

CBCS SCHEME

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18EE732

Seventh Semester B.E. Degree Examination, June/July 2023 Micro and Nano Scale Sensors and Transducers

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. Explain the mechanical structure of capacitive pressure sensor. (07 Marks)
- b. Derive the equation for inductance as a function of position of iron core for an inductive pressure sensor. (07 Marks)
- c. Discuss the experimental results for
i) Sensitivity ii) Temperature hysteresis of an inductive pressure sensor. (06 Marks)

OR

- 2 a. Explain the structural details of ultra high sensitive pressure sensor. (07 Marks)
- b. Derive the equation for pressure as a function of capacitance for a capacitive pressure sensor. (07 Marks)
- c. Discuss the sensor interface circuit used to measure the inductance. (06 Marks)

Module-2

- 3 a. Explain with neat figure the principle of operation of the new acceleration sensor. (07 Marks)
- b. With the help of experimental results, explain :
i) Acceleration as a function of capacitance
ii) Acceleration as a function of capacitance without correction for the value of 'K' for an acceleration sensor. (06 Marks)
- c. Derive the expression for conversion percentage of the reaction as a function of time for CO Gas sensor based on nanotechnology. (07 Marks)

OR

- 4 a. With the help of neat figure explain the principle of operation of the traditional α - particle smoke detector. (07 Marks)
- b. Explain the fundamental principle of operation of CO gas sensor based on nanotechnology. (07 Marks)
- c. Explain the results of following experiments on the CO gas sensor based on nanotechnology.
i) Resistance of the CNT array as a function of CO concentration
ii) Conversion percentage as a function of time and temperature. (06 Marks)

Module-3

- 5 a. Explain the structure detail of a new moisture sensor. (07 Marks)
- b. Discuss the principle of operation of the advanced optical microphone. (06 Marks)
- c. Explain the results of following experiments on the new moisture sensor.
i) Conductivity of porous silicon slab as a function of relative humidity at different temperature
ii) Change in conductivity and capacitance in response to a unit step rise in relative humidity from 5% to 10%. (07 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

OR

- 6 a. Describe the mechanical structure of the integrated microphone assembly. (07 Marks)
 b. Derive the mathematical relation between capacitance of the ultra capacitor and the conductivity at the electrolyte for the new moisture sensor. (07 Marks)
 c. Discuss the results of following experiments on a new optoelectronic microphone.
 i) Determination of resonant frequency
 ii) Probability of error as a function of image size. (06 Marks)

Module-4

- 7 a. Discuss the general structure of "Lab on chip" sensors with neat figure. (07 Marks)
 b. Explain the fundamental principle of operation of the magnetic field sensor. (07 Marks)
 c. With the help of neat diagram, explain the experimental setup for testing the magnetic sensor. (06 Marks)

OR

- 8 a. Explain the working of the thermocouple based self heating RF power sensor. (07 Marks)
 b. Discuss the response of magnetic sensor to DC magnetic fields. (07 Marks)
 c. Explain the working of CMOS on chip sensor for measuring the dielectric constant of organic chemical. (06 Marks)

Module-5

- 9 a. Explain the following for the α -particle icing detector
 i) Principle of operation
 ii) Circuit used in the present prototype (10 Marks)
 b. Discuss the results of following tests with graph
 i) Testing with ice crystals
 ii) Testing with dust particles on an aircraft icing detectors (10 Marks)

OR

- 10 a. Determine the conditions that are necessary for turning ON a MOSFET transistor by means of a flow of positively charged particles. (10 Marks)
 b. With the help of neat figure, explain the concept of a magnetic microrobot actuation in a micro-fluidic chip. (10 Marks)
