Seat No.: _____ Enrolment No.

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 $\Delta T = 10°C$. Use the following material properties: Young' modulus: $E_{SiO2} = E_1 = 385000MPa, E_{Si} = E_2 = 190,000$ MPa. CTE: $\alpha_{SiO2} = \alpha_1 = 0.5 \times 10^{-6}$ /°C; $\alpha_{Si} = \alpha_2 = 2.33 \times 10^{-6}$ /°C.	**07**
		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^{o}C. Find the number of molecules in a cubic meter volume of the carrier gas. Pressurevariation 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**

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