KIBABII UNIVERSITY
(KIBU)

UNIVERSITY EXAMINATIONS
2019/2020 ACADEMIC YEAR

THIRD YEAR FIRST SEMESTER
SPECIAL/SUPPLIMENTARY EXAMINATIONS

FOR THE DEGREE
OF
BACHELOR OF SCIENCE IN PHYSICS

COURSE CODE: SPH 322E

COURSE TITLE: SOLIDIFICATION AND WORKING

DATE: 3/02/2021 **TIME:** 8:00 – 10:00 AM

INSTRUCTIONS TO CANDIDATES

TIME: 2 Hours

Answer question ONE and any TWO of the remaining.

Symbols used bear the usual meaning.

Question One (30 marks)

a) Describe the phenomena of grain growth in metals (3 marks)

b) Discuss the slip systems in a material under tension (3 marks)

c) A piece of copper originally 400mm long is pulled in tension with a stress of 300MPa. If the deformation is entirely elastic, what will be the resultant elongation? (E for copper is $110\times10^{3}\,MPa$) (4 marks)

d) Describe the stress and strain as applied in mechanical testing (2 marks)

e) Discuss the influence of quenching on steel hardness (5 marks)

f) Compute the tensile strength and ductility (%EL) of a cylindrical copper rod if it is cold worked such that the diameter is reduced from 16mm to 12mm (3 marks)

g) Describe the recovery and recrystallization mechanisms in metals (4 marks)

h) Describe the edge and screw dislocations in materials (2 marks)

i) Discuss the following processes used in metallurgy (i) powder metallurgy (ii) Welding (4 marks)

Question Two (20 marks)

a) Discuss the following strengthening mechanisms in metals (i) Strengthening by grain size reduction (ii) Solid-solution strengthening (iii) Strain hardening (9 marks)

b) Discuss the various casting technigues used in metal works (11 marks)

Question Three (20 marks)

3a) Discuss using a well labelled diagram how stress and strain measurements can be implemented (5 marks)

3b) A cylindrical specimen of steel having an original diameter of 14mm is tensile tested to fracture and found to have an engineering fracture strength of 500MPa. If its cross-sectional diameter at fracture is 10.5mm determine (i) The ductility in terms of percentage reduction in area (ii) The true stress at fracture (6 marks)

3c) A cylindrical steel pressure vessel 400 mm in diameter with a wall thickness of 20 mm, is subjected to an internal pressure of 4.5 MN/m^2.

(i) Calculate the tangential and longitudinal stresses in the steel.

(ii) To what value may the internal pressure be increased if the stress in the steel is limited to 120 MN/m^2?

(iii) If the internal pressure were increased until the vessel burst, sketch the type of fracture that would occur. (9 marks)

Question Four (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 $3\times10^{-3}\,mm$ change in diameter if the deformation is entirely elastic (Poisson ratio for brass is 0.34, modulus of elasticity of brass is 97GPa) (5 marks)

b) Discuss the Tensile properties of a metal with reference to the yield point phenomena, yield strength and proportional limit (6 marks)

c) Discuss the following properties of materials Ductility, Resilience and Toughness (9 marks)