Seventh Semester B.Tech. Degree Examination, November 2017
(2013 Scheme)
13.706.2 : MEMS (AT)
(Elective – IV)

Time : 3 Hours

Max. Marks : 100

PART – A

Answer all questions. Each question carries 2 marks.

1. What are the characteristics of MEMS ?

2. Isotropic etching is hardly used for micro manufacturing. Why ?

3. Why semiconductor substrates are preferred for MEMS ?

4. Write down the expression for intrinsic concentration of a semiconductor as a function of bandgap and temperature.

5. The intrinsic carrier concentration of Si at room temperature is $1.5 \times 10^{10}/\text{cm}^3$. If this silicon is doped with arsenic to a concentration of $2 \times 10^{19}/\text{cm}^3$. The electron and hole mobilities of silicon are 1600 cm$^2$/Vs and 400 cm$^2$/Vs respectively. Calculate the resistivity of the doped silicon.

6. Draw the crystal structure of silicon for [100] and [110] orientation.

7. Define pull in voltage of parallel plate actuators.

8. What is Poisson’s ratio ?

9. What is mean by piezo-electric effect ?

10. What is PMMA ?
PART – B

Answer any one question from each Module. Each question carries 20 marks.

Module – I

11. a) Explain the factors to be considered for sensors and actuators. 10
    b) Explain the wafer processing steps with neat diagrams. 10

OR

12. a) Explain surface micromachining process. 10
    b) Explain the history and characteristics of MEMS. 10

Module – II

13. a) Explain the crystal structures and its physical and chemical properties of silicon for [100], [110] and [111] orientations. 10
    b) Analyze the static and dynamic behavior of MEMS devices under loading based on the concept of Newton's laws of motion. 10

OR

14. a) With neat diagrams, explain beam bending due to intrinsic mechanical stress. 10
    b) Derive the resonant frequency and quality factor of a dynamic system. 10

Module – III

15. a) Derive the capacitance of a parallel plate capacitor and explain how the parallel plate capacitor can act as an actuator. 10
    b) Explain the working of thermal sensors with neat diagrams. 10

OR

16. a) Explain any one application of comb drive in detail. 10
    b) With neat diagrams, explain the principle of piezo resistive sensors. 10

Module – IV

17. a) Explain the working principle of cantilever sensors and analyze its performance. 10
    b) Draw the diagram of tactile sensor and explain its operation with an applications. 10

OR

18. a) Explain the various process of deposition in magnetic materials. 10
    b) Design of magnetic coil for specific applications in MEMS. 10