Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME- SEMESTER II– EXAMINATION – SUMMER 2015

Subject Code: 2724703 **Date: 30/05/2015**

Subject Name: FUNDAMENTALS OF MICRO MECHATRONICS SYSTEMS

Time: 2:30 PM – 5:00 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 following related to Micro Mechatronics systems: **07**

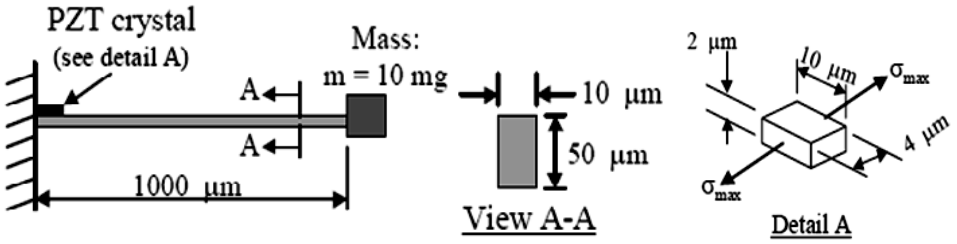
i. Optical Sensors

ii. Pressure Sensors

(b) Differentiate between Micro systems and Micro Electronics Technologies. **07**

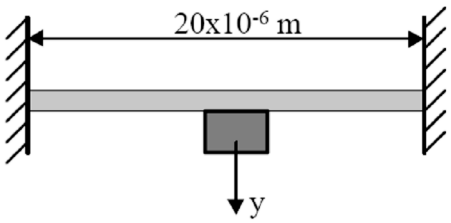
Q.2 **(a)** Describe the three principal signal transduction methods for micro pressure sensors. What are the advantages and disadvantages of using (1) Piezo resistors and (2) Capacitors as signal transducers? **07**

(b) A thin Piezoelectric crystal film of PZT is used to transduce the signal in a micro accelerometer with a cantilever beam made of silicon. The accelerometer is designed for a maximum acceleration and deceleration of 10g. The PZT transducer is located at the support based of the cantilever where the maximum strain exists during bending of the beam. Find the electrical voltage output from the PZT film at the maximum acceleration/deceleration. **07**



OR

(b) A component of a MEMS structure (5gm) is attached to a strip of silicon. The equivalent spring constant is 18,240 N/m. The mass is pulled down by 5E-6 meter initially and is released. Find the natural frequency and maximum amplitude of vibration of the system. Also find the time required to break up the strip if a Force of F (t) = 5cos ɤ nt N is applied to the mass at time t>0. Assume that the material of the mass and the strip is silicon and the strip breaks at a deflection of 1mm. The vibration of the system begins when the system is at rest. **07**



Q.3 **(a)** ñFormation of Boundary layer is closely related to the CVD process.ò Justify **07**

	(b)	Explain the methods of constitutive relations: Hookean Elastic Solid and Greens elastic solid in brief.	**07**

OR

Q.3	**(a)**	List the micro fabrication processes used for MEMS. Explain photolithography and Chemical Vapour Deposition techniques in detail.	**07**
	(b)	What are BIOMEMS? List the major technical issues to be handled by BIOMEMS products. With an example differentiate Biomedical and Biosensors.	**07**
Q.4	**(a)**	Explain the Czochralski method for growing silicon crystals.	**07**
	(b)	Explain the significance of the Trimmer Force scaling vector in the design of Micro mechatronics systems. Estimate the associated changes in acceleration, time and power supply to actuate a Micro mechatronics component if its weight gets reduced by a factor of 20.	**07**

OR

Q.4	**(a)**	Explain the concept of wave propagation in Micro Mechatronics structures.	**07**
	(b)	Explain: Hamiltons principle and Fast Fourier Transformation when applied to Micro Mechatronics systems.	**07**
Q.5	**(a)**	Sketch and explain the Three modes of fracture (in terms of the stress intensity factors) related to the fracture of a solid. With a neat sketch explain the three stages of creep deformation	**07**
	(b)	Differentiate between (a) Ion Implantation and Diffusion process. (b) Squeeze film and damping in shear	**07**

OR

Q.5	**(a)**	ñElectromagnetic forces are not commonly used in MEMS and microsystems as preferred actuation forceò. Evaluate.	**07**
	(b)	Explain the significance of Finite Element Analysis in Designing Micro Mechatronics structures.	**07**

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