Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

VII SEMESTER B.TECH. (MECHATRONICS ENGINEERING)

END SEMESTER EXAMINATIONS - MAKE UP

SUBJECT: MICRO ELECTRO MECHANICAL SYSTEM [MTE 4102]

DEC 2019/ JAN 2010

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Data not provided may be suitably assumed

1A.	Distinguish between various actuation techniques used in microsystem	**4**	**CO1**
1B.	Suggest a suitable solution for effective heat dissipation in microsystem and explain with a neat sketch	**3**	**CO1**
1C.	With the help of schematic arrangement explain the process used for applying photoresist onto the surface of substrates.	**3**	**CO4**
2A	Differentiate Bio sensor and Bio-medical sensor. Explain their working principle with examples	**5**	**CO1**
2B	Estimate the associated changes in the acceleration (a), time (t) and power supply (P) to actuate a MEMS component when electrostatic force is reduced by a factor of 8	**2**	**CO2**
2C	Describe various mechanical problems associated with surface micromachining.	**3**	**CO4**
3A	Compare isotropic and anisotropic etching	**3**	**CO4**
3B	With the help of graphical illustration, describe the fabrication process used to develop thin metallic films of 100 Å thick	**4**	**CO4**
3C	Explain any three types of surface bonding techniques used in MEMS.	**3**	**CO1**
4A	Suggest a method to produce pure silicon crystal. With the help of a neat sketch, explain its working principal in detail	**4**	**CO3**
4B	Determine the minimum thickness of the rectangular diaphragm of a micro pressure sensor made of Silicon with conditions: Plane area = 32 X 10^4 μm^2; a/b ratio = 2; $\alpha = 0.0277$; $\beta = 0.4974$; Applied pressure = 24 MPa; Yield strength of silicon = 7000 MPa; Young's modulus = 190 GPa and Poisson's ratio = 0.25. Also find maximum stress if rectangular diaphragm is replaced with i)square,	**4**	**CO1**

ii)circular diaphragm of same plane area

4C	What are the major technical issues involved in the application of MEMS in biomedicine?	**2**	**CO2**
5A	Suggest a method to develop passivation layer over a silicon substrate? Explain the process with a sketch.	**4**	**CO4**
5B	Determine the required electric voltage for ejecting a droplet of ink from an inkjet printer head using PZT piezoelectric crystal as a pumping mechanism. The ejected ink will have a resolution of 250 dpi (dots per inch). The ink droplet is assumed to produce a dot with a film thickness of 750 nm on the paper. The geometry and dimension of the printer head is illustrated in Fig. 5B. Assume that the ink droplet takes a shape of a sphere and the inkwell is always re-filled after ejection. Piezoelectric coefficients of PZT is 480 X 10^{-12} m/V	**4**	**CO3**

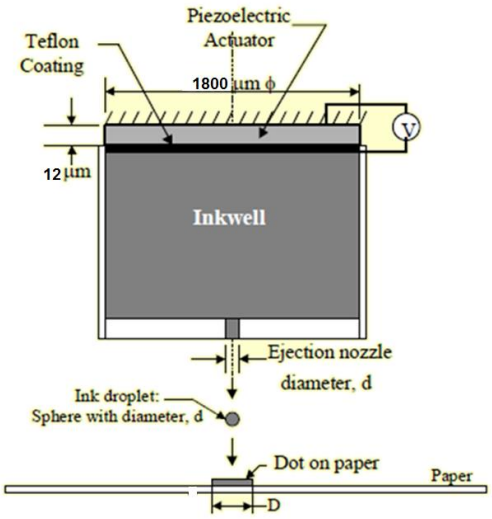

Fig. 5B Ink pumping mechanism in inkjet printer head

5C	Describe the different activities happen in a plasma generator	**2**	**CO1**