



**B.E DEGREE EXAMINATIONS: APRIL 2015**

(Regulation 2009)

Eighth Semester

**MECHATRONICS ENGINEERING**

MCT154: Micro Electro Mechanical Systems

**Time: Three Hours**

**Maximum Marks: 100**

**Answer all the Questions:-**

**PART A (10 x 1 = 10 Marks)**

1. The use of Electro chemical process in MEMS are
  - a) Sensors
  - b) Actuators
  - c) Power supply
  - d) CMOS
2. Micro systems involve
  - a) Fewer electrical feeds and wires
  - b) Mainly use silicon as substrate.
  - c) Complex pattern with dense electrical circuits.
  - d) Front end process
3. Bio Sensor uses
  - a) Biological entities
  - b) Biological substances
  - c) Diagnostic equipments
  - d) Chemicals
4. Permittivity of medium between two particles at vacuum is
  - a) 8.85pF/m
  - b) 8.58pF/m
  - c) 5.85pF/m
  - d) 5.58pF/m
5. The thickness of photo resist range is
  - a) 0.5-2 microns
  - b) 0.1-1microns
  - c) 1-5microns
  - d) 2-3microns
6. Organic materials deposited using CVD
  - a) Al<sub>2</sub>O<sub>3</sub>
  - b) SiC
  - c) SnO<sub>2</sub>
  - d) PtCl<sub>3</sub>
7. Parasite stress occurs in ----- sensor
  - a) Pressure
  - b) Biomedical
  - c) Temperature
  - d) Will not occur in sensors

8. The temperature requires for Eutectic bonding is
  - a) 312°C
  - b) 300°C
  - c) 330°C
  - d) 400°
9. Thermo compression bonding occurs around --- temperature
  - a) 312°C
  - b) 300°C
  - c) 330°C
  - d) 400°
10. --- type of photo resist is used in LIGA process
  - a) Sensitive to X-ray radiation
  - b) Good thermal stability at 240°C
  - c) Un exposed part must be soluble
  - d) Should have porosity

**PART B (10 x 2 = 20 Marks)**

11. What is meant by piezo- resistive coefficient? and why it is required?
12. Justify why you study MEMS?
13. Chemiresistors are preferred than chemicapacitor sensors: Argue whether the statement is correct or wrong.
14. How micro thermal sensors are manufactured?
15. List the MEMS fabrication process.
16. Why do we use plasma etching? Is there any alternate for plasma etching?
17. Name four packaging materials used as insulators
18. Justify, why die passivation is required?
19. When wire bonding is preferred?
20. Justify why Silicone gel is preferred in die protection?

**PART C (5 x 14 = 70 Marks)**

21. a) Explain the down scaling of rigid body dynamics and geometry using appropriate force rules.

**(OR)**

- b) How  $\text{Si}_3\text{N}_4$ , SiC, poly silicon are manufactured and explain their usage in MEMS device with respect to their properties.
22. a) (i) How Inter digital Transducers (IDT) work? And justify how it can be converted as pressure sensors? (8)
  - (ii) Explain the various micro actuation techniques. (6)

**(OR)**

- b) (i) Differentiate absolute pressure from gauge pressure and how MEMS sensors are fabricated to measure these two parameters? (7)
- (ii) Explain the working mechanism of micro motors and micro valves. (7)

23. a) (i) List down the various chemical deposition process and argue when LPCVD should be used with its working principle. (9)
- (ii) Explain the process of sputtering. (5)

**(OR)**

- b) Micro accelerometer used in air bag deployment system can be fabricated using both surface micromachining and bulk manufacturing process. In this process, stationary electrode should be fabricated by surface micro machining and the moving part is manufactured using bulk micro machining technique. Since the moving part should be rigid and requires rectangular section, it has to be etched properly with suitable etch stop.
- (i) Name what kind of accelerometer is used in air bag deployment and propose a suitable etching technique for this application. (7)
  - (ii) Argue about the correctness of this question. (7)

24. a) Explain LIGA process with neat sketches.

**(OR)**

- b) Explain various sealing techniques used in MEMS packaging.

25. a) Discuss the methods available for mask design.

**(OR)**

- b) Choose an appropriate pressure sensor used for tyre pressure sensing and justify your selection. In addition, what kind of packaging techniques you should follow to fabricate such sensor.

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