ADVANCED SENSORS
(AEIE 3242)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) Metal oxide gas sensors fall in category of
(a) bio-sensors (b) chemical sensors
(c) bio-medical sensors (d) none of the above.

(ii) A single crystal of silicon consists of
(a) 15 atoms (b) 18 atoms
(c) 16 atoms (d) 14 atoms.

(iii) Micro capacitive transducers are mostly used for
(a) static measurement (b) dynamic measurement
(c) transient measurement (d) both static and dynamic.

(iv) The toughest plane for processing in a single silicon crystal is
(a) the (100) plane (b) the (110) plane
(c) the (111) plane (d) the (101) plane.

(v) Which of the following is not a part of a smart sensor?
(a) Transducer (b) Network interface
(c) Processor (d) None of the mentioned.

(vi) Micro pressure sensors work on the principle of
(a) deflecting a thin diaphragm (b) heating a thin diaphragm
(c) magnetizing a thin diaphragm (d) none of the above.

(vii) Ion implantation is a process of
(a) introduction of foreign materials in a substrate
(b) deposition of foreign materials in a substrate
(c) both (a) and (b)
(d) none of the above.

(viii) Signal conditioning is carried out in
(a) transducer housing (b) processor
(c) network interface (d) none of the mentioned.

(ix) Micro piezoelectric transducers work on the principle of
(a) electric heating
(b) mechanical-electrical conversion
(c) electrical-mechanical conversion
(d) both (c) & (b).

(x) Sensing element in IR thermal detector can be _____
(a) thermocouple (b) thermopile
(c) bolometer (d) all of the mentioned.

Group – B

2. (a) What are the three principal carbon compounds used in micro sensor design? Explain any one of these compounds in terms of usage.

(b) Describe using a functional block diagram the various parts of an intelligent micro system.

(4 + 2) + 6 = 12

3. (a) Describe with a neat diagram the Czochralski process of manufacturing single crystal silicon. State the key chemical reaction involved.

(b) State how silicon piezoelectric crystal in micro actuators works? Describe the relationship between induced strain and applied voltage.

(4 + 2) + (4 + 2) = 12

Group – C

4. (a) What are the basic components a of a Chemical Vapour Deposition apparatus? What advantage does PECVD have over APCVD and LPCVD?

(b) Describe the APCVD process with a neat diagram. List down three advantages and disadvantages of this process.

(4 + 2) + (3 + 3) = 12

5. (a) What do you understand by lithography? What is the use of mask in photolithography? Name two different types of photoresists used in photolithography.

(b) Define aspect ratio of an etched profile. State what do you mean by perfectly anisotropic etching? Give an example in support of your answer where anisotropic etching is used.

(3 + 2 + 1) + (3 + 2 + 1) = 12

Group – D

6. (a) State the main objectives of microsystem packaging. Why is die level packaging done?

(b) What do you understand by interface in microsystem packaging? List down the considerations needed to be taken while designing interfaces for micro biosystem sensors.

(3 + 3) + (2 + 4) = 12

7. (a) What do you understand by anodic bonding? Show with a block diagram how glass to silicon bonding is done using anodic bonding.

(b) What are the four techniques available for surface bonding in microsystem? What are the principal differences in packaging techniques between microelectronics and microsystems?

(4 + 2) + (4 + 2) = 12

Group – E

8. (a) What do you understand by wireless sensor network? List a few applications of wireless sensor networks for environmental purposes.

(b) Explain with a functional block diagram the various parts of a sensor node in wireless sensor network.

(2 + 4) + 6 = 12

9. (a) How are smart sensors different from conventional sensors? What advantages does a smart sensor provide over a conventional sensor?

(b) Write short notes on any two:
(i) Smart sensor networks,
(ii) Surface micromachining and
(iii) Difference CMOS microelectronic system form MEMS based microsystem.

(3 + 3) + (3 × 2) = 12