Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2018

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 operating principle of two types of micro motors with suitable schematics. (10)

b) Explain the operating principle of Thermal bimorphs with figures (5)

2 a) Give one application of MEMS in automobiles. Illustrate its working with neat sketches. (5)

b) State the reasons for intrinsic stress in thin film materials under room temperature and zero loading conditions. (10)

3 a) Explain with figures two types of sensing schemes used in inertial sensors and micro accelerometer. (10)

b) Explain the constitutive relations between electrical displacement and stress of piezoelectric sensors. (5)

PART B

Answer any two full questions, each carries 15 marks.

4 a) Derive equations for acceleration a, time t and power density P/V based on the Trimmer Force Scaling Vector? What information does the force scaling vector provide to the MEMS designer? (10)

b) What are the advantages of use of polymers in micro systems? Give two examples of Polymers (full chemical/commercial names). (5)

5 a) Why electrostatic actuation is preferred over electromagnetic actuation in micro motors? (5)

b) Explain the Langmuir- Blodgett process with relevant figures. What are the advantages of LB films? (10)

6 a) Explain with figures one method to produce single crystal Silicon (5)

b) A silicon substrate is doped with boron ions at 100 KeV. Assume the maximum concentration after the doping is 30 x 10^{18}/cm3. Find: (a) the dose, Q, (b) the dopant concentration at the depth 0.15 μm, (c) the depth at which the dopant

concentration is at 0.1% of the maximum value. (Given: Rp = 307 nm = $307x10^{-7}$ cm and $\Delta Rp = 69 \times 10^{-7}$ cm at 100 KeV energy level). (10)

PART C

Answer any two full questions, each carries 20 marks.

7 a) State two advantages of LIGA process over other micro machining techniques. Explain with block diagram the steps in LIGA process. State atleast one commonly used chemical in each of the steps. (10)

b) Explain anodic bonding with figures. (5)

c) Explain any one application of MOEMS with figures. (5)

8 a) Explain the following bonding techniques with figures a) Silicon-on-Insulator b) Wire bonding (10)

b) Describe the role of sacrificial layers in surface micromachining with figures. Give examples of two sacrificial materials used in micro system fabrication. (5)

c) State the challenges involved in designing packages for micro systems. (5)

9 a) Explain with figures the steps in surface micro machining. Discuss the various fabrication challenges associated with surface micromachining. (10)

b) Explain with figures two RF MEMS applications. (10)

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