NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF CIVIL AND WATER ENGINEERING
FACULTY OF INDUSTRIAL TECHNOLOGY
BACHELOR OF ENGINEERING (HONOURS) DEGREE
PART II FIRST SEMESTER EXAMINATION – APRIL/MAY 2009
MECHANICS OF SOLIDS – TCW 2101

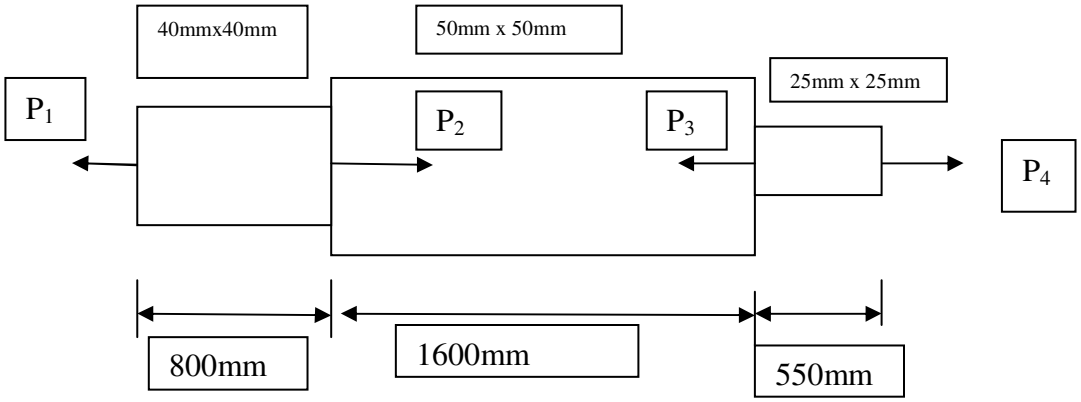
INSTRUCTIONS

Answer all questions. All questions carry equal marks

Time: 3 hours
Total Marks: 100

QUESTION 1

a) A member ABCD is subjected to point load P_1, P_2, P_3 and P_4 as shown in the fig1a**.** Calculate the force P_3 necessary for equilibrium if P_1 = 110kN, P_2 = 200kN and P_4 = 175kN. Determine also the net change in length of the member. Take E = 200 x 10^5 N/mm. **(6 marks)**



(b) Derive an expression for the extension of a uniformly tapping bar which tappers from a diameter d_1 at the larger end to a diameter d_2 at the smaller end. **(6 marks)**

(c) A steel bar 6m long is at a temperature of 26^{o}C.Find the free expansion of the length when the temperature is raised to 60^{o}C. Find also the temperature stress produced when Take E = 12 x 10
(i) The extension of the rod is prevented.
(ii) When the rod is allowed to expand by 4.7mm. **(6 marks)**

(d) Explain how stress is induced in a number when its temperature is altered. **(2 marks)**

QUESTION 2

(a) List any three types of support connections. **(3 marks)**

(b) Draw the shear force, normal force and bending moment diagrams for the beam shown in fig 2(b). **(15 marks)**

(c) State the relationship between the bending moment and defection of a beam. **(2marks)**

