

Form A:

Ref. No. Ex/PG/LST/T/121A/2019

**Master of Laser Science and Technology Examination, 2019**  
(2<sup>nd</sup> Semester)

**SUBJECT: Laser Surface Modification & Forming Processes**

Time : Three hours

Full Marks 100

**Use Separate Answer Scripts for Each PART**

**Part I**

Answer any Five question

- |       |  |    |
|-------|--|----|
| 1.    | What are the major process parameters for laser surface heat treatment? Explain each of them very briefly. | 10 |
| 2.    | Explain the Advantages and Disadvantages of Laser Surface Heat Treatment.                                  | 10 |
| 3.    | Explain very briefly the micro-structural changes in steels during laser surface heat treatment            | 10 |
| 4. a) | Explain the Advantages and Disadvantages of Laser Cladding.  | 7  |
| b)    | Write short notes on: Austenite  | 3  |
| 5. a) | Explain Laser shock peening process with suitable diagram.   | 8  |
| b)    | Write short notes on: Dilution   | 2  |
| 6. a) | Compare the different mechanism for Laser Forming processes  | 7  |
| b)    | Write short notes on: Carburising  | 3  |

Form A:

Ref. No. Ex/PG/LST/T/121A/2019

Master of Laser Science and Technology Examination, 2019

(2<sup>nd</sup> Semester)

SUBJECT: Laser Surface Modification & Forming Processes

Time : Three hours

Full Marks 100

Use Separate Answer Script for Each PART

**Part II**

Answer any two questions

1. a) What are positive and negative bendings in the laser bending process? 2
- b) Compare the temperature distributions in temperature gradient mechanism and buckling mechanism and explain the reasons. 4
- c) State the advantages of laser bending over the conventional bending processes. 4
- d) AISI 304 stainless steel sheet metal is bent to form a shallow V-shape using a 1.8 kW CO<sub>2</sub> laser. The beam radius is 3 mm, and scanning is done at a rate of 20 mm/s along the width of the sheet metal. If the sheet thickness is 2.5 mm, width is 150 mm, and length is 300 mm, determine the following, after the single pass 15
- a. the bend angle
- b. the induced force, F
- c. the bending moment, M and
- d. strains,  $\epsilon_1$  and  $\epsilon_2$ , in the upper and lower parts of the sheet, respectively.
- The properties of the AISI 304 stainless steel are approximated as density,  $\rho = 7850$  kg/m<sup>3</sup>, specific heat,  $C_p = 502$  J/kg K, thermal conductivity,  $k = 21.5$  W/m K, modulus of elasticity,  $E = 190$  GPa and linear coefficient of thermal expansion,  $\beta = 17.2 \times 10^{-6}$  /K. Assume a surface reflection coefficient of 0.65.
2. a) Explain the effect of the primary laser process parameters and plate thickness on the direction of the bending angle in buckling mechanism. 10
- b) Discuss very briefly the mechanism of laser bending along with the temperature, stress and displacement distributions in a thick plate. 15

Form A:

Ref. No. Ex/PG/LST/T/121A/2019

Master of Laser Science and Technology Examination, 2019

(2<sup>nd</sup> Semester)

SUBJECT: Laser Surface Modification & Forming Processes

Time : Three hours

Full Marks 100

3. a) Explain the applications of laser bending in diverse industries. 5
- b) Bending of a steel plate is achieved through Temperature Gradient Mechanism with a laser beam of diameter  $d$ , beam power  $P$  and the scanning speed  $Ux$ . The thickness of the plate is  $h$ , and the length of the plate is  $b$  along the direction of laser scanning. The linear coefficient of thermal expansion, the density and the specific heat of the plate are  $\beta$ ,  $\rho$  and  $Cp$ , respectively. Assuming a two-layer model of the heated zone, find an expression for the bend angle in terms of appropriate parameters. 20