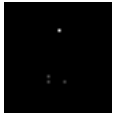


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**CS/M.Tech (EIE)/SEM-2/EIEM-201(D-7)/09****SENSORS-SCIENCE AND TECHNOLOGY****SEMESTER - 2**

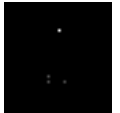
Time : 3 Hours]


[Full Marks : 70

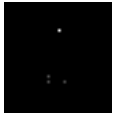
*The figures in the margin indicate full marks.**Candidates are required to give their answers in their own words as far as practicable.*Answer any *five* of the following.

5 ∞ 14 = 70

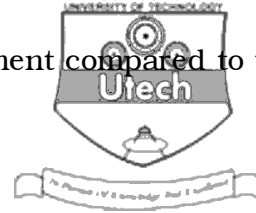
1. a) What is Minimum Detectable Signal (MDS) in a sensor ? Discuss what you know about selectivity and specificity in a sensor. What is selectivity matrix ? 6
b) How do you define reliability function in case of a sensor ? If M units of produced sensors are checked N times to obtain average of failure at 1.5% at an instant t , what would be the value of the reliability function ? 8
2. a) How do you obtain a single crystal ingot of Si for making wafers ? What is the starting material ? Draw the flow-chart to demonstrate the process of obtaining the wafer. 7
b) Why do we need oxidation of Si-wafer and how is it done ? Briefly explain with thickness-time relation diagram. How time and temperature can be reduced in such a process to attain the level of oxidation ? 7
3. a) What is photoresist ? What is its function in pattern transfer ? Describe with sketches and flow-charts, the pattern transfer process. 8
b) Distinguish between isotropic and anisotropic etchings. 6



4. a) Compare the operational principles and performance characteristics between the barrel etcher and plasma etcher. Append sketches.  9
- b) What is selectivity in an etching process ? How is it enhanced ? Discuss with a typical example and reaction equations. 5
5. a) Discuss the terms pre-dep and drive-in in connection with impurity diffusion in semiconducting wafers. How are solid solubility of impurities related to temperature ? Explain with curves. What is deglazing ? 7
- b) How does doping using ion-implantation process differ from diffusion process ? Give sketches to support your answer. What is ion-channeling ? 7
6. a) Name the different metallization techniques. Sketch a technique where a pressure between 10^{-2} and 10^{-5} Pa of selective vapours is maintained in the chamber. Describe its operation briefly. What are its limitations ? 7
- b) What are the different wire-bonding techniques ? Compare the techniques from implementation point of view. What is 'purple-plague' ? How can it be avoided ? 7
7. a) Describe with flow-chart the production process of thick-film CO-detector. If hydrogen is to be detected what change would you make in the process ? 7
- b) What is a cermet ? Discuss its operation when :
- i) Ag is embedded in it
- ii) Ru-based complex oxide is embedded in it. What is 'percolation threshold' ? Can you find it in all types of cermets ? 7



8. a) What are three steps in a thin film production process ? Describe with sketch a PECVO process. What is its temperature requirement compared to the LPCVD ?



8

- b) How do you characterize a thin film sensor ? What precautions should you take during characterization of a sensor ?

6

9. Write short notes on any *two* of the following :

2 × 7

- a) Smart Sensors
- b) Masking and pattern generation
- c) Sensor modeling
- d) Ceramic sensors.

END