TECHNICAL UNIVERSITY OF MOMBASA

SCHOOL OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF BUILDING & CIVIL ENGINEERING
UNIVERSITY EXAMINATION FOR:

BACHELOR OF TECHNOLOGY IN CIVIL ENGINEERING

TCV 4222: STRENGTH OF MATERIALS II

END OF SEMESTER EXAMINATION
SERIES: JANUARY 2025
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 question ONE (Compulsory) and any other TWO questions.
The abbreviations used have their common meanings
The density of concrete to be taken as 25kN/m^3
Do not write on the question paper.

QUESTION ONE (30 Marks)

(a) A solid shaft is subjected to a torque of 100Nm. Find the necessary shaft diameter if the allowable shear stress is 100N/mm^2 and the allowable twist is 3° per 10 diameter length of the shaft. Take G = 1 x 10^5 N/mm^2. (15 Marks)

(b) A rectangular strut is 150mm and 120mm thick. It carries a load of 180kN at an eccentricity of 10mm in a plane bisecting the thickness. Find the maximum and minimum intensities of stress in the section. (10 Marks)

(c) List five assumptions made when considering the Euler column theory. (5 Marks)

QUESTION TWO (20 Marks)

Check the stability of a cantilever retaining wall shown in figure Q2 to retain an earth embankment with a horizontal top 4m above ground level. The density of earth is 18 kN/m^3, angle of internal friction $\theta = 25°$ and soil bearing capacity is 180 kN/m^2. Take the coefficient of friction between soil and concrete to be 0.5.

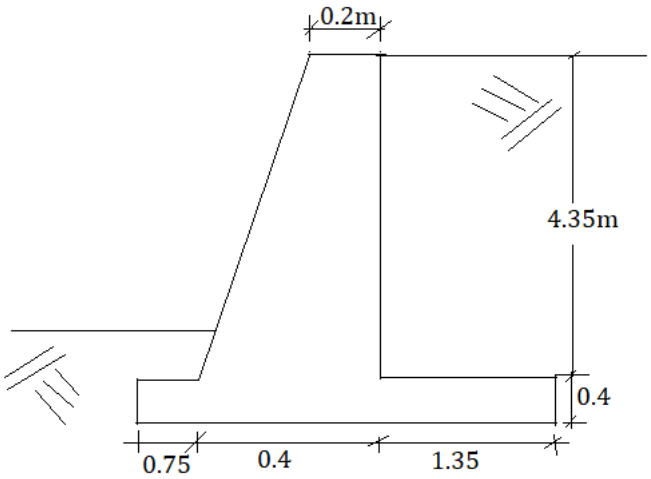

Figure Q2

QUESTION THREE (20 Marks)

(a) A hollow alloy tube 4m long with external and internal diameter of 40mm and 25mm respectively was found to extend 4.8mm under a tensile load of 60kN. Find the buckling load for the tube, when used as a strut with both ends pinned. Also find the safe load on the tube, taking factor of safety as 5. (15Marks)

(b) A sold steel shaft in a rolling mill transmits 20 kW of power at 2Hz. Determine the smallest safe diameter of the shaft if the shear stress is not to exceed 40MPa and the angle of twist is limited to 6^o in a length of 3m. Use G = 83GPa. (5 Marks)

QUESTION FOUR (20 Marks)

Figure Q4(a) shows a cast iron beam having a cross-section of the given dimensions in millimetres. If the allowable stresses for cast iron are $4kN/m^2$ and $8kN/m^2$ for tension and compression respectively, find the maximum allowable value of the central concentrated load P.

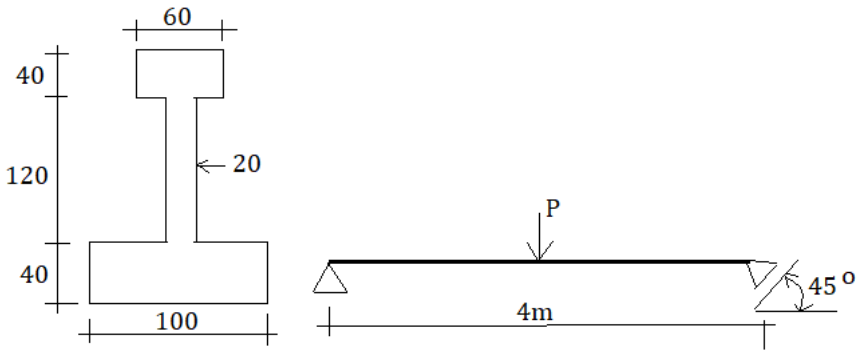

Figure Q4(a)

QUESTION FIVE (20 Marks)

(a) A steel plate 80x20mm is embedded inside two timber pieces as shown in figure Q5(a). Calculate the moment of resistance of the composite beam if allowable stresses in timber and steel are $70kN/mm^2$ and $1120kN/mm^2$ respectively. Take $E_s = 20E_t$. (10 Marks)

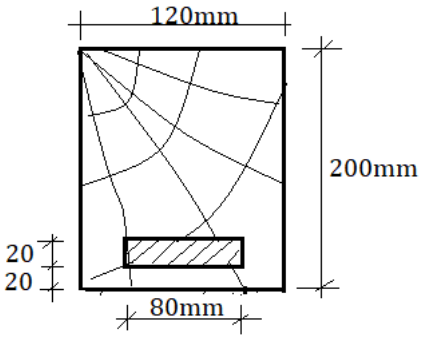

Figure Q5

(b) Briefly discuss the theory of failure of solid materials in accordance to the maximum shear strain energy. (10 Marks)