

B.Tech III Year I Semester (R15) Regular & Supplementary Examinations March 2021

MEMS & MICROSYSTEMS

(Electronics & Communication Engineering)

Time: 3 hours

Max. Marks: 70

PART – A

(Compulsory Question)

- 1 Answer the following: (10 X 02 = 20 Marks)
- What is micro system? Give some example.
 - Write various types of MEMS materials.
 - Define which MEMS sensor is deployed in the air bags of car to sense the crash.
 - What types of magnetic materials are used in MEMS? Defend their use.
 - Differentiate bulk and surface micromachining.
 - List the properties of magnetic materials for MEMS.
 - What are the features of MEMS capacitive accelerometers?
 - What is a MEMS gyro SENSOR?
 - What are macro and micro fluids?
 - What are the types of Chemical and Bio-medical micro systems?

PART – B

(Answer all five units, 5 X 10 = 50 Marks)

UNIT – I

- Explain the difference between MEMS and Microsystems.
- What are the advantages of MEMS and microfabrication? How miniaturizations help in engineering industry?

OR

- Explain the multidisciplinary nature of microsystem.
- Why silicon is used as a substrate material in MEMS? Discuss various other substrate materials that are in use.

UNIT – II

- Describe Microelectronic technology for MEMS.
- Discuss the criteria for selecting materials for the masks used in etching.

OR

- What is meant by surface micromachining? How this method is used for MEMS fabrication?
- Discuss about photolithography for MEMS manufacture.

UNIT – III

- Explain the working principles of various types of thermal flow sensors.
- Discuss the working principle and purpose of MEMS Gyro Sensor.

OR

- Discuss on the working principle of an ink-jet printer based on electro thermal principle.
- Explain the working principle of MEMS Inertial Sensor and list its applications.

UNIT – IV

- Discuss the fabrication steps involved in MEMS capacitive accelerometer.
- Explain how piezoresistor is used to measure pressure?

OR

- Explain the construction and working of micromachined micro accelerometers for MEMS.
- Explain the operating principles of MEMS piezoelectric accelerometer.

UNIT – V

- Explain the principle of working of Carbon Nano Tubes (CNT).
- Write on the sensing mechanisms and principles of Bio-medical micro systems.

OR

- Discuss about Polymer MEMS and what are its uses?
- What is meant by Microfluidics? How the flow in Microchannels take place?

B.Tech III Year I Semester (R15) Supplementary Examinations August 2021

MEMS & MICROSYSTEMS

(Electronics & Communication Engineering)

Time: 3 hours

Max. Marks: 70

PART – A

(Compulsory Question)

- 1 Answer the following: (10 X 02 = 20 Marks)
- Mention different intrinsic characteristics of MEMS.
 - Write any two properties of MEMS materials.
 - List the role of sensors and actuators in the context of MEMS.
 - What are hard magnetic materials?
 - List out any four advantages and disadvantages of thermal actuator.
 - Write the considerations on micro scale fluid.
 - What is piezoelectricity?
 - What is a typical micro fluidic channel?
 - List the features of polymers used in the MEMS.
 - Explain about an E-nose sensor?

PART – B

(Answer all five units, 5 X 10 = 50 Marks)

UNIT – I

- Explain the significance of micro electro mechanical system.
 - Discuss the challenges faced by the MEMS industry.
- OR**
- Briefly explain about micro sensors.
 - What are the different materials used in MEMS fabrication processes and explain each one of their properties and applications?

UNIT – II

- Explain the new materials that replace the silicon material in micromachining.
 - Explain various steps involved in micro stereolithography.
- OR**
- Discuss the criteria for selecting materials for the masks used in etching.
 - Differentiate bulk and surface micromachining and mention their uses.

UNIT – III

- Discuss on the working principle of an ink-jet printer based on electro thermal principle.
 - Explain MEMS gyroscope. What are their applications?
- OR**
- Explain thermally activated MEMS relay.
 - Write the principle and operation of micro machined flow sensor and its applications.

UNIT – IV

- Explain about MEMS accelerometers for avionics.
 - Write about the working of a Gripping Piezo actuator.
- OR**
- Explain the process of temperature drift and damping analysis.
 - List out different piezoelectric crystals and explain their applications in MEMS.

UNIT – V

- Discuss different wafer bonding techniques.
 - Explain the principle of working of chemical and bio-medical micro systems.
- OR**
- Explain the levels of micro system packaging.
 - What is meant by BioMEMS? Discuss the challenges involved in BioMEMS.

B.Tech III Year I Semester (R15) Supplementary Examinations October 2020

MEMS & MICROSYSTEMS

(Electronics & Communication Engineering)

Time: 3 hours

Max. Marks: 70

PART – A

(Compulsory Question)

- 1 Answer the following: (10 X 02 = 20 Marks)
- (a) Define microsensors.
 - (b) What are the applications of MEMS?
 - (c) What is MEMS technology?
 - (d) List the properties of silicon nitride.
 - (e) What is a MEMS gyro sensor?
 - (f) What is meant by differential temperature technique?
 - (g) Define temperature drift.
 - (h) How does a piezoresistive accelerometer work?
 - (i) How is nanotechnology different from biotechnology?
 - (j) Write the fluid actuation methods in micro fluidic systems.

PART – B

(Answer all five units, 5 X 10 = 50 Marks)

UNIT – I

- 2 What do you understand by MEMS? Sketch the functional relationship between various components in a micro sensor.

OR

- 3 Explain about the MEMS fabrication processes and explain each one of their properties.

