Code No: R193204H **R19** **SET - 1**

III B. Tech II Semester Regular Examinations, June-2022

MEMS AND ITS APPLICATIONS

(Electronics and Communication Engineering)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions **ONE** Question from **Each unit**
All Questions Carry Equal Marks
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UNIT-I

1. a) Explain the basic building blocks of MEMS with neat diagrams. [8M]
   b) Describe the role of quantum physics in the design of MEMS and Microsystems. [7M]

(OR)

2. a) Give one application of MEMS in automobiles. Illustrate its working with neat sketches. [8M]
   b) Write a technical note on application of MEMS and Microsystems in [7M]
      (i) Biomedical Industry and
      (ii) Aerospace industry.

UNIT-II

3. a) Explain the principle of operation of MEMS pressure sensors with neat diagrams. [8M]
   b) Demonstrate the working of thermocouple with neat diagram. [7M]

(OR)

4. a) List some of the piezoelectric materials and piezoresistive materials. Differentiate between them based on their property. [8M]
   b) With block diagram explain the functionality of [7M]
      (i) Micro gripper
      (ii) Micro motors

UNIT-III

5. 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? [8M]
   b) Why electrostatic actuation is preferred over electromagnetic actuation in micro motors? [7M]

(OR)

6. a) With reference to scaling of electrostatic forces explain why electrostatic actuation is preferred over electromagnetic actuation in micro motors. [8M]
   b) Compare the properties of Silicon, SiO2 and SiC. [7M]

UNIT-IV

7. a) Explain in detail about Micro systems fabrication process. [8M]
   b) Demonstrate about physical vapour deposition. [7M]

(OR)

8. a) Explain with figures the steps in surface micromachining. Discuss the various fabrication challenges associated with surface micromachining. [8M]
   b) With neat diagrams explain the different etching processes in detail. [7M]

UNIT-V

9. a) Demonstrate the working principle of RF MEMS in [8M]
      (i) RF communication and
      (ii) Global positioning systems.
   b) Explain with near diagrams any two applications of RF MEMS. [7M]

(OR)

10. a) Illustrate about PIN diode RF switches with neat circuit diagram. [8M]
    b) Explain the various contact mechanisms for RF switches. [7M]

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Code No: R193204H **R19** **SET - 2**

III B. Tech II Semester Regular Examinations, June-2022

MEMS AND ITS APPLICATIONS

(Electronics and Communication Engineering)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions **ONE** Question from **Each unit**
All Questions Carry Equal Marks
*****

UNIT-I

1. a) List the types of micro sensors available in the market. With a neat sketch explain the working principal of any two types of sensors. [8M]
   b) Explain MEMS history and development and its application in an health care industry. [7M]

(OR)

2. a) Describe the concept miniaturization of MEMS. Distinguish between micro sensors and micro actuators. [8M]
   b) Explain why atomic structure of matter is considered as a decisive factor in micro system. [7M]

UNIT-II

3. a) Explain in detail about MEMS chemical sensors. [8M]
   b) Discuss on electrostatic actuation model with neat diagram. [7M]

(OR)

4. a) Illustrate the mathematical description of piezoelectric effect with relevant diagrams. [8M]
   b) State the constraints in pumping fluids in micro channels. What pumping scheme is usually used in micro fluidics? Give one example. [7M]

UNIT-III

5. a) With reference to scaling of electromagnetic forces, derive the expressions for electromagnetic potential energy and force. [8M]
   b) Explain in detail about scaling in electricity. [7M]

(OR)

6. a) Suggest at least one of the properties and applications of the following MEMS Materials. Silicon, Silicon nitride, Poly silicon, Quartz, Nickel, P Type silicon, gold, conductive polymers. [8M]
   b) What is meant by packaging? What are the special requirements for packaging materials? Which material is used for packaging? [7M]

UNIT-IV

7. a) Explain in detail about chemical vapour deposition techniques. [8M]
   b) Discuss the criteria for selecting materials for the masks used in etching. [7M]

(OR)

8. a) Explain with neat sketches, various process steps in bulk micromachining process to fabricate a pressure sensor. [8M]
   b) Describe steps of fabrication of a square tube using LIGA process. [7M]

UNIT-V

9. a) What are the advantages of using RF MEMS as compared to traditional units and systems? [8M]
   b) What is a phase shifter? Explain the principle of operation of a switched-line phase shifter. [7M]

(OR)

