



ELIZADE UNIVERSITY, ILARA-MOKIN,
ONDO STATE, NIGERIA

DEPARTMENT OF AUTOMOTIVE ENGINEERING

FIRST SEMESTER EXAMINATIONS

2019/2020 ACADEMIC SESSION

COURSE: ATE 305 – Micro-Electro-Mechanical-Systems (3 Units)

CLASS: 300 Level Automotive Engineering

TIME ALLOWED: 2 ½ Hours

INSTRUCTIONS: Answer any FIVE questions

Date: February, 2020

HOD'S SIGNATURE

Question 1 (General)

- a. Briefly explain the MCNC MUMPs and MOSIS [3 Marks]
- b. With sketches, differentiate between NPN and PNP transistors [3 Marks]
- c. List any two wafer manufacturing methods [2 Marks]
- d. List the steps required in LIGA micromachining [3 Marks]
- e. What is the function of Micro-positioners? [1 Mark]

Question 2 (IC CAD tools to design MEMS structures using MCNC MUMPs service)

- a. What are MEMS CAD Tools? [2 Marks]
- b. List any four advantages of MUMPs and MOSIS [4 Marks]
- c. Sketch and explain the MEMS design flow chart [4 Marks]
- d. What is the full meaning of the following acronyms: (i) VLSI (ii) ULSI? [2 Marks]

Question 3 (Basic IC and Wafer Production Techniques)

- a. List the basic steps required in the production of Integrated Circuit (IC) [2 ½ Marks]
- b. Sketch, list and briefly explain Czochralski Method in relation to fig. Q3(b) [4 ½ Marks]

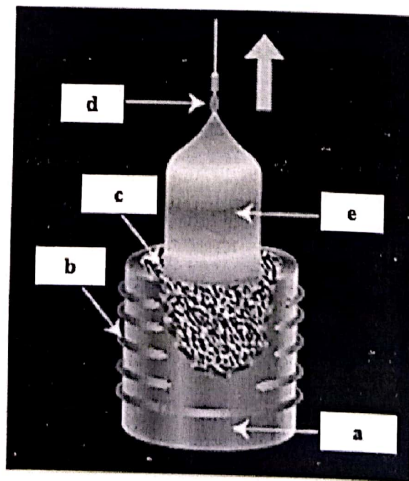


Fig: Q3(b)

- c. What is the essence of initial and final wafer tests in IC fabrication? [2 Marks]
- d. What is the full meaning of the following acronyms? [3 Marks]
(i) DRIE (ii) RIE (iii) LIGA

Question 4 (Micro-actuators and Micro-sensors)

- a. Differentiate between **Micro-actuators** and **Microsensors**? [3 Marks]
[1 ½ Marks]
- b. Why are MEMS used for Sensors? [1 ½ Marks]
- c. Give any three examples of non-electrical physical or chemical quantity that are being converted into electrical signal by microsensors. [1 ½ Marks]
- d. Briefly explain the following: [6 Marks]
(i) Micro-motor (ii) Micro-gripper (iii) Micro accelerometer

Question 5 (Basic IC Manufacturing Processes)

- a. What is **Photolithography**? [2 Marks]
- b. Sketch, label and briefly explain photolithography process in relation to **fig. Q3(b)** [5 Marks]

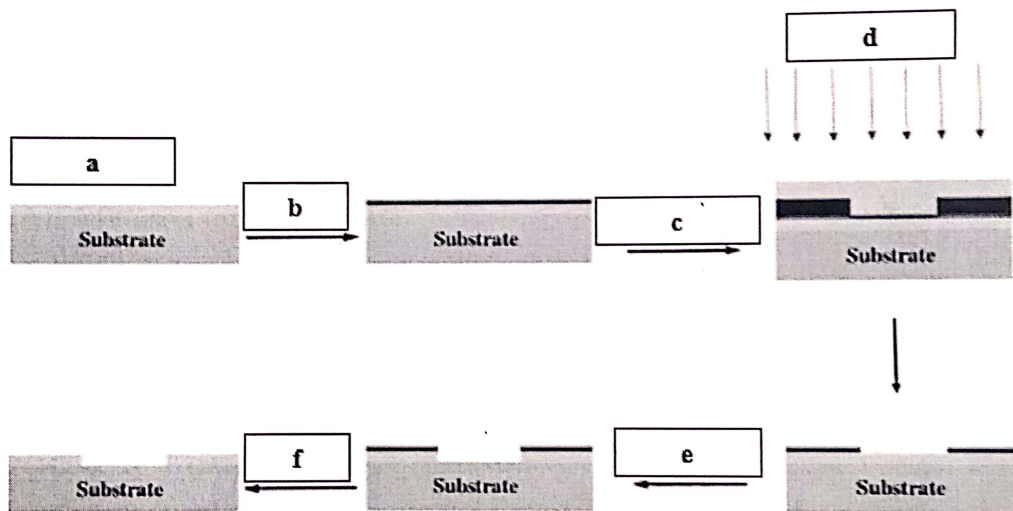


Fig. Q3(b)

- c. What is the function of HMDS in photolithography? [2 Marks]
- d. What is the full meaning of the following acronyms in relation to Micro-Electro-Mechanical-System: (i) PMMA (ii) HMDS (iii) MST? [3 Marks]

Question 6 (Micro-electromechanical systems fabrications)

- a. (i) What are **MEMS**? (ii) List any three Automotive applications of MEMS? [3 Marks]
- b. List the three MEMS fabrication methods, explain briefly any one. [4 Marks]
- c. In relation to MEMS fabrication, differentiate between the following: (i) Dry and Wet Etching (ii) Isotropic and Anisotropic Etchants [5 Marks]

Question 7 (Electronics Devices Fundamentals)

- a. Define the following terms: (i) Integrated circuit (ii) Semiconductor (iii) Emitter (iv) Collector. [4 Marks]
- b. Differentiate between active and passive components [3 Marks]
- c. What is the difference between 'VLSI' and 'ULSI'? [3 Marks]

d. Determine the value of the resistor in the 4-colour band resistor shown in fig. Q7 (b).

The diagram shows a resistor with four color bands. From left to right, the bands are: Gold, Red, Violet, and Yellow. Lines connect these bands to the legend table below.

	1st Digit	2nd Digit	Multiplier	Tolerance
Black	0	0	x 1	Silver ±10%
Brown	1	1	x 10	Gold ±5%
Red	2	2	x 100	
Orange	3	3	x 1000	
Yellow	4	4	x 10000	
Green	5	5	x 100000	
Blue	6	6	x 1000000	
Violet	7	7		
Grey	8	8		
White	9	9		

fig. Q7 (b) [2 Marks]