industries. a) Describe how Additive Manufacturing technology was applied in the solution. b) Discuss the advantages gained and the challenges faced during its implementation.	10	10	6	1,2,3,4
11.	What is the Powder Bed Fusion (PBF) process? Discuss its advantages and explain any one binding mechanism involved in the PBF process.	10	10	1	2,3
12.	What are the essential components required for a laser based additive manufacturing system? How does it differ from arc based additive manufacturing processes?	10	10	2	1,2,3
13.	Discuss the key process parameters in water or Gas atomization process and how they influence the final powder characteristics.	10	10	3	3,4
14.	List and explain the various processing issues and defects that can occur in laser-based additive manufacturing process.	10	10	4	2,3,4

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|---|-----------|-----------|----------|----------------|
| 15. Why is post-processing essential for laser-based AM components, and how does it differ from post-processing of conventionally manufactured parts? Discuss any two types of post-processing techniques in laser-based AM components. | 10 | 10 | 3 | 2,4 |
| 16. (a) List the key parameters that promote the fine particle size in the water or gas atomization processes. (5 Marks)
(b) Material 'X' was processed using laser additive manufacturing with a laser beam power of 2.5 kW, a scan speed of 0.6 m/min, and a powder feed rate of 4 g/min. Calculate the laser energy per unit length and the powder deposited per unit length. (5 Marks) | 10 | 10 | 6 | 1,2,3,4 |
| 17. Explain the differences between conduction mode and keyhole mode in laser beam welding in terms of energy transfer, penetration depth, and weld pool behaviour. Also, Discuss the advantages and limitations of each mode, and analyse how different factors such as material properties and laser parameters influence the mode selection in industrial welding applications. | 10 | 10 | 1 | 1,2 |
| 18. Discuss the causes and solutions for the following defects in laser welding:
a) Lack of fusion
b) Excess Penetration
c) Porosity
(d) Distortion | 10 | 10 | 2 | 1,2 |

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