



MACHAKOS UNIVERSITY
University Examinations for 2021/2022 Academic Year
SCHOOL OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF BUILDING AND CIVIL ENGINEERING
SECOND YEAR SECOND SEMESTER EXAMINATION FOR
BACHELOR OF SCIENCE (CIVIL ENGINEERING)
ECV 208: STRENGTH OF MATERIALS II

DATE: 26/5/2022

TIME: 11.00-1.00 PM

INSTRUCTIONS:

- *This paper comprises of five questions. Answer **three** questions*
- *Question one is **compulsory** and carry 30 marks*
- *Answer any other **two** questions*

QUESTION ONE (COMPULSORY) (30 MARKS)

- a) The line of thrust, in a compression testing specimen 15mm diameter, is parallel to the axis of the specimen but is displaced from it. Calculate the distance of the line of thrust from the axis when the maximum stress is 20% greater than the mean stress on a normal section. (7 marks)
- b) In a hollow circular shaft of outer and inner diameters of 20cm and 10 cm respectively, the shear stress is not to exceed 40 N/mm^2 . Find the maximum torque which the shaft can safely transmit. (5 marks)
- c) State FIVE assumptions made in the Eulers column theory. (5 marks)
- d) A solid round bar 4m long and 5cm in diameter was found to extend 4.6mm under a tensile load of 50 kN. This bar is used as a strut with both ends hinged. Determine the buckling load for the bar and also the safe load taking factor of safety as 4.0. (5 marks)
- e) Define the term composite beams and give THREE examples. (4 marks)
- f) The principal stresses at a point in an elastic material are 100 N/mm^2 (tensile), 80 N/mm^2 (tensile) and 50 N/mm^2 (compressive). If the stress at the elastic limit in simple tension is 200 N/mm^2 , determine whether failure of the material will occur according to maximum principal stress theory. If not, then determine the factor of safety. (4 marks)

QUESTION TWO (20 MARKS)

A masonry retaining wall of trapezoidal section is 1.5m wide at the top, 3.5m wide at the base and 6m high. The face of the wall retaining earth is vertical and the earth level is upto the top of the wall. The density of the earth is 1600 kg/m^3 for the top 3m and 1800 kg/m^3 below this level. The density of masonry is 2300 kg/m^3 . Find the total lateral intensities at the base. Take the angle of repose as 30° for both types of earth.

QUESTION THREE (20 MARKS)

A column is rectangular in cross-section of $300 \text{ mm} \times 400 \text{ mm}$ in dimensions. The column carries an eccentric point load of 360 kN on one diagonal at a distance of quarter diagonal length from a corner. Calculate the stresses at all four corners. Draw stress distribution diagrams for any two adjacent sides.

QUESTSION FOUR (20 MARKS)

- a) Calculate the Euler's critical load for a strut of T-section, the flange width being 10cm, overall depth 8cm and both flange and stem 1cm thick. The strut is 3m long and is built in at both ends. Take $E = 2 \times 10^5 \text{ N/mm}^2$. (12 marks)
- b) A hollow alloy tube 5m long with external and internal diameters 40mm and 25mm respectively was found to extend 6.4mm under a tensile load of 60 kN. Find the buckling load for the tube when used as column with both ends pinned. Also find the safe load for the tube, taking a factor of safety=4. (8 marks)

QUESTION FIVE (20 MARKS)

- a) According to the theory of maximum shear stress, determine the diameter of a bolt which is subjected to an axial load of 9 kN together with a transverse shear force of 4.5 kN . Elastic limit in tension is 225 N/mm^2 , factor of =3 and Poisson's ratio=0.3. (8 marks)
- b) Determine the diameter of a bolt which is subjected to an axial pull of 9 kN together with a transverse shear force of 4.5 kN using :
 - i. Maximum principal stress theory and
 - ii. Maximum principal strain theoryGiven the elastic limit in tension= 225 N/mm^2 , factor of safety=3 and Poisson's ratio=0.3 (12 marks)