

**MICRO AND NANO MANUFACTURING
(MECH 4122)**

Time Allotted : 2½ hrs

Full Marks : 60

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 4 (four) from Group B to E, taking one from each group.*

Candidates are required to give answer in their own words as far as practicable.

Group – A

1. Answer any twelve:

12 × 1 = 12

Choose the correct alternative for the following

- (i) Sacrificial layer is used in which of the following micro machining technique?
(a) Bulk micro machining (b) Surface micro machining
(c) Laser micro machining (d) None of the above.
- (ii) Aspect ratio in micro drilling is the ratio of following factors
(a) Drilling depth: drilling diameter (b) Drilling diameter: drilling depth
(c) Drill bit diameter: drill bit length (d) Drill bit length: drill bit diameter.
- (iii) Laser beam machining process can be used for
(a) Conductors (b) Insulators (c) Metals (d) All of the mentioned.
- (iv) “Micro-mirror arrays for high definition projection system” is example of the following device
(a) MEMS device (b) MEDS device
(c) MERS device (d) MECS device.
- (v) Choose the odd one out.
(a) Micro-turning (b) Micro-milling
(c) Micro-EBM (d) Micro-grinding.
- (vi) In which of the following micro machining technique micromechanical devices are manufactured by etching deeply into material?
(a) Bulk micro machining (b) Surface micro machining
(c) Laser micro machining (d) None of the above.
- (vii) Graphene is an example of _____
(a) one-dimensional material (b) two-dimensional material
(c) three-dimensional material (d) zero-dimensional material.
- (viii) Micro-EDM tool should not have
(a) low thermal conductivity (b) high machinability
(c) high melting point (d) high specific heat.

- (ix) Which of the following material cannot be machined by Micro-EDM?
 (a) Steel (b) WC (c) Titanium (d) Glass.
- (x) Metal is removed from which of the components in electro discharge machining?
 (a) Electrode tool (b) Work piece
 (c) Electrode tool & Work piece (d) None of the mentioned.

Fill in the blanks with the correct word

- (xi) "MEMS" stand for _____.
- (xii) Full form of LASER is _____.
- (xiii) SEM stands for _____.
- (xiv) When the mass flow rate of the abrasive increases, the material removal rate _____.
- (xv) Duty cycle is the ratio of _____.

Group - B

2. (a) Explain surface micro machining technique with suitable figures. *[[CO1](Understand/LOCQ)]*
- (b) Demonstrate the technique of electron-beam nanolithography with suitable figures. *[[CO5](Apply/IOCQ)]*
6 + 6 = 12
3. (a) Justify the applications of MEMS in modern automobile air bag safety system . *[[CO1](Evaluate/HOCQ)]*
- (b) Explain the working principle of "laser micro machining" technique with suitable figures. *[[CO3](Understand/LOCQ)]*
6 + 6 = 12

Group - C

4. (a) Explain any one micro drilling process. Name any two materials which are used for making micro drill bit. *[[CO2](Understand/LOCQ)]*
- (b) Explain the process of micro turning with example. *[[CO2](Understand/LOCQ)]*
6 + 6 = 12
5. (a) Propose a technique with sketch for micro bending process with the help of laser. *[[CO5](Apply/IOCQ)]*
- (b) Write a short note on Micro-Milling. *[[CO2](Understand/LOCQ)]*
6 + 6 = 12

Group - D

6. (a) Explain the working principle of micro LBM process with a suitable diagram. *[[CO3](Understand /LOCQ)]*

- (b) Explain with a suitable diagram how an intensifier works to increase hydraulic pressure. [[C03) (Understand /LOCQ)]
6 + 6 = 12
7. (a) What are the process parameters and applications of Micro-EDM? [[C03)(Analyse/IOCQ)]
(b) With a suitable diagram, explain the working principle of Electron Beam Machining process. [[C03)(Understand/LOCQ)]
6 + 6 = 12

Group - E

8. (a) Explain soft lithography process with neat sketch. [[C05)(Remember/LOCQ)]
(b) What are the different types of carbon nanotubes, explain with suitable diagram? [[C01)(Remember /LOCQ)]
6 + 6 = 12
9. (a) Distinguish between optical microscope and electron microscope. [[C06)(Analyse/IOCQ)]
(b) Describe the working principle of magneto-rheological finishing process with neat sketches. [[C04)(Remember/LOCQ)]
6 + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	68.75	25	6.25

Course Outcome (CO):

After the completion of the course students will be able to

- CO1. Use the micro and nano manufacturing processes in different engineering applications.
- CO2. Explain the conventional techniques used in micro manufacturing.
- CO3. Describe the different types of non-conventional micro-nano manufacturing techniques.
- CO4. Explain the different types of micro and nano finishing processes.
- CO5. Discuss various types of micro and nanofabrication techniques.
- CO6. Identify different techniques used in micro joining and the metrology tools in micro and nano manufacturing.

**LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question.*

