

3 Hours

Max Marks: 80

N.B.

- 1) Q. No. 1 is compulsory.
- 2) Attempt any three out of remaining questions.
- 3) Assume any suitable data wherever required but justify the same.

- 1 a Justify the statement that silicon based microelectronics is different than micro-fabrication (MEMS fabrication). 20
- b State various Chemical Vapor Deposition Techniques. Explain in brief any one of the techniques of Chemical Vapor Deposition for MEMS device fabrication.
- c Define Piezo-resistive property of single crystal silicon as MEMS material. Also define and justify that semiconductor material has high Gauge factor.
- d What is the resonant frequency  $F_0$  for the silicon cantilever beam of  $2000\mu\text{m}$  long and  $200\mu\text{m}$  wide and  $1.5\mu\text{m}$  thick? (Data : for silicon  $E = 190 \text{ GPa}$  and The density is  $2.39 \text{ g/cm}^3$ )
- 2 a Explain transduction pertaining to capacitive measurement, Piezo-resistive for MEMS. Also state different parameters on which this transduction depend. 10
- b Discuss fabrication process for DMD. Justify clearly choice of material, process parameters & sub-type of processes preferred 10
- 3 a Justify the need of vacuum pressure in Physical Vapor Deposition (PVD). Explain in brief any one of the techniques of PVD for MEMS device fabrication. Also define the terms step coverage and shadowing. 10
- b Describe the representative process flow for fabricating the micro-heater. Also explain the operating principle of this MEMS device in detail with its analytical expression. 10
- 4 a Explain the process Integration for typical MEMS Device 10
- b Give two examples of combination of structural, sacrificial layers and etchants used in MEMS fabrication along with their applications 10
- 5 a Explain what do you mean by Wafer bonding? State the need of the same. What are the different types of Wafer bonding? 10
- b Discuss MEMS reliability in detail. 10
- 6 Write a short note on (any three) 20
- a Plasma Etching
- b Advantages and limitations of surface micromachining
- c High Aspect Ratio MEMS
- d DMD (Digital Mirror Device)