VIT
Vellore Institute of Technology

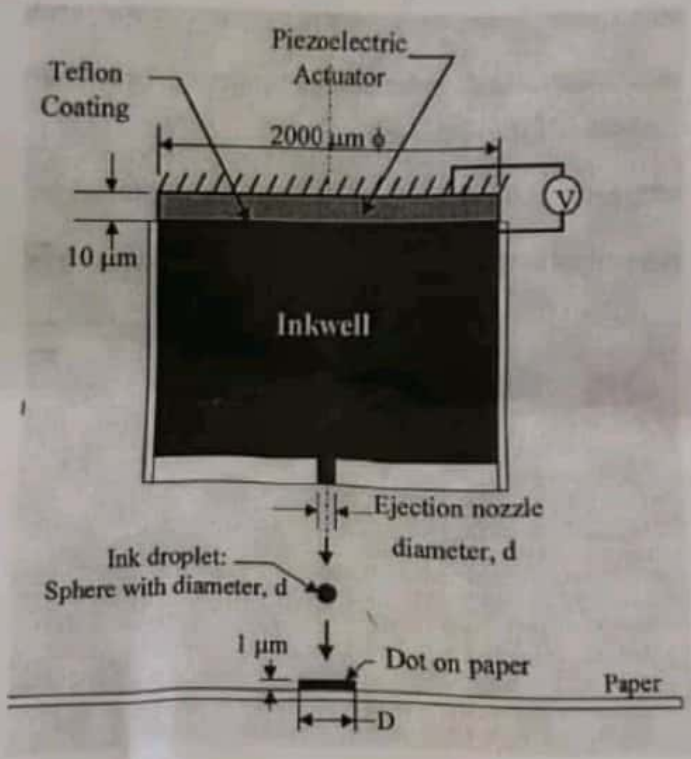
Final Assessment Test – November 2019

Course: MEE1008 - MEMS
Class NBR(s): 6841
Time: Three Hours
Slot: A1+TA1
Max. Marks: 100

KEEPING MOBILE PHONE/SMART WATCH, EVEN IN 'OFF' POSITION, IS EXAM MALPRACTICE

Answer any TEN Questions
(10 X 10 = 100 Marks)

1. Discuss the generic and distinct characteristics of MEMS devices and analyse the engineering implications.
2. With neat sketches, describe the principle of the following micromachining techniques. i) Bulk micromachining. ii) Surface micromachining.
3. 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 600 dpi (dots per inch). The ink droplet is assumed to produce a dot with a film thickness of 1 μm on the paper. The geometry and dimension of the printer head is illustrated below. Assume that the ink droplet takes a shape of a sphere and the inkwell is always re-filled after ejection.



4. Explain the scaling of electrostatic and electromagnetic forces in MEMS devices and elaborate the operation of MEMS device based on electrostatic forces of attraction.
5. Determine the maximum stress on a silicon nitride membrane filter. The membrane has a dimension of 1 mm × 1 mm × 1 μm. The Young's modulus for silicon nitride is 3×10^{11} Pa, and its Poisson's ratio is 0.25. The opening factor is 0.25. The working fluid is air at a flow rate of 100 ml/min. The density and the viscosity of air at room temperature are 1 kg/m^3 and 1.82×10^{-5} Pa-sec, respectively. Would the filter work if the fluid were water?

6. Write short notes on the following MEMS sensor and actuator with its applications

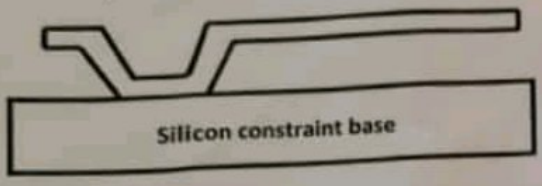
   a) Pressure micro sensor

   b) Bio-medical micro sensor

   c) SMA micro actuator

   d) Piezoelectric micro actuator

7. Design a microfabrication process for a micro-cantilever structure over a MEMS substrate and explain the process sequence with neat sketches.



8. Write a Case Study on usage of a) MEMS in Smart homes b) MEMS for Visually impaired.

9. You have joined an automotive company as an engineer with expertise in Mechatronics and you have been posted in the MEMS engineering division. Construct and explain an Air-bag deployment system using MEMS Accelerometer and actuator for deploying Airbag during sudden braking.

10. Describe the construction of a microfluidic valve and pump device for injecting drugs into a patient. What parameters need to be considered for the above?

11. Discuss the ion implantation process for doping silicon substrates with various impurities.

12. Discuss the process steps involved in fabrication of a long square tube using LIGA process.

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