



TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL & AUTOMOTIVE ENGINEERING

UNIVERSITY EXAMINATION FOR:

BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

EMG 2406: MATERIAL SCIENCE

END OF SEMESTER EXAMINATION

SERIES: APRIL 2016

TIME: 2 HOURS

DATE: Pick Date May 2016

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of **FIVE** questions. Attempt any **THREE** questions.

Do not write on the question paper.

Question ONE

- (a) Describe with the aid of sketches, describe the Acoustic Emission technique of NDT. (10 marks)
- (b) Give the advantages and disadvantages of using ultrasound inspection for detecting flaws during the manufacture of steel tubes. (6 marks)
- (c) With the aid of a diagram show how the Probability of detection of flaws by sound varies with defect depth (4 marks)

Question TWO

- (a) Define Composite Material. Explain the classification based on Matrix, Geometry of Reinforcement and Construction. Explain briefly the Filament Winding Process. (10 marks)
- (b) Explain with a diagram the Pultrusion Process and mention its application. (10 marks)

Question THREE

- (a) A sample of Polyethylene is found to have an average molecular weight of 15000 amu. What is the degree of polymerization, n , of the “average” polyethylene molecule?
Take $C = 12.01$ $H = 1.008$ (4 marks)
- (b) A regular Copolymer of ethylene and vinyl chloride contains alternating mers of each type. What is the weight percent of ethylene in this copolymer?
 $C = 12.01$ $H = 1.008$ $Cl = 35.45$ (4 marks)
- (c) (i) State **THREE** additives used in blending of Polymers. For each provide a function.
- (ii) Briefly explain ‘**CRAZING**’ and state conditions that lead to brittle fracture in Polymers. (8 marks)
- (a) With the aid of a clearly labelled diagram, distinguish the variations of strengths for:-
- (i) Isotactic crystalline Polystyrene
(ii) Cross linked atactic Polystyrene
(iii) Viscous, amorphous Polystyrene (4 marks)

Question FOUR

- (a) Explain dislocation and show how the burgers vector can be used to distinguish between edge and screw dislocations. (4 marks)
- (b) (i) With the aid of a diagram, describe the dislocation movement as observed in plastic deformation.
- (ii) State **THREE** characteristics of dislocation. (8 marks)
- (c) Explain the following Strengthening Mechanisms:-
- (i) Strain hardening
(ii) Precipitation hardening
(iii) Solid solutions
(iv) Smaller grains (8 marks)

Question FIVE

- (a) State FOUR mechanical properties of Ceramics. (2 marks)
- (b) A Reaction-bonded Silicon Nitride has a strength of 300 MPa and a fracture toughness (K_{IC}) of $3.6 \text{ MPa}/\text{m}^2$. Determine the largest-size internal crack that this material can support without fracture? Take $Y = 1$ (6 marks)
- (c) With the aid of a graph, show the solidification of a crystalline and amorphous glass clearly indicating the Principal points. (6 marks)
- (d) Describe how to determine the Flexural Strength of a brittle Ceramic. (6marks)