



NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF ENGINEERING

DEPARTMENT OF INDUSTRIAL AND MANUFACTURING ENGINEERING

BENG (HONS) INDUSTRIAL AND MANUFACTURING ENGINEERING

SOLID MECHANICS II

EIE 2203

SECOND SEMESTER EXAMINATION PAPER

MARCH 2025

This examination paper consists of 4 printed pages

Time Allowed: 3 HOURS
Total Marks: 100
Examiner's Name: ENG G MUNHUWAMAMBO

INSTRUCTIONS AND INFORMATION TO CANDIDATE

1. Answer any FOUR (4) Questions.
2. Each Question carries a total of 25 Marks.
3. Start the answer to each full question on a fresh page.
4. Ensure neatness and legibility of work.
5. Use of calculators is permissible.

QUESTION ONE

A rectangular section 80 mm deep x 50 mm long is used as a 1,5-metre-long cantilever and loaded at its free end with a 5 kN load inclined at 30° to the vertical. Take Young's Modulus of Elasticity as 200 MN/m^2 .

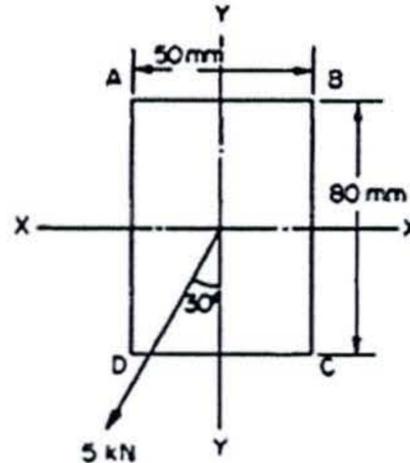


Figure question 1

Determine:

- the greatest tensile stress in the section. (15)
- the maximum deflection. (10)

QUESTION TWO

An 8-metre-long column is constructed from two 400 mm x 250 mm I-section joists joined as shown below. One end is fixed, the other free and a load equal to half of the Euler load is applied. Determine the load factor provided if the Perry-Robertson formula is used. Use the information below,

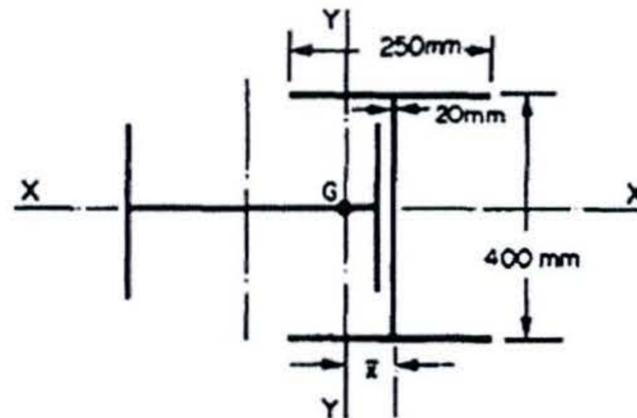


Figure question 2

For each joist,

$$I_{max} = 213 \times 10^{-6} \text{ m}^4 \text{ and } I_{min} = 9,6 \times 10^{-6} \text{ m}^4, A = 8,4 \times 10^{-3} \text{ m}^2$$

The flanges are 20 mm thick. For the joist material, take $E=208 \text{ GN/m}^2$ and Stress along the y axis is given as 270 GN/m^2 . (25)

QUESTION THREE

A compound thick cylinder is formed by shrinking a cylinder of internal diameter 100 mm and external diameter 200 mm on to an external cylinder of internal diameter 200 mm and external diameter 300 mm. The resultant shrinkage pressure is found to be 20 MN/m^2 at the neutral line. An internal pressure of magnitude 60 MN/m^2 is now applied to the cylinder.

Determine:

- a) the value of hoop and radial stress on the inside cylinder due to both internal pressure and shrinkage pressure. (14)
- b) the value of hoop and radial stress on the outside cylinder due to both internal pressure and shrinkage pressure. (11)

QUESTION FOUR

A rectangular steel bar 25 mm by 50 mm is subjected to a 500 Nm torque

NB take $G = 80 \text{ GN/m}^2$

Determine:

- a) the maximum stress set up. (14)
- b) the angle of twist. (11)

QUESTION FIVE

A thick cylinder of internal radius 180 mm and external radius 360 mm is subjected to an internal pressure of 80 MN/m^2 and external pressure of 20 MN/m^2 .

Determine;

- a) the hoop and radial stresses on the inside surface of the cylinder. (12)
- b) the hoop and radial stresses on the outside surface of the cylinder. (8)
- c) the longitudinal stress on the cylinder if the cylinder is assumed to have closed ends. (5)

QUESTION SIX

A material is subjected to two mutually perpendicular direct stresses of 60 MN/m^2 tensile and 40 MN/m^2 compressive, together with a 50 MN/m^2 shear stress, the shear couple acting on the 60 MN/m^2 stress is clockwise in effect. Determine:

- a) the magnitude of the shear stresses. (11)

- b) the direction of the planes on which these stresses act.
- c) the value of the maximum shear stress.

(8)

(6)

End of examination question paper