UNIT – II

- 4 Discuss the microelectronics technology for MEMS.

OR

- 5 Write about the surface and quartz micromachining.

UNIT – III

- 6 Describe the working principle of MEMS pressure sensors.

OR

- 7 Explain in detail the working principle of Gyro sensors.

UNIT – IV

- 8 Describe the working principle of MEMS micro accelerometers.

OR

- 9 What is piezoelectricity? Explain the operating principles of MEMS piezoelectric accelerometer.

UNIT – V

- 10 What are the applications of polymers in MEMS and explain methods to make polymers electrical conductive.

OR

- 11 Write short notes on: (i) Bio-Sensors. (ii) Fluidics.

B.Tech III Year I Semester (R15) Supplementary Examinations June/July 2019

MEMS & MICROSYSTEMS

(Electronics & Communication Engineering)

Time: 3 hours

Max. Marks: 70

PART – A

(Compulsory Question)

- 1 Answer the following: (10 X 02 = 20 Marks)
- List any four applications of MEMS.
 - Name the two types of wet etching.
 - List one piezoelectric material found in nature.
 - Is transducer and sensor same. Justify your answer.
 - How many junctions does thermopile have?
 - Name a semiconducting material used in metal oxide semiconductor.
 - Define actuator.
 - Name the mass used in micro accelerometer.
 - Abbreviate CNT.
 - What kinds of samples are used in biomedical sensors?

PART – B

(Answer all five units, 5 X 10 = 50 Marks)

UNIT – I

- 2 Compare MEMS and Microsystems.

OR

- 3 List out the significance of silicon nitride and poly silicon in MEMS devices.

UNIT – II

- 4 With a neat sketch, explain in steps to be followed for the two sacrificial layer processes and the issues involved in surface micromachining.

OR

- 5 Discuss the advantages and the principle of working in microstereolithography with neat diagrams.

UNIT – III

- 6 (a) Calculate the capacitance value for a two fixed parallel planar plates separated by a distance of $100\mu\text{m}$ and the area between the plates as $400\mu\text{m} \times 400\mu\text{m}$. The media between the two plates is air.
- (b) With neat diagram, explain the working of MEMS Gyro sensor.

OR

- 7 Discuss the three principal signal transduction methods for micro pressure sensors. Provide at least one major advantage and one disadvantage of each of these methods.

UNIT – IV

- 8 Derive the expressions for the equivalent spring constants for the beam springs: (i) At fixed ends. (ii) At simple supported ends.

OR

- 9 Discuss the principle of micro accelerometers for a: (i) Spring mass system. (ii) Beam attached mass system with neat diagrams.

UNIT – V

- 10 How will you detect tuberculosis in a patient using electronic nose? Explain.

OR

- 11 Discuss the three levels of microsystem packaging with neat block diagram.

Code: 15A04506

B.Tech III Year I Semester (R15) Regular & Supplementary Examinations November/December 2019

MEMS & MICROSYSTEMS

(Electronics & Communication Engineering)

Time: 3 hours

Max. Marks: 70

PART – A
(Compulsory Question)

- 1 Answer the following: (10 X 02 = 20 Marks)
- Mention the range of size for MEMS devices.
 - List two advantages of microsensors.
 - Mention the use of sacrificial layer.
 - Mention two differences between bulk and surface micromachining.
 - Give any two advantages of thermal sensing.
 - Give the principle on which MEMS gyro sensors works?
 - Give the equations pertaining to MEMS accelerometers.
 - List the use of MEMS in space applications.
 - Bring out the advantages of using polymers for biomedical applications.
 - List the advantages of using microfluidics.

PART – B

(Answer all five units, 5 X 10 = 50 Marks)

UNIT – I

- 2 (a) Bring out the advantages of miniaturization.
(b) Discuss any two materials suitable for usage for MEMS.
(c) Write a note on the market survey for MEMS.

OR

- 3 (a) List out the characteristics of Silicon that makes it suitable for MEMS devices.
(b) Write a note on Gallium Arsenide and other Group-III material properties and their applications.
(c) Define piezoresitivity and piezoelectricity.

UNIT – II

- 4 (a) With neat sketches, bring out the methodology for surface micromachining to fabricate a microcantilever.
(b) Discuss any two etch stop techniques.

OR

- 5 (a) Elaborate the fabrication of a micro cantilever using bulk micromachining process with neat sketches.
(b) Bring out the features of: (i) Micromachined microstructure. (ii) Micro stereolithography.

UNIT – III

- 6 (a) Discuss the method of pressure sensing using MEMS pressure sensors.
(b) Describe the special features required by MEMS flow sensors. Also name a few applications using this sensor.

OR

- 7 (a) Describe in detail the operation and applications of MEMS gyro.
(b) List out the advantages and disadvantages of thermal sensors. Briefly describe the sensing and actuation methodologies using thermal sensors.

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UNIT - IV

- 8 (a) Using appropriate sketches, discuss the operation of a MEMS accelerometer.
(b) Using neat sketches, describe the process used for fabricating a MEMS accelerometer.
- OR**
- 9 (a) Elaborate on the various capacitive sensing methods used for acceleration sensing in a MEMS accelerometer.
(b) With neat sketches, bring out the Piezoresistive accelerometer technology.

UNIT - V

- 10 (a) Discuss any two wafer bonding techniques for MEMS.
(b) Discuss the various specialized techniques for MEMS packaging.
- OR**
- 11 (a) Discuss the various carbon nanotechnology structures and their special features. Also mention the applications of CNTs.
(b) Discuss the MEMS technology available for biomedical Applications.