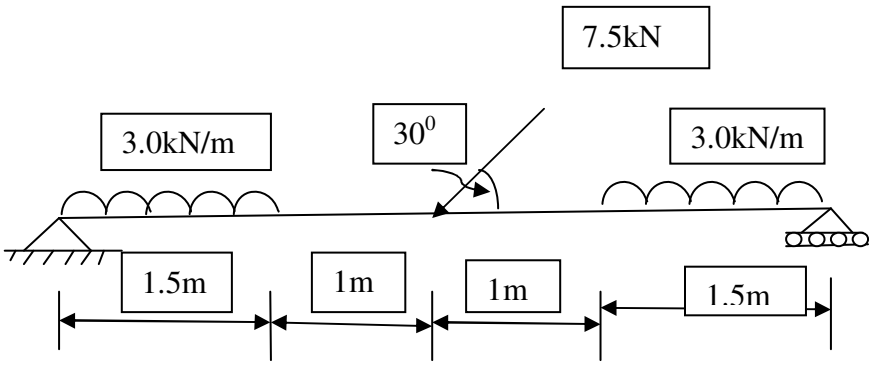


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Fig 2b

QUESTION 3

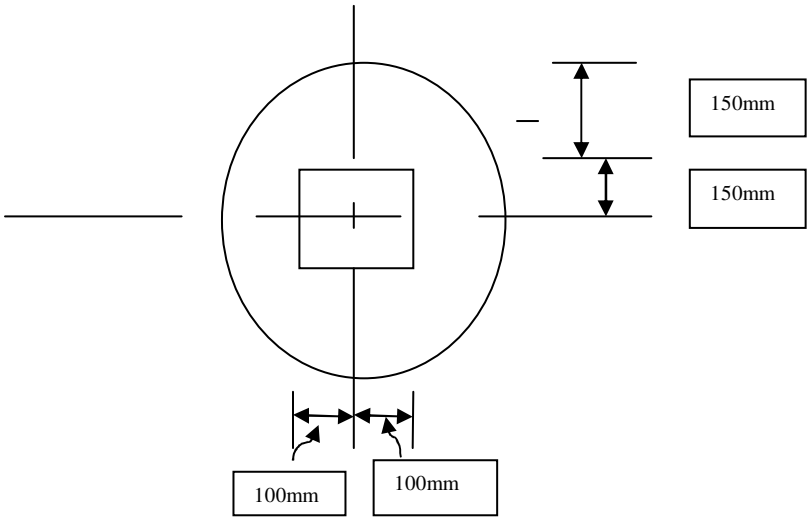
(a) State any four (4) assumptions in the theory of bending (elastic). **(4 marks)**

(b) Define the term 'section modulus'. **(2marks)**

(c) A rolled steel; joint of I section has following dimensions:
(i) Flange: 300mm (width) x 24mm (thickness)
(ii) Web: 16mm (thickness)
(iii) Overall depth: 600mm

If the beam carries a uniformly distributed load of 50kN/m on a span of 9m, calculate the stress produced due to bending. **(7marks)**

d) Find the moment of inertia, section modulus and moment of resistance for the section shown below. **(5marks)**



(e) What is the angle of obliquity that gives:
(i) Maximum normal stress and (ii) Maximum tangential stress on an axially loaded member. **(2 marks)**

QUESTION 4

(a) Under what condition does torsion on occur? **(3 marks)**

(b) List four (4) assumptions in the theory of pure tarsi on. **(4 marks)**

(c) A hallow shaft of 25mm outside diameter and 16mm internal diameter is subjected to a torque of 400Nmm. Find the shear stresses at the outside and inside of the shaft. **(4 marks)**

(d) A steel shaft transmitters 110HP at 160rpm. If the shaft is 100mm in diameter, find the torque on the staff and the maximum shear stress induced. Find also the twist in a 6m length. Take $C= 8x10^2$ N/mm. **(9marks)**

QUESTION 5

a) Define (i) Stress and (ii) Strain **(3 marks)**

(b) State Hook's law and draw a well labeled stress-strain curve for a typical elastic material. **(4 marks)**

(c)What is the difference between the Modules of Elasticity and the Shear Modulus (Modulus of rigidity) **(2 marks)**

(d) (i)A load of 35N has to be hoisted at the end of a steel wire. If the tensile stress in the wire must not exceed $0.6N/mm^2$, what is the minimum required diameter of the wire? What will be the extension of the wire if it is 2.5m long? Take $E=2x10^5$ N/mm. **(5 marks)**

(ii) A steel rod, 2.5mm in diameter is subjected to an axial pull of 75kN. Find

(a) the stress in the rod

(b) the strain in the rod and,

(c) the elongation of the rod **(6 marks)**