Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII (NEW) EXAMINATION – SUMMER 2022

Subject Code:3172014 Date:14/06/2022

Subject Name:MEMS and Nano Technology

Time:02:30 PM TO 05:00 PM Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

Q.1	**(a)**	Give the name popular micro actuation techniques used in micro devices.	**03**
	(b)	Explain the difference between MEMS and microsystems.	**04**
	(c)	Explain the working and applications of different types of Micro accelerometers. Also discuss the principles of damping used with their applications.	**07**
Q.2	**(a)**	Explain creep is a temperature independent phenomenon.	**03**
	(b)	Why traditional manufacturing techniques cannot be used at micro level?	**04**
	(c)	Why Micro Mechatronics technology is not adapted in the design and packaging of MEMS and Microsystems.	**07**
		OR	
	(c)	Calculate the electrostatic force on the plate electrodes with an applied dc voltage at 70V. Two square plates with the dimensions as 1000μm each are used. The plates are initially misaligned by 20 percent in both length and width directions. Pyrex glass is used as dielectric material.	**07**

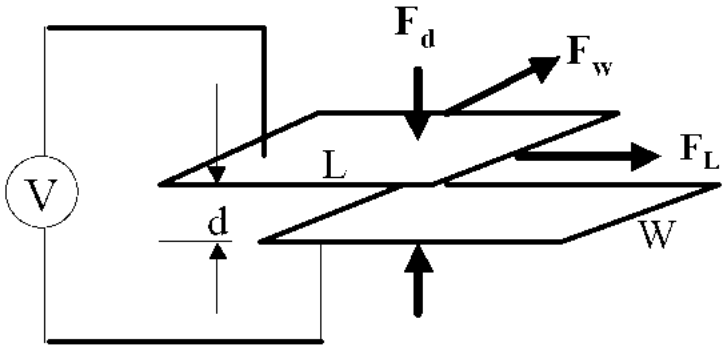

Figure 1

Q.3	**(a)**	Give at least three distinct advantages of miniaturization of machines and device.	**03**
	(b)	Explain the construction and working of a MEMS Pressure sensor.	**04**
	(c)	Explain the three principal signal transduction methods for micro pressure sensors with advantages and disadvantages of each of the methods.	**07**
		OR	
Q.3	**(a)**	"Silicon and its compounds are used as Ideal Substrate materials for MEMS" Justify.	**03**
	(b)	Explain the Photolithography process with a suitable example.	**04**
	(c)	Determine the thickness of the beam spring shown in figure 2 below if the maximum allowable deflection of the beam mass is 5mm, one microsecond after the deceleration from its initial velocity of 50km/hr to a standstill. The proof mass of the vibrating beam is 16E-11kg. The entire structure is assumed to be made of silicon with Young's modulus as 190GPa.	**07**

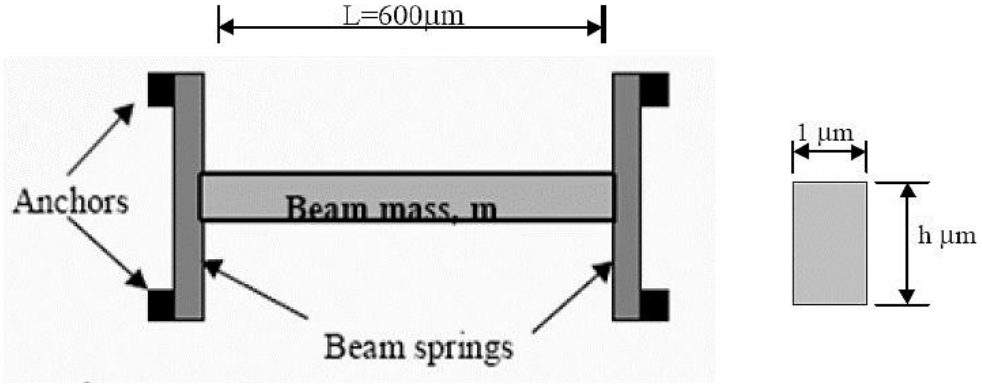

Figure 2

Q-4	**(a)**	What is piezoelectric crystals?	**03**
	(b)	Explain the effect of damping on the amplitude of vibration of a cantilever beam mass system with a suitable example.	**04**
	(c)	Explain the Czochralski method for producing single-crystal silicon.	**07**
		OR	
Q.4	**(a)**	Explain Spectroscopy.	**03**
	(b)	Differentiate between Ion Implantation and Diffusion processes.	**04**
	(c)	Explain the working and applications of different types of Micro accelerometers.	**07**
Q.5	**(a)**	"At the nanometer scale, properties become size dependent". Evaluate	**03**
	(b)	Explain difference between Squeeze film and damping in shear.	**04**
	(c)	Describe applications of carbon nanotubes? Explain the use of carbon nanotubes as nano bio sensors.	**07**
		OR	
Q.5	**(a)**	What are the types carbon nanotubes?	**03**
	(b)	Explain Chemical Vapor Deposition process.	**04**
	(c)	Differentiate between Scanning Electron Microscopy and Scanning Probe Microscopy	**07**

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