MACHAKOS UNIVERSITY

University Examination 2018/2019

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

SECOND YEAR SPECIAL/SUPPLEMENTARY EXAMINATION FOR

BACHELOR OF SCIENCE (CIVIL ENGINEERING)

ECV 208: STRENGTH OF MATERIALS II

DATE: 27/9/2019 **TIME: 2.00-4.00 PM**

INSTRUCTIONS: Answer questions **ONE** and any other **TWO** questions.

1. a) State **five** assumptions made in the use of Euler's theory in analysis of struts and columns (5 marks)

   b) State **six** assumptions made in the theory of torsion (6 marks)

   c) A temporary beam is used to support an elevated stage at the local theatre for a special production as shown in figure 1. The expected loading on the beam is 2kN/m. The stage manager thinks a simple wood beam; 10cm by 5cm will do just fine. But the consulting engineer recommends rigidly attaching a 0.5cm thick steel plate on the top and a 1.0cm thick steel plate on the bottom. What is the maximum bending stress in the steel and wood for the two material beam? If the beam is only wood, is it safe? Ewood= 10Gpa E steel = 205Gpa (7 marks)

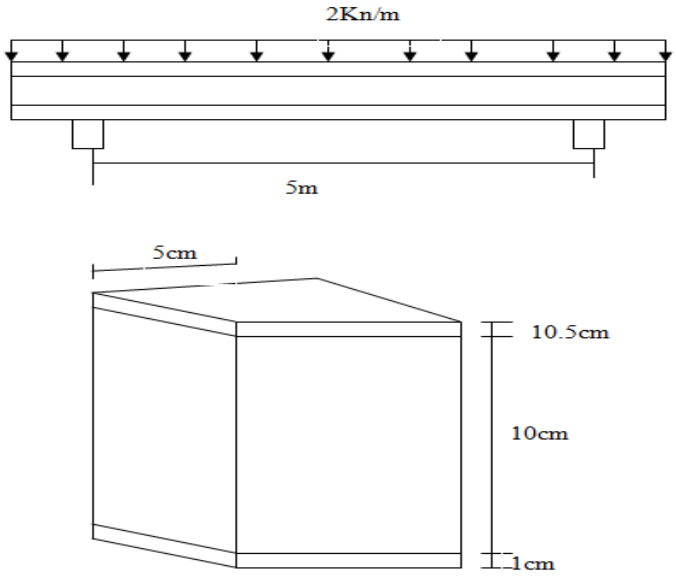

Figure 1

d) Using Eulers formula, determine the critical stresses for a strut of slenderness ratio of 80, 120, 160 and 200 under the conditions of : E=250 Gpa (8 marks)

i. Both ends hinged

ii. Both ends fixed

e) State four advantages of composite beams (4 marks)

2. a) Principal stresses in a cast-iron body are 40 Mpa tensile and 90Mpa compressive, third principal stress being zero. Determine the factor of safety based on elastic limit. If the criterion of failure is principal stress theory. The elastic limit in simple tension is 80 Mpa and in simple compression 450Mpa for cast iron (6 marks)

b) Define the term "composite beam" and give three examples of the same (4 marks)

c) A shaft transmits 280 kN of power at 160 rpm. Determine

i. The diameter of a solid shaft to transmit the required power

ii. The inner and outer diameters of a hollow circular shaft if the ratio of the inner to the outer diameter is 2/3

iii. The percentage saving in the material on using a hollow shaft instead of a solid shaft.

Take the allowable stress as 80Mpa and the density of material 78kN/m^3 (10 marks)

3. a) Check the stability of the reinforced concrete retaining wall shown in figure 2. The soil is silty gravel sand with a horizontal surface and no surcharge. The water table lies well below the base. The wall was propped while the backfill was placed using only light compaction. Soil properties c'=0, ϕ=40 γ=20 Kn/m^3. Concrete γ= 24kN/m^3 (15 marks)

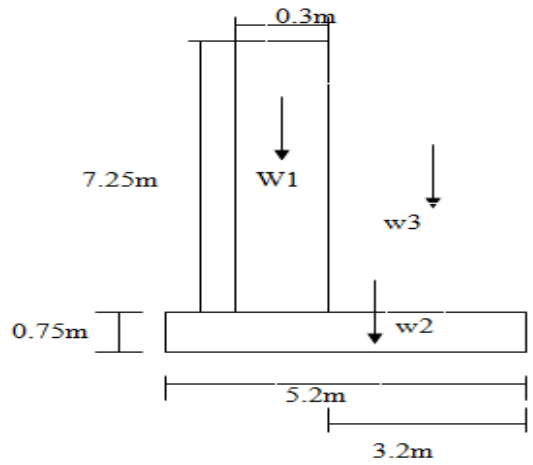

Figure 2

b) Calculate the resultant active thrust on a vertical smooth retaining wall of height 5.4m. The water table is well below the bas of the wall. Soil properties ϕ=30^o, c'=0 γ=20kN/m^3 (5 marks)

4. Find the maximum bending stress σ_{bmax} developed in the steel and wood region of the cross section shown in figure 3 E wood= 10Gpa E steel =210 Gpa (20 marks)

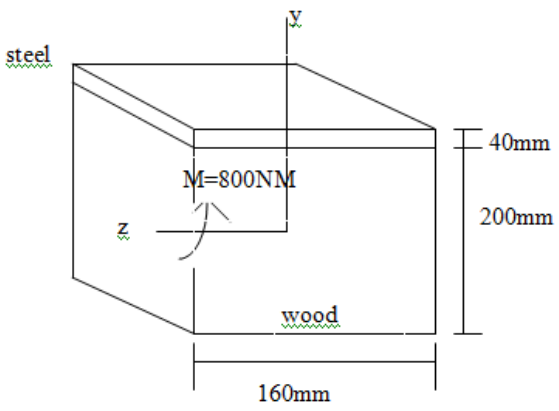

Figure 3

5. a) A 4m long hollow alloy tube with inside and outside diameters as 36mm and 48mm elongates by 3mm under a tensile force of 50kN. Determine the building load for the tube when it is used as a column with both ends pinned and with a factor of safety of 5 (8 marks)

b) A 800mm long straight bar of alloy steel and 10mm*4mm section is mounted on a strut testing machine and loaded axially. The load is increased till the bar buckles. Determine the maximum central deflection before the material attains the yield point of 300Mpa. Assume the Euler formula for pinned ends E=75Gpa (12 marks)