Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S6 (S,FE) Examination December 2025 (2019 Scheme)

Course Code: ECT362

Course Name: INTRODUCTION TO MEMS

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks. Marks

1		Compare micro sensors and micro actuators with suitable examples	(3)
2		Why is MEMS technology considered multidisciplinary? Mention three contributing fields	(3)
3		Write the formula for deflection of a cantilever beam with a point load at the free end	(3)
4		What are intrinsic stresses? Give any two causes	(3)
5		Compare scaling behaviour of electrostatic and electromagnetic forces.	(3)
6		How does heat conduction scale in miniaturized devices?	(3)
7		What is ion implantation? Mention its advantages in MEMS fabrication.	(3)
8		Distinguish between dry oxidation and wet oxidation	(3)
9		Describe any one sealing method used in assembly of micro systems	(3)
10		Mention three applications of MOEMS in optical systems.	(3)

PART B

Answer one full question from each module, each carries 14 marks.

Module I

11	a)	Explain the shape memory effect. Describe their actuation mechanism, advantages, limitations, and MEMS applications.	(6)
	b)	Describe the working principle of micro accelerometer with neat schematic diagrams. Give two applications	(8)

OR

12	a)	Describe the principle of magnetic actuation in MEMS. Mention a few magnetic actuator structures with real-world applications.	(7)

b) Explain the working and applications of MEMS micro grippers. Compare thermal and electrostatic micro grippers. (7)

Module II

13 a) Determine the moment of inertia for a beam under longitudinal strain and also find the flexural formula. (8)

b) Describe the different boundary conditions of beams that are encountered in MEMS systems. (6)

OR

14 a) Derive the expression for the spring constant of a cantilever beam. How do geometry, material properties, and boundary conditions influence the stiffness of MEMS beams? (7)

b) Explain intrinsic stresses in thin-film MEMS structures. Discuss various sources, effects on device performance, and methods for minimizing these stresses. (7)

Module III

15 a) Discuss the properties, advantages, fabrication methods, and applications of SU-8, PMMA, and PDMS in MEMS and microfluidics. (8)

b) Derive the expressions for Electromagnetic potential energy and force with reference to scaling of electromagnetic forces (6)

OR

16 a) Define Trimmer Force Scaling Vector. Use scaling laws to estimate the changes in acceleration, time to actuate a MEMS component if its weight is reduced by a factor of 10. (7)

b) Explain why silicon is the most preferred material for MEMS. Discuss its mechanical, electrical, thermal, and fabrication-related advantages. (7)

Module IV

17 a) With necessary diagrams describe ion implantation technique (7)

b) Explain the Oxide growth process in Silicon with relevant figures (7)

OR

18 a) With neat sketches, explain any two problems associated with surface micromachining. (8)

b) With neat sketches, explain bulk micro manufacturing. (6)

Module V

19	a)	Explain the anodic bonding process in detail. Discuss its mechanism, required conditions (temperature, voltage, materials), challenges, and typical applications in MEMS devices such as pressure sensors.	(10)
	b)	Discuss the transition from MEMS to NEMS	(4)

OR

20	a)	Explain the major steps involved in assembly of MEMS-based microsystems. Discuss alignment issues, packaging-induced stress, sealing, and testing challenges with examples.	(10)
	b)	Explain the challenges involved in designing packages for microsystems	(4)

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