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

SPECIAL/SUPPLEMENTARY EXAMINATION

SERIES: MARCH 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 timber beam 100mm wide and 200mm deep is strengthened by a steel plate 100mm wide and 10mm thick, screwed at the bottom surface of the timber beam as shown in Fig. Q1a. Calculate the moment of resistance of the beam, if the safe stresses in timber and steel are $10N/mm^2$ and $150mm^2$ respectively. Take $E_s = 20E_t$. (15 Marks)

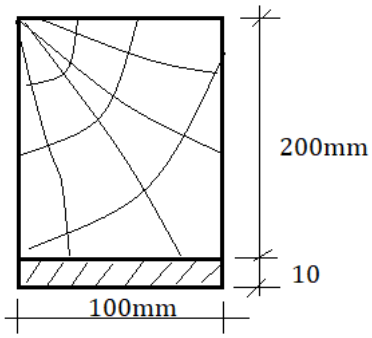
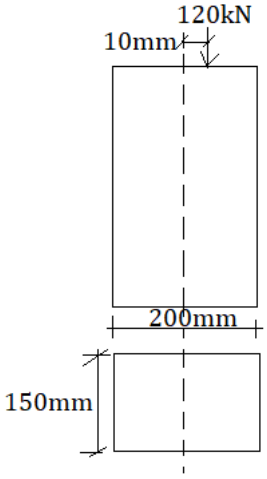


Fig. Q1a

(b) 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)

QUESTION TWO (20 Marks)

(a) A rectangular column of width 200mm and of thickness 150mm carries a point load of 240kN at an eccentricity of 10mm as shown in Fig. Q2a. Determine the maximum and minimum stresses on the section. (10 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)

QUESTION THREE (20 Marks)

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

(b) Figure Q3(b) 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. (15 Marks)

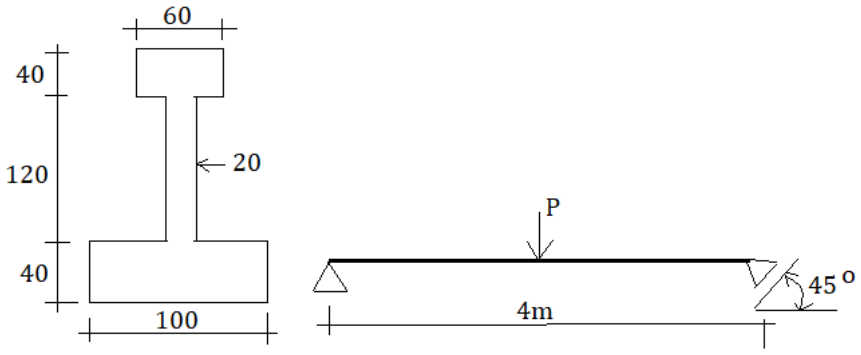


Figure Q3(b)

QUESTION FOUR (20 Marks)

A masonry retaining wall of trapezoidal section is 10 m high and retains earth which is level up to the top. The width at the top is 2 m and the bottom 8 m and the exposed face is vertical. Find the maximum

and minimum intensities of normal stress at the base. Take density of earth as 1600 kg/m^3, density of masonry 2400 kg/m^3 and angle of response of earth 30 degrees.

QUESTION FIVE (20 Marks)

(a) 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. (10 Marks)

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