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 MPa/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)