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Subject Code: BOE063

Roll No:

BTECH

(SEM. VI) THEORY EXAMINATION 2025-26

INTRODUCTION TO MEMS

TIME: 3 HRS

M.MARKS: 70

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt *all* questions in brief.

2x7 = 14

(a)	Define MEMS and give two advantages.	CO1	K1
(b)	What is bulk micromachining?	CO1	K2
(c)	Define stress and strain	CO2	K2
(d)	What is squeeze-film damping?	CO3	K2
(e)	Define pull-in voltage	CO4	K1
(f)	What is Seebeck effect?	CO5	K2
(g)	A thermocouple produces $40 \mu\text{V}/^\circ\text{C}$. Find output voltage when temperature difference is 50°C .	CO5	K3

SECTION B

2. Attempt any *three* of the following:

7 x 3 = 21

(a)	Explain MEMS fabrication techniques: bulk and surface micromachining.	CO1	K2
(b)	Derive expression for deflection of a cantilever beam subjected to point load.	CO2	K3
(c)	Explain squeeze-film air damping with governing equation and assumptions	CO3	K3
(d)	Describe electrostatic actuation and derive force expression for parallel plate actuator.	CO4	K3
(e)	Explain thermocouples and thermal sensors used in MEMS	CO5	K2

SECTION C

3. Attempt any *one* part of the following:

7 x 1 = 7

(a)	Explain piezoresistive effect and its application in MEMS sensors	CO1	K3
(b)	Describe piezoelectric sensors with working principle and advantages	CO1	K2

4. Attempt any *one* part of the following:

7 x 1 = 7

(a)	Air flows between two parallel plates separated by a small gap. Given viscosity $\mu = 1.8 \times 10^{-5} \text{Ns/m}^2$, plate velocity = 2 m/s, gap = 1 mm. Find shear stress using Couette flow model.	CO2	K3,K4
(b)	Explain moment of inertia and its role in beam stiffness	CO2	K2

5. Attempt any *one* part of the following:

7 x 1 = 7

(a)	Derive Reynolds equation for squeeze-film air damping.	CO3	K3
(b)	Explain slide-film damping using Couette-flow and Stokes-flow models	CO3	K3

6. Attempt any *one* part of the following:

7 x 1 = 7

(a)	Derive expression for pull-in voltage in electrostatic actuator.	CO4	K3
(b)	Explain fringe effect and its impact on electrostatic actuation	CO4	K2

7. Attempt any *one* part of the following:

7 x 1 = 7

(a)	Explain MEMS resonator design and its limitations.	CO5	K3
(b)	Discuss RF MEMS switches and their advantages over conventional switches.	CO5	K2