Reg No.:
 Name:

 APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

 SEVENTH SEMESTER B.TECH DEGREE EXAMINATION(R&S), DECEMBER 2019

 Course Code: EC465

 Course Name: MEMS

 Max. Marks: 100
 Duration: 3 Hours

#### PART A

## Answer any two full questions, each carries 15 marks. Marks

- 1 a) Explain the basic building blocks of MEMS with neat diagrams. (8)
  - b) Explain the principle of operation of thermal sensors and actuators with neat (7) diagrams.
- 2 a) Derive the equation for pull in voltage. Also explain the advantages and (8) limitations of electrostatic actuation methods.
  - b) Describe the principle of micro-accelerometer with a neat schematic. (7)
- 3 a) Explain the operating principle of two types of micro motors with suitable (8) schematics
  - b) Determine the moment of inertia for a beam under longitudinal strain and also (7) find the flexural formula

## PART B

### Answer any two full questions, each carries 15 marks.

- 4 a) Explain Trimmer force scaling vector. Use scaling laws to estimate the changes in (8) acceleration and time to actuate a MEMS component if its weight is reduced by a factor of 10.
  - b) Explain with figures one method to produce single crystal silicon. Why is silicon (7) used as a substrate material for MEMS.
- 5 a) With reference to scaling of electrostatic forces explain why electrostatic (8) actuation is preferred over electromagnetic actuation in micro motors.
  - b) Explain the steps involved in photolithography with neat sketches. (7)
- 6 a) Explain scaling in fluid mechanics .What are the advantages of piezoelectric (7) pumping.
  - b) Discuss different types of polymers used in MEMS. (8)

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## PART C

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Answer any two full	auestions.	each	carries	20 marks.	

7	a)	Explain surface micro machining process for fabricating a mechanical structure	(10)
		with neat sketches.	
	b)	State the objectives and explain the general considerations in micro system	(10)
		packaging	
8	a)	Explain LIGA process in detail.	(10)
	b)	Explain with figures two RF MEMS applications	(10)
9	a)	Explain the three levels of micro system packaging	(10)
	b)	Explain Anodic bonding and Silicon Fusion Bonding	(10)