

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-VIII(NEW) EXAMINATION – SUMMER 2019****Subject Code:2182008****Date:09/05/2019****Subject Name:Mems And Nanotechnology****Time:10:30 AM TO 01:00 PM****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1** (a) Explain the use of carbon nanotubes as nano bio sensors **03**
- (b) Explain difference between Squeeze film and damping in shear. **04**
- (c) What are the qualities desired for a substrate to be considered in Micro fabrication? Explain with an example. **07**

- Q.2** (a) Discuss the major technical issues to be handled in BIOMEMS products. **03**
- (b) Write down merits and demerits of micro actuation techniques in MEMS. **04**
- (c) With neat sketch of MEMS thermal sensor explain its construction and working. **07**

OR

- (c) Explain the role of Finite Element Analysis in the Design of MEMS structures. **07**

- Q.3** (a) Discuss the significance of scaling laws in Miniaturization with reference to Geometry and Rigid body dynamics. **03**
- (b) Compare microelectronics vs Microsystems. **04**
- (c) A microacuator made of a bilayer strip -an oxidized silicon beam- is illustrated in Figure 1. A resistance heating film is deposited on the top of the oxide layer. Estimate the interfacial force between the Si and SiO₂ layers and the movement of the free end of strip with a temperature rise $\Delta T = 10^{\circ}\text{C}$. Use the following material properties:

Young' modulus: $E_{\text{SiO}_2} = E_1 = 385000\text{MPa}$, $E_{\text{Si}} = E_2 = 190,000\text{MPa}$.

CTE: $\alpha_{\text{SiO}_2} = \alpha_1 = 0.5 \times 10^{-6} / ^{\circ}\text{C}$; $\alpha_{\text{Si}} = \alpha_2 = 2.33 \times 10^{-6} / ^{\circ}\text{C}$.

OR

- Q.3** (a) Explain working principle of Chemical Vapor Deposition process. **03**
- (b) Justify: At the nanometer scale, properties become size dependent. **04**
- (c) Explain the Czochralski process for producing single crystal silicon. **07**

- Q.4** (a) Writedown four qualities desired for substrate yo be considered in Microsystems. **03**
(b) Explain Chemical Vapor Deposition process. **04**
(c) A CVD process involves a reactant being diluted at 2% in the carrier oxygen gas at 490°C. Find the number of molecules in a cubic meter volume of the carrier gas. Pressure variation in the process is negligible. **07**

OR

- Q.4** (a) What is Etching explain? **03**
(b) Explain the working and applications of different types of Micro accelerometers. **04**
(c) Explain the method used for growing silicon crystals. **07**

- Q.5** (a) Differentiate between Ion Implantation and Diffusion process. **03**
(b) Discuss the significance of scaling laws in Miniaturization with reference to Geometry and Rigid body dynamics **04**
(c) What do you understand by ‘Molecular Recognition’? Explain in brief in context of Nanotechnology. How it is useful to the society at large? **07**

OR

- Q.5** (a) Give at least three distinct advantages of miniaturization of machines and device. **03**
(b) Evaluate the effect of creep in MEMS devices diminishes at higher values of temperature. **04**
(c) Explain the Photolithography process in detail with a suitable example. **07**
