



**MASINDE MULIRO UNIVERSITY OF
SCIENCE AND TECHNOLOGY
(MMUST)**

MAIN CAMPUS

**UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR**

**SECOND SEMESTER EXAMINATIONS
FOR THE DEGREE OF MASTER OF SCIENCE
IN
STRUCTURAL ENGINEERING**

COURSE CODE: CSE 821

COURSE TITLE: ADVANCE MECHANICS OF MATERIALS II

DATE: WEDNESDAY 27TH APRIL 2022 TIME: 8.00 – 11.00 AM

INSTRUCTIONS:

1. This paper contains **THREE** questions
2. Answer **ALL** questions
3. Marks for each question are indicated in the parenthesis.
4. No unauthorized materials are allowed in the examination room
5. Examination duration is **2 Hours**

MMUST observes **ZERO** tolerance to examination cheating

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

Q.1

- a) An isotropic material is subjected to normal stresses in three perpendicular directions σ_x , σ_y and σ_z , of a multiaxial stress cube. Write the expression equations the resultant normal strains in the directions, x , y and z will be given by: (6 marks)
- b) Aluminium has a yield stress $\sigma_{\text{yield}} = 40$ ksi in tension, a yield strain $\epsilon_{\text{yield}} = 0.004$, an ultimate stress $\sigma_{\text{ult}} = 45$ ksi, and the corresponding ultimate strain $\epsilon_{\text{ult}} = 0.17$. Determine the material constants and plot the corresponding stress-strain curves for the following models:
- the elastic-perfectly plastic model.
 - the linear strain-hardening model.
 - the nonlinear power-law model.

PLAN

We have coordinates of three points on the curve: $P_0(\sigma_0 = 0.00, \epsilon_0 = 0.000)$, $P_1(\sigma_1 = 40.0, \epsilon_1 = 0.004)$ and $P_2(\sigma_2 = 45.0, \epsilon_2 = 0.017)$.
Using these data we can find the various constants in the material models. (14 marks)

Q.2

- a) List five basic hypothesis concepts in the theory of plasticity. (5 marks)
- b) A region on the surface of a 6061-T4 aluminum alloy component has strain gage attached, which indicate the following stresses:

$$\sigma_{11} = 70 \text{ MPa}$$

$$\sigma_{22} = 120 \text{ MPa}$$

$$\sigma_{12} = 60 \text{ MPa}$$

Determine the yielding for both Tresca's and von Mises' criteria, given that $\sigma_0 = 140$ MPa (the yield stress) and interpret the results (15 marks)

Q.3

- (a) Describe stress cycle of Drucker's Postulate. (7 marks)
- (b) Explain with illustration the following plastic deformation that relates to yield surface changes: (8 marks)
- Isotropic Hardening
 - Kinetic Hardening
- c) A rod, 50 mm long, is extended to 60 mm and then compressed back to 50 mm. Determine the total deformation and incremental that has occurred. (5 marks)