



(University of Choice)

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

MAIN CAMPUS

**UNIVERSITY EXAMINATIONS
2015/2016 ACADEMIC YEAR**

SECOND YEAR FIRST SEMESTER EXAMINATIONS

**FOR THE DIPLOMA
IN
CIVIL AND STRUCTURAL ENGINEERING**

COURSE CODE: DCE 065

COURSE TITLE: STRENGTH OF MATERIALS

DATE: MONDAY 7TH DECEMBER 2015 TIME: 2.00 – 4.00 PM

INSTRUCTIONS:

1. This paper consists of FIVE Questions
2. Answer any FOUR Questions
3. Examination duration is **2 Hours**

MMUST observes ZERO tolerance to examination cheating

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

Question One

a) A tensile test is carried out on a bar of mild steel of diameter 2cm. The bar yields under a load of 80kN. It reaches a maximum load of 150kN, and breaks finally at a load of 70kN.

Estimate

[6 marks]

- i) The tensile stress at the yield point
- ii) The ultimate tensile stress
- iii) The average stress at the breaking point, if the diameter of the fractured neck is 1cm

b) A 6m long hollow bar of circular section has 140mm diameter for a length of 4m while it has 120mm diameter for a length of 2m. The inside diameter is 80mm throughout. Find the elongation of the bar, when it is subjected to an axial tensile force of 300kN. Take $E = 200\text{GPa}$

[6marks]

c) A plane element in a boiler is subjected to tensile stresses of 400MPa on one plane and 150MPa on the other at right angles to the former. Each of the above stresses is accompanied by a shear stress of 100MPa such that when associated with the minor tensile stress tends to rotate in anti-clockwise direction. Find

- i) The principal stresses
- ii) The maximum shearing stresses

[8 marks]

Question Two

a) A hollow circular column having external and internal diameters of 300mm and 250mm respectively carries a vertical load of 100kN at the outer edge of the column. Calculate the maximum and minimum intensities of stress in the section **[8 marks]**

b) A shaft is made of solid round bar 30mm diameter and 0.5 m long. The shear stress must not exceed 200Mpa. Calculate the maximum torque that should be transmitted and the angle of twist which will occur. Take $G = 90\text{GPa}$ **[6 marks]**

c) A hollow steel tube 3.5m long has external diameter of 120mm. In order to determine the internal diameter, the tube was subjected to a tensile load of 400kN and the extension was measured to be 2mm. If $E = 200\text{GPa}$. Determine the internal diameter of the tube **[6 marks]**

Question Three

a) A reinforced concrete column 500 mm by 500mm in section is reinforced with 4 steel bars of 25mm diameter, one in each corner. The column is carrying a load of 1000kN. Find the stresses in the steel and concrete. Take E for steel = 210 GPa and E for concrete = 14 GPa **[8 marks]**

b) Two parallel walls 6m apart are stayed together by a steel rod 25mm diameter passing through metallic plates and nuts at each end. The nuts are tightened home, when the rod is at a temperature of 100°C. Determine the stress in the rod, when the temperature falls down to 60°C, if

- i) The ends do not yield and
- ii) The ends yield by 1mm

Take $E = 200\text{GPa}$ and $\alpha = 12 \times 10^{-6}/^\circ\text{C}$

[6 marks]

c) A metal bar 50mm x 50mm in section is subjected to an axial compressive load of 500kN. If the contraction of a 200mm gauge length was found to be 0.5mm and the increase in thickness 0.04mm, find the values of modulus of modulus of elasticity and Poisson's ratio for the bar material

[6 marks]

Question Four

a) A punch having diameter $d = 20 \text{ mm}$ is used to punch a hole in an 8 mm steel plate. If a force $P = 110 \text{ kN}$ is required to create the hole, what is the average shear stress in the plate and the average compressive stress in the punch?

[6 marks]

b) Calculate the maximum stress induced in a cast iron pipe of external diameter 40cm, internal diameter 20cm and length 4m when the pipe is simply supported at both ends and carries a point load of 80kN at the centre

[6 marks]

c) The stresses at a point of a machine component are 150MPa and 50MPa both tensile. Find the intensities of normal, shear and resultant stresses on a plane inclined at an angle of 55° with the axis of major tensile stress. Also determine the magnitude of the maximum shear stress in the component

[8 marks]

Question Five

a) A 150mm (width) by 250mm (depth) rectangular beam is subjected to a maximum bending moment of 750kNm. Determine

- i) The maximum stress in the beam
- ii) The radius of curvature for that portion where the bending is maximum
- iii) The value of longitudinal stress at a distance of 65mm from the top surface of the beam

Take $E = 200\text{GPa}$

[8marks]

b) The ratio of inside and outside diameter of a hollow tube is 0.6. The material must not experience a shear stress greater than 0.5 MPa. The shaft must transmit 1 MW of mechanical power at 1200 rev/min. Calculate the shaft diameters

[6 marks]

c) Sketch a the stress-strain curve for a mild steel

[6 marks]