

INSTITUTE OF AERONAUTICAL ENGINEERING

(AUTONOMOUS)

Code No: BCC210

MODEL QUESTION PAPER - II

M.Tech II Semester Regular Examinations, August 2018

DESIGN FOR MANUFACTURING OF MEMS AND MICRO SYSTEMS

(CAD/CAM)

Time: 3 hours

Max. Marks: 70

Answer ONE Question from each Unit

All Questions Carry Equal Marks

All parts of the question must be answered in one place only

UNIT-I

1. (a) Explain the operation of micro pressure sensor using capacitance signal transduction. [7M]
(b) Explain MEMS history and development and its application in an automobile. [7M]
2. (a) Explain the concept miniaturization of MEMS. Distinguish between micro actuator and micro accelerometer. [7M]
(b) Calculate the electrostatic forces on the plate electrodes with an applied DC voltage at 70V. The geometry and dimensions of the plate electrode are shown in figure. The plate are initially misaligned by 20 percent in both length and width directions. Pyrex is used as the dielectric material, so there is no gap change with the applied voltage. [7M]

UNIT-II

3. (a) Discuss the role of electrochemistry in micro fabrications write the merits and demerits. [7M]
(b) Explain the diffusion process and discuss how electric resistivity of silicon versus doses of dopant, develop a relationship between them. [7M]
4. (a) Determine the optimum temperatures of silicon substrates for which doping of arsenic, phosphorous and boron are to be carried out by diffusion process. [7M]
(b) Phosphorus is to be doped into silicon wafer substrate by a diffusion process. The substrate is heated at 1000°C for 30 minutes in the presence of the dopant with the depth $x = 0.075\mu\text{m}$ beneath the substrate surface. [7M]

UNIT-III

5. (a) Discuss the static bending theory applied to Microsystems. [7M]
(b) Give a detailed note on the application of finite element stores analysis in Microsystems design. [7M]
6. (a) Discuss the phenomenon of incompressible fluid flow in micro conducts. [7M]

- (b) Estimate the flow rate of a nitrogen gas in a section of minute tube 30 nm in diameter x 50 nm long. A pressure difference of 0.5 Pa is applied to drive the flow. The flow is conducted at room temperature, 20°C. [7M]

UNIT-IV

7. (a) Summarize the steps involved in Design of a silicon die for pressure design for microsystem design with a neat sketch.. [7M]
- (b) Estimate the pressure drop in a minute stream of alcohol through a section of a tapered tube 10 cm length. The inlet velocity is 600μ m/s. The mass density of alcohol is 789.6 kg/m^3 . The tube is inclined 30° from horizontal plane. Using Hagen-Poiseuille equation. [7M]
8. (a) Explain ion implantation in detail with a neat sketch. List out merits. [7M]
- (b) Estimate the ratio of airflow in the section of small tube $10\mu\text{m}$ in diameter and 1cm in length. Assume that a pressure difference of 5 Pa is maintained between the inlet and outlet of the tube section. The airflow takes places at room temperature. [7M]

UNIT-V

9. (a) Explain the key process involved in photolithography with necessary sketches. [7M]
- (b) What are the different material used in MEMS fabrication process and explain each one with their properties and application. [7M]
10. (a) Explain the working of surface micro machining with neat sketches and compare with bulk micro machining. [7M]
- (b) Explain the various steps involved in the fabrication of a cantilever structure by surface machining. [7M]