

BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: BTECH
BRANCH: MECH/CSE/EEE/IT

SEMESTER : VI
SESSION : SP/2023

SUBJECT: EC361 INTRODUCTION TO MEM

TIME: 3 Hours

FULL MARKS: 50

INSTRUCTIONS:

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
 2. Attempt all questions.
 3. The missing data, if any, may be assumed suitably.
 4. Before attempting the question paper, be sure that you have got the correct question paper.
 5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.
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| Q.1(a) Give a brief history of MEMS development. What is the role of Silicon micromachining MEMS? Why is silicon the material of choice for MEMS? | [5] CO1 | Remember |
| Q.1(b) Explain the two most important patterning techniques in microfabrication, i.e., Photoresist and Photolithography. Derive a scaling law for the ratio of surface area and the volume of a cube and discuss the consequences for MEMS design | [5] CO2 | Apply |
| Q.2(a) Explain the concepts of stress and strain in context of MEMS with suitable diagrams. How do these manifest themselves in MEMS devices? | [5] CO2 | Understand |
| Q.2(b) Explain how normal stress and strain differ from shear stress and strain. A silicon cube with a volume of 1 cm^3 is placed on a surface. A force of 1 mN is applied vertically on the face. Find (i) the type of stress and (ii) the magnitude of stress induced in the direction of the applied force. | [5] CO3 | Analyze |
| Q.3(a) Summarize the major advantages and disadvantages of electrostatic sensing and actuation. Consider an air-gap capacitor made with two fixed parallel planar plates. At rest (zero bias), the distance between two parallel plates is $x_0 = 100 \mu\text{m}$, and the areas of plates are $A = 400 \times 400 \mu\text{m}^2$. The media between the two plates is air. The biasing voltage between these two plates is 5 Volts. Calculate the numerical value of the capacitance and the magnitude of the attractive force (F). What is the capacitance value if half of the area is filled with water (as the inter plate media)? | [5] CO3 | Evaluate |
| Q.3(b) Explain the four mechanisms for heat to move from one point to another. Write down the governing equations for these mechanisms and explain the various terms involved. | [5] CO2 | Understand |
| Q.4(a) Explain why MEMS packaging is difficult as compared to IC packaging. Explain different MEMS integration techniques. | [5] CO3 | Remember |
| Q.4(b) Design a simple MEMS Accelerometer using MEMS capacitor as a sensor. State the concerned equations. | [5] CO5 | Create |
| Q.5(a) Explain the working of MEMs blood sensor with suitable diagrams. Why did NovaSense BP meter use double membrane design? | [5] CO3 | Remember |
| Q.5(b) Justify with arguments why MEMS technology is a perfect solution for low-cost, high-performance microphones. Why did Knowles use a cantilever design instead of a membrane. | [5] CO3 | Understand |