KIBABII UNIVERSITY
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UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR

THIRD YEAR FIRST SEMESTER MAIN EXAMINATIONS

FOR THE DEGREE
OF
BACHELOR OF SCIENCE IN PHYSICS

COURSE CODE: **SPM 312**

COURSE TITLE: **MATERIALS TESTING AND EVALUATION**

DATE: **24/05/2022** **TIME: 2:00PM-4:00PM**

INSTRUCTIONS TO CANDIDATES

TIME: 2 Hours

Answer question ONE and any TWO of the remaining.

Symbols used bear the usual meaning.

KIBU observes ZERO tolerance to examination cheating

This Paper Consists of 2 Printed Pages. Please Turn Over.

Question One (30 marks)

a) Using an illustration show how the secant and tangent modulus of a specimen can be determined from a stress strain relationship. (4 marks)

b) A piece of copper originally 305 mm long is pulled in tension with a stress of $276 Mpa$. If the deformation is entirely elastic, what will be the resultant elongation(young's modulus of copper is $110 \times 10^3 Mpa$) (4 marks)

c) Differenciate between materials in terms of their properties: metals, ceramics, polymers, composites. (4 marks)

d) Compute the percentage cold work of a cylindrical copper rod if it is cold worked such that the diameter is reduced from 15.2mm to 12.2mm. (3 marks)

e) Using a labeled diagram, describe the three Fatique fracture processes (4 marks)

f) Discuss the following terms as applied to materials: Isotropy, Elasticity, Malleability, Strength (4 marks)

g) Discuss the Poisson ratio stating the relation with the Young's Modulus of elasticity (4 marks)

h) A cast Iron bed plate for a pump has a crack length of 100μm. The Youngs Modulus of cast Iron is $210 GN/m^2$ and the specific surface energy is $10 J/m^2$. Show that the fracture strength required is $1.6 \times 10^8 N/m^2$ (3 marks)

Question Two (20 marks)

a) A tensile stress is to be applied along the long axis of a cylindrical brass rod that has a diameter of 10mm, Determine the magnitude of the load required to produce a $2.5 \times 10^{-3} mm$ change in diameter if the deformation is entirely elastic (young's modulus of brass is $97 \times 10^3 mpa$)

(8 marks)

b) Discuss the mechanical properties ductility resilience and toughness. (9 marks)

c) What is the approximate Brinell hardness of a 1040 steel having a yield strength of 690 MPa? (3 marks)

Question Three (20 marks)

a) Discuss four Non destructive testing methods of properties of materials (12 marks)

b) A tensile test specimen having a diameter of 12.7mm was loaded upto a load of 76 kN and its diameter was measured as 12mm. Compare true stress and strain with engineering stress and strain (8 marks)

Question Four (20 marks)

a) Discuss the rotating beam Fatigue test using a well labeled schematic diagram(11 marks)

b) Discuss three theories of Fatigue (9 marks)

Question Five (20 marks)

a) A uniform bar of length L, cross-sectional area A, and unit mass ρ is suspended vertically from one end, show that its total elongation is $\delta = \rho g L^2 / 2E$. If the total mass of the bar is M, show also that $\delta = MgL^2 / 2AE$

(4 marks)

b) A steel bar 50mm in diameter and 2m long is surrounded by a shell of a cast iron 5mm thick. Compute the load that will compress the combined bar a total of 0.8mm in the length of 2m. For steel E=200GPa, and for cast iron, E=100GPa. (6 marks)

c) A reinforced concrete column 200mm in diameter is designed to carry an axial compressive load of 300kN. Determine the required area of the reinforcing steel if the allowable stresses are 6MPa and 120MPa for the concrete and steel respectively. Use $E_{concrete} = 14GPa$ and $E_{steel} = 200GPa$ (10 marks)