TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology
Department of BUILDING & Civil engineering
UNIVERSITY EXAMINATION FOR:

BACHELOR OF TECHNOLOGY IN CIVIL ENGINEERING

TCV 4222 : STRENGTH OF MATERIALS II

ORDINARY EXAMINATION
SERIES: APRIL 2024. **TIME:** 2 HOURS

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of five questions.

Attempt any THREE questions.

Do not write on the question paper.

QUESTION 1

(a) Describe the limitations of Euler Theory of Buckling (5 Marks)

(b) A solid shaft is subjected to a torque of 100 Nm. Find the necessary shaft diameter if the allowable shear stress is 100 N/mm^2 and the allowable twist is 3 degrees per 10 diameter length of the shaft. Take G = 1 x 10^5 N/mm^2. (5 marks)

(c) A flitched beam consists of two 50 mm x 200 mm wooden beams and a 12 mm x 80 mm steel plate. The plate is placed centrally between the wooden beams and recessed into each so that, when rigidly joined, the three units form a 100 mm x 200 mm section as shown in figure 1(a) below. Determine the moment of resistance of the flitched beam when the maximum bending stress in the timber is 12 MN/m^2.What will then be the maximum bending stress in the steel? (10 Marks)

For steel $E = 200\ GN/m^2$; for wood $E = 10\ GN/m^2$.

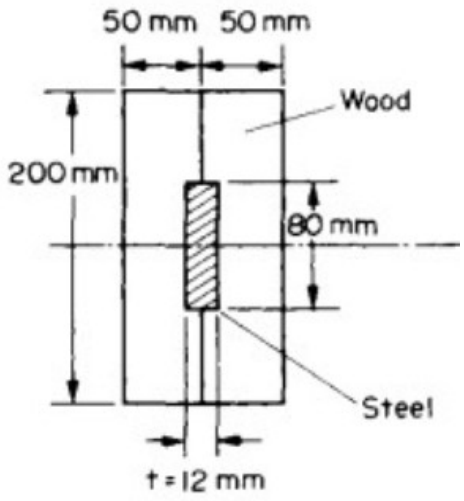

Figure 1(a)

QUESTION 2

a) List five assumptions made when considering the Euler column theory for buckling load. (5Marks)

b) The crippling load of a section was established to be 30 Kn at a length of 3.0 m. when its ends were pinned. Determine the crippling load of the section of the same length under the following end conditions.

i) One end is fixed, other end is free.

ii) Both ends are fixed.

iii) One end is fixed but the other end is hinged. (9 Marks)

c) A hollow alloy tube 4m long with internal and external diameter of 40 mm and 25 mm respectively was found to extend 4.8 mm under tensile load of 60Kn. Find the buckling load for the tube, when used as strut with both ends pinned. Also find the safe load on the tube, taking a factor of safety as 5. (6 Marks)

QUESTION 3

a) Using illustrations, describe pure bending. (5 marks)

b) Check the stability of a cantilever retaining wall shown figure 3(a) below to retain an earth embankment with a horizontal top 3.5 m above ground level. Density of earth is 18 kN/m^3, angle of internal friction θ = 30° and soil bearing capacity is 200 kN/m^2. Take coefficient of friction between soil and concrete to be 0.5. (15 marks)

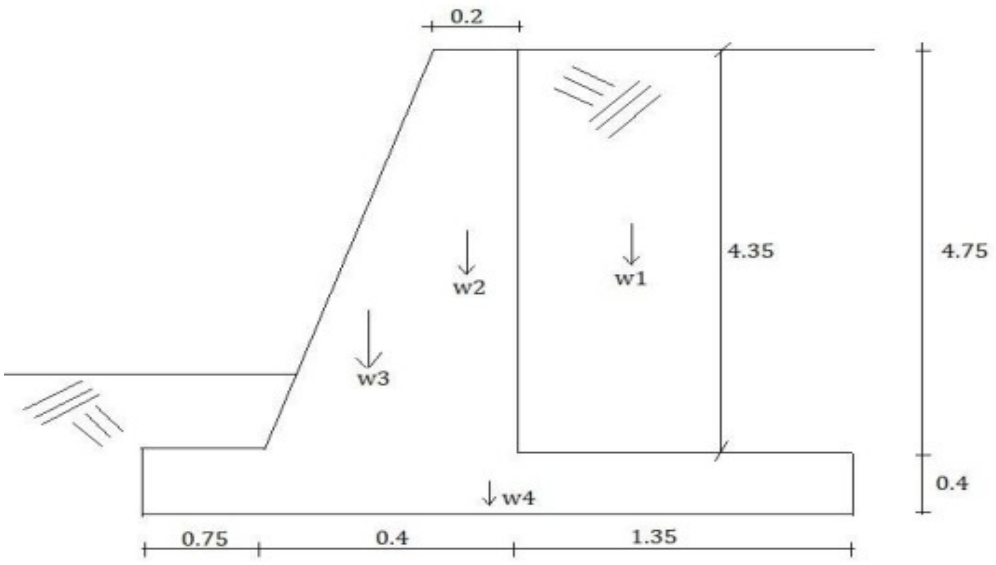

Figure 3(a)

QUESTION 4

a) An I section as shown in figure 4(a) below, is simply supported over a span of 12 m. If the maximum permissible bending stress is 80 N/mm2, what concentrated load can be carried at a distance 4.0 m from any one support? (5marks)

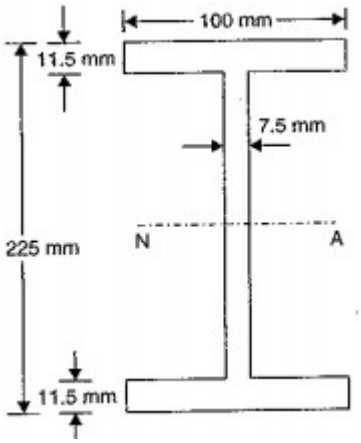

Figure 4(a)

b) A hollow shaft 30 mm internal diameter is subjected to a twisting moment of 800 Mn and an axial compression force of 40 Kn. Determine the factor of safety according to each theory of failure if the tensile and compressive strength of the material is 280 N/mm2 and Poisson's ratio , 1/m=0.3. (15 Marks)

QUESTION 5

a) An I-section beam 350 mm x 150 mm has a web thickness of 10 mm and a flange thickness of 20 mm. If the shear force acting on the section is 40 Kn, find the maximum shear stress developed in the I-section. (5 marks)

b) 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/m2 in tension, find the maximum u.d.1. That the beam can carry over a simply supported span of 5 m. (9marks)

c) Describe the following theories of failure
   i) Maximum principal stress theory
   ii) Maximum shear stress theory
   iii) Maximum principal strain theory (6 marks)