NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF SCIENCE AND TECHNOLOGY EDUCATION

DEPARTMENT OF TECHNICAL AND ENGINEERING EDUCATION AND TRAINING

PTE 6188 ADVANCED MATERIAL SCIENCE

Main Examination

November 2024

This examination paper consists of 3 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

Copyright: National University of Science and Technology 2024

Question 1

Explain the following concepts about material and engineering science:

a) surface modification of materials **[5]**

b) atomic structure and bonding **[5]**

c) crystal structures **[5]**

d) material surface processing **[5]**

e) material characterisation **[5]**

Question 2

a) Describe how the following material waste can be recovered:

i. wood sawdust **[3]**

ii. metal swarf **[3]**

b) With illustrations, explain three types of static stresses to which materials are subjected. **[9]**

c) Give a detailed account of four shaping processes supported by relevant examples. **[10]**

Question 3

a) Describe the deformation processing for metals and give examples where possible. **[6]**

b) Explain methods for modifying the surfaces of the following materials:

i. Wood **[3]**

ii. Metals **[3]**

iii. Plastics **[3]**

c) Discuss the mechanics and chemistry of the chemical machining process. **[10]**

Question 4

a) Differentiate hybrid composite from advanced composite. **[5]**

b) Explain the concept of the rule of mixtures regarding composite materials. **[5]**

c) A polymer matrix composite consists of polyester reinforced with Kevlar-29 fibers. The volume fractions of polyester and Kevlar are 60% and 40%, respectively. The Kevlar fibers have a modulus of elasticity = 60 GPa in the longitudinal direction and 3 GPa in the transverse direction. The polyester matrix has a modulus of elasticity = 5.6 GPa in both directions. Determine the modulus of elasticity for the composite in the

i. longitudinal direction **[10]**

ii. transverse direction. **[5]**

Question 5

a) Narrate the concept of the viscoelastic behaviour of polymers. **[5]**

b) Briefly describe the parameters of viscosity in plastic product making. **[5]**

c) Explain the concept of vulcanisation as referred to as elastomers. **[5]**

d) Describe the two methods that are used for the synthesis of polymers. **[10]**

END OF EXAMINATION