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

CLASS: BTECH **SEMESTER : VITH**
BRANCH: CSE, AI & ML, EEE **SESSION : SP/2025**

SUBJECT: EC361 INTRODUCTION TO MEMS

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.

			CO	BL
Q.1(a)	Explain the historical development of MEMS technology and discuss the intrinsic characteristics that make MEMS suitable for modern applications.	[5]	1	3
Q.1(b)	Differentiate between bulk micromachining and surface micromachining. Explain their roles in MEMS fabrication. Describe the basic steps involved in photolithography.	[5]	1	3
Q.2(a)	Define tensile stress and tensile strain. Explain the stress-strain curve for a ductile material under tensile load. Indicate and describe the key regions such as elastic limit, yield point, and ultimate tensile strength.	[5]	2	3
Q.2(b)	A phosphorous-doped silicon resistor is 100μm long, 2μm wide, and 0.5 μm thick. The doping concentration 10^{17} atoms/cm3.The electron mobility(μ_n) which is a function of the doping concentration, is approximately 1350 cm^2/Vs. The hole mobility is approximately 480 cm^2/Vs. What are the concentrations of electrons and holes under thermal equilibrium at room temperature? Find the resistivity of the material and the total resistance.	[5]	2	3
Q.3(a)	Explain the working principle of piezoelectric sensors. How do they differ from piezoresistive sensors? Compare piezoresistive and capacitive sensing techniques in terms of sensitivity and fabrication complexity.	[5]	3	3
Q.3(b)	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=100μm and the areas of plates are A = 400 * 400 μm^2. The media between the two plates is air. The biasing voltage between these two plates is V=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]	3	3
Q.4(a)	Discuss the classification of MEMS inductors and explain major design issues that affect their performance in RF applications.	[5]	4	3
Q.4(b)	What are the major integration challenges faced in MEMS packaging? How are hermetic sealing and material compatibility addressed?	[5]	4	3
Q.5(a)	Discuss the background and historical development of MEMS blood pressure sensors, highlight the key device design considerations, and describe a successful commercial implementation.	[5]	5	3
Q.5(b)	Review the background and historical development of MEMS accelerometers, explain the key device design considerations, and describe a successful commercial implementation.	[5]	5	3

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