KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2020/2021 ACADEMIC YEAR

SECOND YEAR FIRST SEMESTER
MAIN EXAMINATIONS

FOR THE DEGREE OF BACHELOR OF SCIENCE IN RENEWBLE ENERGY AND BIOFUELS TECHNOLOGY

COURSE CODE: REN 211

COURSE TITLE: SOLID MECHANICS

DURATION: 2 HOURS

DATE: 15/06/2021 **TIME: 8-10PM**

INSTRUCTIONS TO CANDIDATES

- Answer **QUESTION ONE** (Compulsory) and any other two (2) Questions.
- Indicate **answered questions** on the front cover.
- Start every question on a new page and make sure question's number is written on each page.

This paper consists of **4** printed pages. Please Turn Over

QUESTION 1 (30 marks)

a. Define the following terms:
   i. Load (2 marks)
   ii. Point of contraflexure (2 marks)
   iii. State of pure bending (2 marks)

b. State two examples each of static force and dynamic force. (4 marks)

c. State any five (5) assumptions made in the theory of simple bending. (5 marks)

d. Determine the elasto-plastic and fully plastic moments of resistance of a universal Beam having the following properties and comment on the plastic moment capacity of the section. Zxx = 1.42 x 106 mm^4, Sxx = 1.65 x 106 mm^4. Yield Strength, p_y = 275 N/mm^2. (5 marks)

e. The section shown in Fig. 1 below is that of a cantilever 5 m long carrying a uniform load of 4 kN/m, which is applied perpendicular to the x–x axis. Calculate:
   i. The maximum bending stress in the beam under this loading. (5 marks)
   ii. The maximum concentrated load that may be carried at the free end of the cantilever in addition to the uniform load, if the permissible bending stress is 120 N/mm^2. (5 marks)

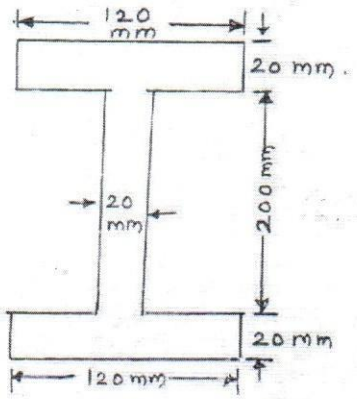

Fig. 1

QUESTION 2 (20 marks)

Fig. 2 is a steel beam with a cantilever and support at points A and B. Calculate:
   i. The reactions at A and B. (5 Marks)
   ii. Draw the shearing force diagram. (5 marks)
   iii. Draw the bending moment diagram. (5 marks)
   iv. Determine the position and magnitude of the maximum bending moment. (5 marks).

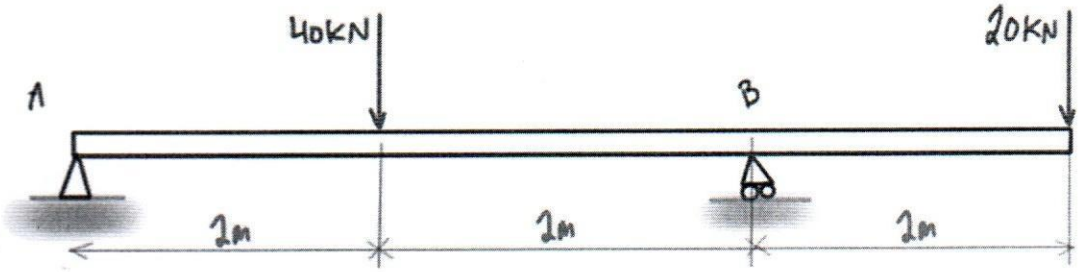

Fig. 2

QUESTION 3 (20 marks)

a. Derive the general expression for simple bending from the first principles. (10 marks)
b. A truck with axle loads of 40 kN and 60 kN on a wheel base of 5 m rolls across a 10 m span. Compute:
   i. The maximum bending moment. (7 marks)
   ii. The maximum shearing force. (3 marks)

QUESTION 4 (20 marks)

A composite beam section consists of a timber joist and a steel plate of the same length as shown in Fig. 3 below. The beam when loaded is subject to a sagging bending moment in the plane y-y axis which has a maximum value of 1.8 kNm. Determine the maximum compressive and tensile bending stresses induced in the section by this moment when:

a. The two sections remain in contact with each other but are not bolted together. (12 marks).
b. The two sections are firmly bolted together along their lengths. (8 marks)

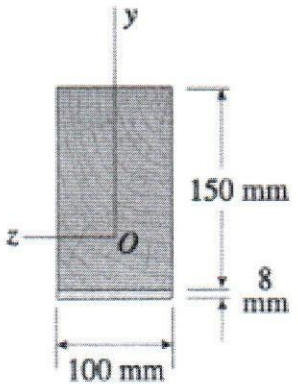

Fig. 3

QUESTION 5 (20 marks)

a. Determine the second moments of area of the rectangle shown in Fig. 4 about:
   i. x – x axis (5 marks)
   ii. y – y axis (5 marks)

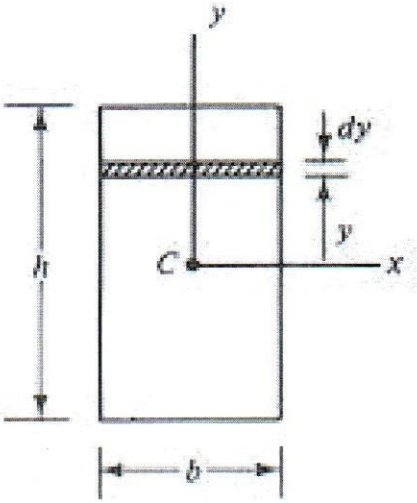

Fig. 4

b. A hollow circular shaft is required to transmit a torque of 6,000 Nm and is 4 m long. If the maximum permissible angle of twist is 2 degrees over the whole length, determine the diameters required when in a ratio of 2:1. G = 70 kN/mm^2. (10 marks)

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