(University of Choice)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS 2023/2024 ACADEMIC YEAR

THIRD YEAR FIRST SEMESTER EXAMINATIONS

FOR THE DEGREE OF BACHELOR OF TECHNOLOGY EDUCATION IN MECHANICAL ENGINEERING

COURSE CODE: TEM 321

COURSE TITLE: SOLID MECHANICS II

DATE: 14/12/2023 TIME: 8:00 AM – 10:00 AM

INSTRUCTIONS:

1. This paper contains FOUR Questions
2. Answer Question ONE and any other TWO Questions
3. Marks for each question are indicated in the parenthesis.
4. It is in the best interest of the candidate to write legibly
5. Examination duration is **2 Hours**

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 3 Printed Pages. Please Turn Over.

QUESTION ONE (Compulsory) (30 Marks)

a) A cantilever beam is carrying a uniformly distributed load of 10 kN/m over the entire span of 5 m.

i) Draw the shear force and bending moment diagram for the beam (6 marks]

ii) Determine the maximum bending stress in the beam given that the section is 200 mm wide by 300 mm deep [8 marks]

iii) Determine the slope at the supports and maximum deflection in the beam using Moment area method [8 marks]

b) A shaft is made from tube. The ratio of the inside diameter to the outside diameter is 0.6. The material must not experience a shear stress greater than 500 kPa. The shaft must transmit 1.5 MW of mechanical power at 1500 rev/min. Calculate the shaft diameters [8 marks]

QUESTION TWO (20 Marks)

a) A cylindrical bar of diameter 20 mm and length 6m is axially loaded with a tensile force of 50 kN. Determine the normal and shear stresses acting on an element which makes 30^o inclination with the vertical plane [8 marks]

b) At a point of a material, the 2D stress system is defined by
σ_x = 60 MPa (tensile); σ_y = 45 MPa (tensile); τ_{xy} = 37.5 MPa
Evaluate the values of the principal stresses and their direction. Find the greatest shearing stress [12 marks]

QUESTION THREE (20 Marks)

a) A column 400 mm x 400 mm carries a vertical load of 250 kN at a distance of 20 mm from the neutral axis. Determine the maximum and minimum stress developed in the section [6 marks]

b) A thin cylinder of internal diameter 1.25 m contains a fluid at an internal pressure of 2 N/mm^2. Determine the maximum thickness of the cylinder if:

i) The longitudinal stress is not to exceed 30 N/mm^2 [4 marks]

ii) The circumferential stress is not to exceed 45 N/mm^2 [4 marks]

c) Outline the similarities and the differences of thin cylinders, thick cylinders and spherical vessels [6 marks]

QUESTION FOUR (20 Marks)

a) A member is subjected to the combined action of bending moment 400 Nm and torque 300 Nm. What respectively are the equivalent bending moment and equivalent torque [4 marks]

b) A thin cylinder of 100 mm internal diameter and 5 mm thickness is subjected to an internal pressure of 10 MPa and a torque of 2000 Nm. Calculate the magnitudes of the principal stresses [10 marks]

c) Justify the need for theories of failure in materials [3 marks]

d) Outline the application and limitation of maximum principal stress theory [3 marks]

----END OF QUESTION PAPER----