NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF SCIENCE AND TECHNOLOGY EDUCATION

DEPARTMENT OF ART, DESIGN AND TECHNOLOGY EDUCATION

MATERIAL SCIENCE

PDT2328

Main Examination

November 2024

This examination paper consists of 4 pages

Time Allowed: **3 Hours**

Total Marks: **100**

Examiner's Name: **Mr T. Muzari**

External Examiner: **Dr.C.Kahanji**

INSTRUCTION AND INFORMATION TO THE CANDIDATE

1. Answer **Question 1(compulsory)** and any other three
2. Each question is worth 25marks
3. Use of calculators is permissible

MARK ALLOCATION

QUESTION	MARKS
1	25
2	25
3	25
4	25
5	25
Total marks attainable by the candidate	100

Question 1(Compulsory)

a) Clarify the following terms considering that electrical conductivity depends on the number of electrons in the outer most shell:

i. Conductors **[2marks]**

ii. Semi-conductors **[2marks]**

iii. Insulators s **[2marks]**

b) Briefly cite and describe the main differences between ionic, covalent, and metallic bonding. **[9marks]**

c) Give a brief account of the classification of wood-based composite materials taking note of the raw materials and process types. **[10 marks]**

Question 2

a) Explain the difference between atomic structure and crystal structure. **[6 marks]**

b) Sketch and show inter-axial angles and lengths of the following unit cells:

i. Face-centred orthorhombic. **[3 marks]**

ii. body centred tetragonal. **[3 marks]**

iii. face centred cubic. **[3 marks]**

c) Given an all right angled unit cell for a hypothetical metal measuring 0,35nm long, 0,35nm wide and 0,45nm high with an atomic weight of 141g/mol:

i. State the crystal system this unit cell belongs to **[2marks]**

ii. What would this crystal structure be called? **[2marks]**

iii. Illustrate the unit cell showing the dimensions and angles respectively. **[3marks]**

iv. Calculate the density of the material giving your answer in grammes per cubic centimetres. **[5marks]**

Question 3

a) Describe the three main groups of engineering materials. **[6marks]**

b) **Figure Q3b** is a Block with a 200mm diameter through hole. Provide an explanation of making the hole if the block is made of :

a) Wood **[3marks]**

b) Metal **[3marks]**

c) Plastic **[3marks]**

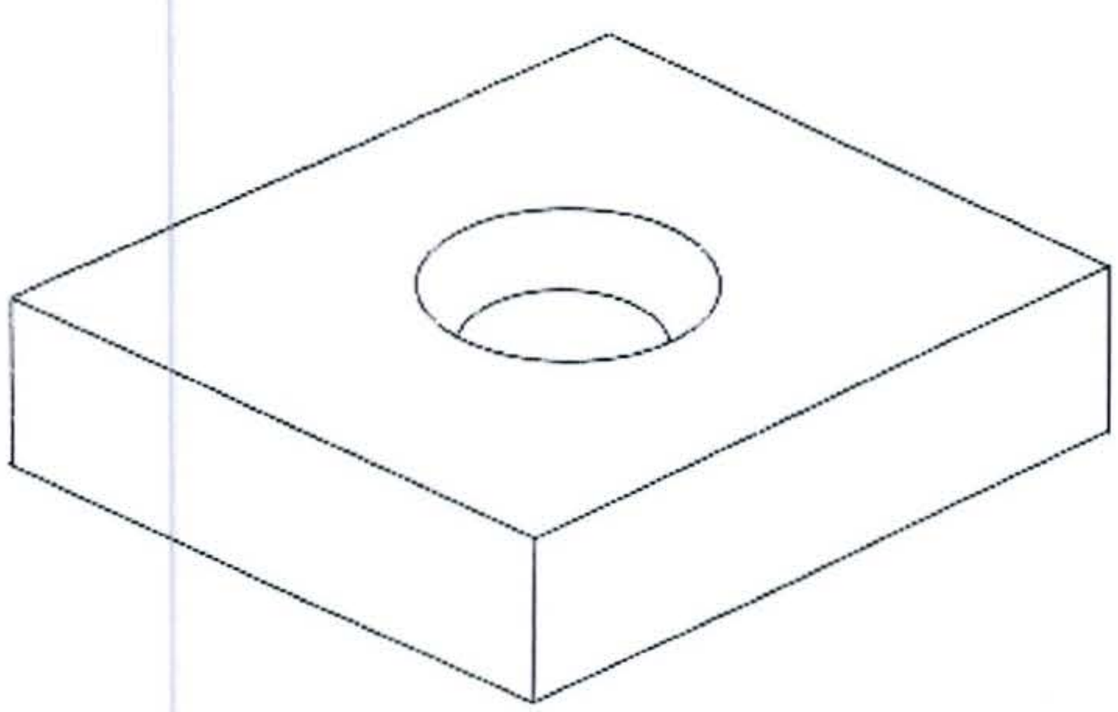

Figure Q3b Block

c) Sketch three methods of dealing with sharp corners of the Figure 3Qb Block for increased user safety. **[6marks]**

d) Assuming that Figure 3Qb Block is made of metal, describe two methods that **deteriorate** the block. **[4marks]**

Question 4

a) Differentiate thermosetting and thermoplastic plastics. **[4marks]**

b) Explain the reasons why some plastic materials deform with very low heat. **[5marks]**

c) Describe **three** additives to polymers that impart special characteristics during polymer. **[6marks]**

d) State and briefly explain any **five** methods used in forming and shaping thermoplastics. **[10marks]**

Question 5

a) Describe the tripartite relationship of structure-property-processing for enhanced performance of engineering materials. **[9marks]**

b) State and explain the factors engineers consider in the selection of engineering materials for an engineering application. **[6marks]**

c) Distinguish the following principal properties of materials which are of importance to the designer:

i. Elasticity and plasticity. **[5marks]**

ii. Ductility and malleability. **[5marks]**

END OF EXAMINATION