



COLLEGE OF ENGINEERING, PUNE
(An Autonomous Institute of Government of Maharashtra.)
SHIVAJI NAGAR, PUNE - 411 005

END Semester Examination
(MT(DE)-14003) Laser Materials Processing (TH)

Course: B.Tech.

Semester: Sem VII

Year: 2014-2015

Duration: 3 Hours

Branch: Metallurgical Engineering

Max.Marks:60

Date:26/11/2014

Time:- 2.00 to 5.00 pm

Instructions:

MIS No.:

--	--	--	--	--	--	--	--	--	--

1. Figures to the right indicate the full marks.
2. Mobile phones and programmable calculators are strictly prohibited.
3. Writing anything on question paper is not allowed.
4. Exchange/Sharing of anything like stationery, calculator is not allowed.
5. Assume suitable data if necessary.
6. Write your MIS Number on Question Paper.
7. Draw neat figures wherever required.
8. Answer **all** questions.

Q.1 (a) What are the basic components of a laser source? Draw a schematic diagram of a pulsed Nd:YAG laser source. State the wavelength and average power of Nd:YAG laser.5

(b) What is the importance of 'Fresnel number, N' in a laser cavity? Explain it for a cylindrical cavity of length L and radius a.5

Q.2 (a) Explain the sequence of absorption events varying with absorbed power of a laser beam with a solid material. State the approximate values of power densities at which metals start to evaporate and at which its plasma is formed.5

(b) How do the laser wavelength, temperature and surface films affect the reflectivity of material?5

OR

Explain two case studies in which laser welding was successfully utilized to replace the conventional joining process for the desired application.5

Q.3 (a) What do you understand by 'transverse electromagnetic mode (TEM)' of a laser beam? How does the intensity distribution change for TEM₀₀, TEM₀₁ and TEM₁₀ modes?4

(b) A quality factor (M^2) of laser beam is used as a comparator for actual beam divergence (θ_{act}) with the divergence from a Gaussian laser beam with the same initial waist size, (θ_r). Explain the steps and entities calculated while finding the M^2 value.6

OR

Write short note **on any two** of the following

- i. Laser surface hardening
 - ii. Laser cladding with preplaced powder
 - iii. Shielding gases used in laser welding process
-6

- Q.4 (a) What are the different ways in which laser is used to cut materials? How do the relative energy levels vary in those laser cutting ways?6
- (b) State the equation for the surface temperature (T) at any time (t) after the start of laser irradiation, when one-dimensional heat flow with constant energy input is considered. Also explain how the time required to reach the boiling point on the surface of the material being irradiated (t_v) can be calculated from the equation.4

OR

The laser cutting parameters can be grouped as Beam properties, Transport properties, Gas properties and Material properties. Identify two parameters in each group and state their effects on the process.4

- Q.5 (a) State and explain the main characteristics of laser welding process. In what way it is different from arc welding processes?6
- (b) What is the role of keyhole and plasma in laser welding process? Is the formation of plasma beneficial for joining of metallic materials? Why or why not?4

OR

What is the difference in Conduction-limited laser welding and "keyhole" type welding?4

- Q.6 (a) Enlist the commonly found welding defects in laser welded steel joints. Explain the reasons and remedial measures for any two defects.6

OR

State at least five design rules that are followed while using laser welding process. Explain your answer in brief using suitable figures.6

- (b) What are the inherent risks involved in utilizing a laser machine for material processing? What will you advice to reduce the laser risks?4

-@-@-@-