



ELIZADE UNIVERSITY, ILARA-MOKIN,
ONDO STATE, NIGERIA

DEPARTMENT OF AUTOMOTIVE ENGINEERING

FIRST SEMESTER EXAMINATIONS

2020/2021 ACADEMIC SESSION

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

CLASS: 300 Level Automotive Engineering

TIME ALLOWED: 2 Hours

INSTRUCTIONS: Attempt Question 7 and any other FOUR (4).

Date: March, 2021

HOD'S SIGNATURE

Question 1 (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. With sketches differentiate between 'PNP' and 'NPN'? [3 Marks]
- d. Determine the value of the resistor in the 6-colour band resistor shown in fig. Q7 (b). Then what does column a, b, c, d, e, and f represent?

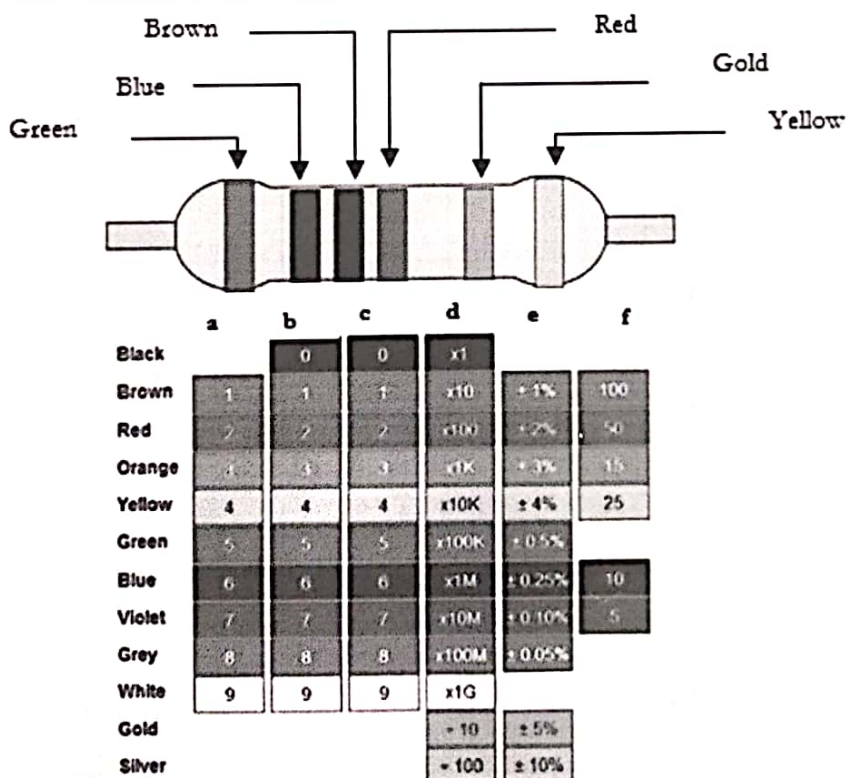


fig. Q7 (b) [2

Marks]

Question 2 (Basic IC and Wafer Production Techniques)

- a. Write short notes on the following (i) Raw wafer (ii) Epitaxial wafer (iii) Silicon on Insulator (SOI) wafer [4 Marks]
- b. Sketch, list and briefly explain Czocharlski Method in relation to fig. Q2(b) [4 Marks]

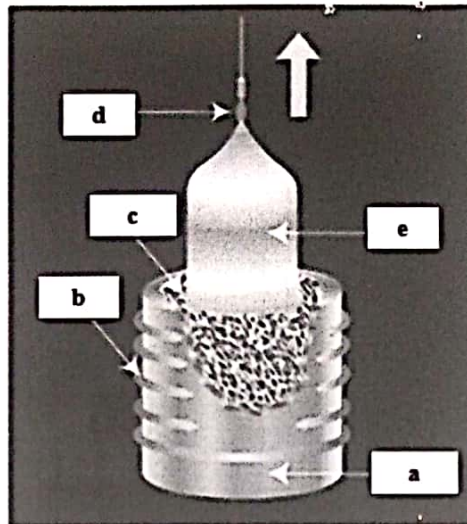


Fig. Q2(b)

- c. What is the essence of initial and final wafer tests in IC fabrication? [2 Marks]
 Give any two (2) reasons why silicon is one of the most commonly used semiconductors in ICs fabrication? [2 Marks]

Question 3 (Basic IC Manufacturing Processes)

- a. What is the difference between 'Photolithography' and 'X-ray lithography'? [2 Marks]
 b. Sketch, label and briefly explain photolithography process in relation to integrated circuit (IC) fabrication [6 Marks]
 c. What is the function of HMDS in photolithography? [2 Marks]
 d. Differentiate between positive and negative photoresist [2 Marks]

Question 4 (Micro-electromechanical systems fabrications)

- a. What are MEMS? [1 ½ Marks]
 b. List any three Automotive applications of MEMS? [1 ½ Marks]
 c. List the three MEMS fabrication methods, explain briefly LIGA Micromachining in relation the production of micro-spur gear. [5 Marks]
 d. In relation to MEMS fabrication, differentiate between the following: (i) Dry and Wet Etching (ii) Isotropic and Anisotropic Etchants [4 Marks]

Question 5 (Micro-actuators and Micro-sensors)

- a. Differentiate between **Micro-actuators** and **Microsensors**? [3 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 6 (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 difference between 'VLSI' and 'ULSI'? [2 Marks]

Question 7 (General)

- a. Briefly explain the MCNC MUMPs and MOSIS [3 Marks]
 b. List any two wafer manufacturing methods [1 Mark]
 c. What is the importance of 'Spin Coating' in photolithography? [1 Mark]
 d. Draw and explain briefly, the five (5) major parts of a wafer [5 Marks]
 e. What is the function of **Micro-positioners**? [1 Mark]