(*University of Choice*)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS 2018/2019 ACADEMIC YEAR

SECOND YEAR FIRST SEMESTER EXAMINATIONS

FOR THE DIPLOMA

IN

CIVIL ENGINEERING

COURSE CODE: DCE 065

COURSE TITLE: STRENGTH OF MATERIALS

DATE: MONDAY 28TH JANUARY 2019 TIME: 3.00PM – 5.00PM

INSTRUCTIONS:

1. This paper contains **FOUR** questions
2. Question **ONE** is **COMPULSORY**
3. Attempt any other **TWO** questions
4. Marks for each question are indicated in the parenthesis.
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) Differentiate between
   i. Young's Modulus and Modulus of Rigidity (2 Marks)
   ii. Polar second moment of area and section modulus (2 Marks)

b) What are the assumptions that make the torsion theory to hold? (5 Marks)

c) The coupling shown below is constructed from steel of rectangular cross-section and is designed to transmit a tensile force of 50kN. If the bolt is of 15mm diameter calculate
   i. the shear stress in the bolt; (4 Marks)
   ii. the direct stress in the plate; (3 Marks)
   iii. the direct stress in the forked end of the coupling (3 Marks)

d) Outline assumptions of the theory of pure bending (3 Marks)

e) Define the following: (4 Marks)
   i. Principle planes
   ii. Principle shear

f) A circular bar 40mm diameter carries an axial tensile load of 100kN. What is the value of shear stress on the planes of which the normal stress has a value of $50MN/m^2$ tensile? (4 Marks)

QUESTION TWO (20 MARKS)

a) A 25 mm diameter bar is subjected to an axial tensile load of 100kN. Under the action of this load a 200mm gauge length is found to extend 0.19×10^{-3}mm. Determine the modulus of elasticity for the bar material. (5 Marks)

b) If, in order to reduce weight whilst keeping the external diameter constant, the bar is bored axially to produce a cylinder of uniform thickness, what is the maximum diameter of bore possible given that the maximum allowable stress is $240MN/m^2$? The load can be assumed to remain constant at 100kN. (5 Marks)

c) What will be the change in the outside diameter of the bar under the limiting stress quoted in (b)? ($E = 210GN/m^2$ and $v = 0.3$). (5 Marks)

d) A circular bar ABC, 3m long, is rigidly fixed at its ends A and C .The portion AB is 1.8m long and of 50mm diameter and BC is 1.2m long and of 25 mm diameter. If a twisting moment of 680N m is applied at B, determine the values of the resisting moments at A and C and the maximum stress in each section of the shaft. What will be the angle of twist of each portion? For the material of the shaft $G = 80\ GN/m^2$. (5 Marks)

QUESTION THREE (20 MARKS)

a) A uniform T-section beam is 100 mm wide and 150 mm deep with a flange thickness of 25 mm and a web thickness of 12 mm. If the limiting bending stresses for the material of the beam are 80 MN/m2 in compression and 160 MN/m^2 in tension, find the maximum u.d.l. That the beam can carry over a simply supported span of 5 m. (10 Marks)

b) An I-section girder, 200 mm wide by 300 mm deep, with flange and web of thickness 20 mm is used as a simply supported beam over a span of 7 m. The girder carries a distributed load of 5 kN/m and a concentrated load of 20 kN at mid-span. Determine:
   i. The second moment of area of the cross-section of the girder, (5 Marks)
   ii. The maximum stress set-up. (5 Marks)

QUESTION FOUR (20 MARKS)

a) A material is subjected to two mutually perpendicular direct stresses of 80 MN/m^2 tensile and 50 MN/m^2 compressive, together with a shear stress of 30 MN/m^2. The shear couple acting on planes carrying the 80 MN/m^2 stress is clockwise in effect. Calculate
   i. The magnitude and nature of the principal stresses. (5 Marks)
   ii. The magnitude of the maximum shear stresses in the plane of the given stress system. (5 Marks)
   iii. The direction of the planes on which these stresses act. (5 Marks)

b) Confirm your answer of part (a) means of a Mohr's stress circle diagram, and from the diagram determine the magnitude of the normal stress on a plane inclined at 20" counterclockwise to the plane on which the 50 MN/m^2 stress acts. (5 Marks)