10. a) Explain the RF design consideration to be taken into account while designing RF switch. [8M]
    b) List out the integrating and biasing issues for RF switches. [7M]

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Code No: R193204H | R19 | SET - 3

III B. Tech II Semester Regular Examinations, June-2022

MEMS AND ITS APPLICATIONS

(Electronics and Communication Engineering)

Time: 3 hours | Max. Marks: 75

Answer any **FIVE** Questions **ONE** Question from **Each unit**
All Questions Carry Equal Marks
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UNIT-I

1. a) What are main components of Microsystems? Explain each component briefly. [8M]
   b) Describe the evolution of Micro fabrication. [7M]

(OR)

2. a) Summarize the applications of Microsystems in different industries. [8M]
   b) What are MEMS and Microsystems? How will you classify them from the conventional systems? [7M]

UNIT-II

3. a) Explain in detail about MEMS biosensors. [8M]
   b) Describe the operating principle of two types of micro motors with suitable schematics. [7M]

(OR)

4. a) With suitable diagrams explain the working principle of Micro valves and micro pumps also discuss their various applications with regard to actuation. [8M]
   b) Explain the principle of operation of micro-accelerometer with a neat schematic diagram. [7M]

UNIT-III

5. a) With suitable diagram explain the principles of piezoelectric micro cantilever beam. Describe in detail about pressure sensors. [8M]
   b) List the properties and applications of piezoelectric materials. [7M]

(OR)

6. a) Explain scaling in heat conduction and heat convection. [8M]
   b) State three relevant properties of silicon carbide and silicon nitride for use in Microsystems. [7M]

UNIT-IV

7. a) Demonstrate the steps involved in photolithography. State the chemicals used in each of the stages along with the operating conditions. [8M]

b) State various chemical vapor deposition techniques. Explain in brief the techniques of chemical vapor deposition for MEMS device fabrication. [7M]

(OR)

8. a) Describe the role of sacrificial layers in surface micromachining with figures. Give examples of two sacrificial materials used in micro system fabrication. [8M]

b) Explain in detail about epitaxial deposition. [7M]

UNIT-V

9. a) Illustrate about various actuation methods used in RF switching. [8M]

b) Explain the working of RF based communication system. [7M]

(OR)

10. a) Demonstrate the reconfigurable antenna using RF MEMS switch? [8M]

b) Explain the fabrication of MEMS capacitive switch. [7M]

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Code No: R193204H **R19** **SET - 4**

III B. Tech II Semester Regular Examinations, June-2022

MEMS AND ITS APPLICATIONS

(Electronics and Communication Engineering)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions **ONE** Question from **Each unit**
All Questions Carry Equal Marks
*****

UNIT-I

1. a) What is MEMS? What are the types of MEMS transducers? Give advantages and disadvantages of MEMS. [8M]
   b) Distinguish between Microelectronics and Microsystems. [7M]

(OR)

2. a) Illustrate about Intelligent Microsystems with neat diagram. [8M]
   b) Demonstrate the multi-disciplinary nature of Microsystems engineering. [7M]

UNIT-II

3. a) Describe the principle of operation of acoustic sensors and actuators with neat diagrams. [8M]
   b) Explain with neat diagram actuation using shape memory alloys. [7M]

(OR)

4. a) Explain the concept of cantilever piezoelectric actuator model with neat diagram. [8M]
   b) Outline the working principle of micro-values and micro fluids. [7M]

UNIT-III

5. a) With reference to scaling of electrostatic forces explain why electrostatic actuation is preferred over electromagnetic actuation in micro motors. [8M]
   b) Describe about scaling in Electromagnetic forces. [7M]

(OR)

6. a) Demonstrate the oxide growth process in silicon with relevant figures. [8M]
   b) Explain scaling in fluid mechanics. What are the advantages of piezoelectric pumping? [7M]

UNIT-IV

7. a) With a neat diagram explain in detail about ion implantation and diffusion. [8M]
   b) Explain in detail about the process of oxidation. [7M]

(OR)

8. 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. [8M]
   b) Demonstrate the thin film deposition techniques. [7M]

UNIT-V

9. a) Describe about RF MEMS and MEMS inductors. [8M]
   b) Explain the potential applications of RF MEMS in wireless communication? [7M]

(OR)

10. a) Draw and explain the equivalent circuit of RF MEMS switch? [8M]
    b) Discuss electromagnetic modeling of RF shunt switch? [7M]

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