



# **DEDAN KIMATHI UNIVERSITY OF TECHNOLOGY**

## **UNIVERSITY EXAMINATIONS**

**2021/ 2022 ACADEMIC YEAR**

**SUPPLEMENTARY/ SPECIAL EXAMINATIONS – MAY 2022**

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**BACHELOR OF TECHNOLOGY IN BUILDING CONSTRUCTION (B. Tech. 3.2)**

**COURSE CODE: ECE 4106**

**COURSE TITLE: STRUCTURAL DESIGN I**

### **INSTRUCTIONS TO CANDIDATES**

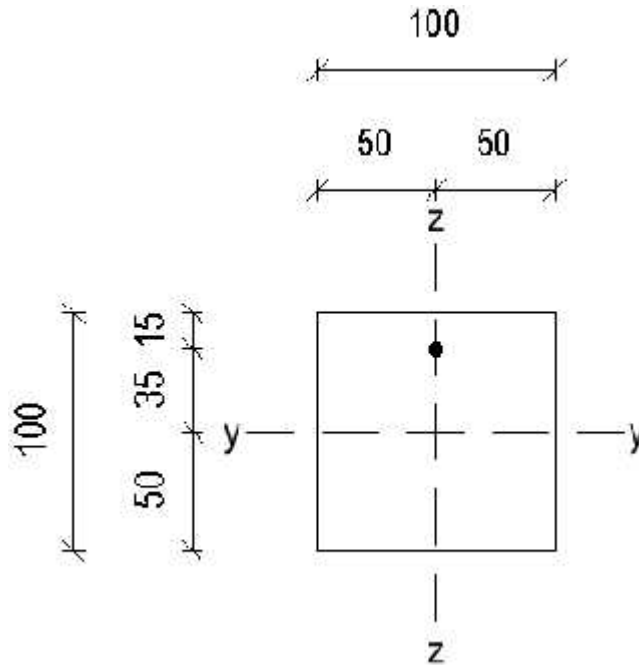
- Attempt any THREE (3) questions
- Relevant design codes are allowed
- Scientific non-programmable calculators may be used
- Clearly state any assumptions made

**TIME: 2 HOURS**

**This paper consists of 3 printed pages**

**Question 1** (20 mks)

A mechanically graded timber column of strength class C16 consists of a 100 mm square section which is restrained at both ends in position but not in direction. The column has an actual height of the column is 3.75m, and carries an axial load of 10 kN applied 35 mm eccentric to its y–y axis as shown in **Figure Qn 1** below. Check the adequacy of the column assuming that the service conditions comply with Service Class 2

**Figure Qn 1**

You are required to;-

1. Calculate the slenderness ratio (3 marks)
2. Check the buckling resistance of the section (10 marks)
3. Check the lateral torsional stability of the section (7 marks)

**Question 2** (20 mks)

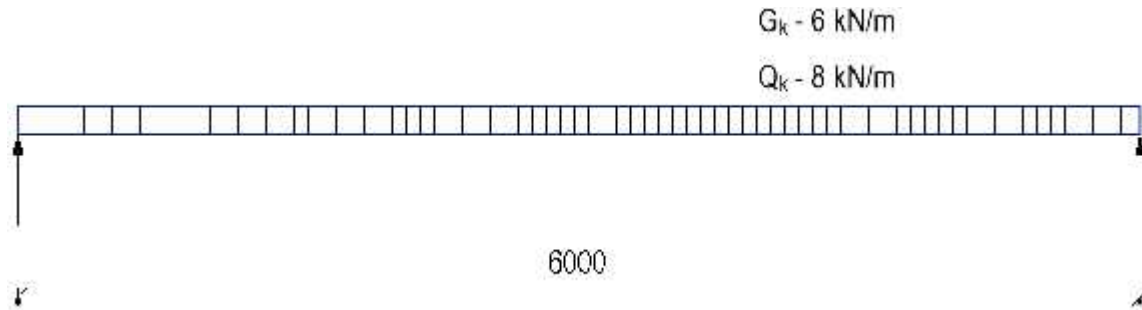
Select and check a suitable steel column to support a design axial permanent load of 600 kN together with a major axis variable bending moment of 300 kNm applied at the top of the element. Assume S275 steel is to be used and that the column is pinned at both ends.

You are required to;-

1. Select the appropriate steel section (5 marks)
2. Check resistance of the section to bending and axial force (7 marks)
3. Check resistance of the section to combined bending and axial compression (8 marks)

**Question 3** (20 mks)

Select and check a suitable beam section using S275 steel to support the loads shown in **Figure Qn 3** below. Assume beam is fully laterally restrained and that it sits on 125 mm bearings at each end. Ignore the self-weight of the beam

**Figure Qn 3**

You are required to;-

1. Select the appropriate steel section (5 marks)
2. Determine the bending and shear resistance of the section (4 marks)
3. Determine the web buckling resistance of the section (8 marks)
4. Check the deflection of the section (3 marks)

**Question 4** (20 mks)

- a. A solid timber beam, 75 mm wide  $\times$  250 mm deep, in strength class C16, 3.4 m simply supported, supports uniformly distributed permanent (including self-weight of beam) and variable actions of 0.2 kN/m and 2 kN/m respectively. Assuming the beam is torsionally restrained at supports and the exposure is service class 2, check its bending capacity (10 marks)
- b. A 305x305x118 UC carrying an axial design load of 2200 kN is supported on a 500x500x30mm base plate. Check the adequacy of the column baseplate. Assume that the foundations are of concrete of compressive cylinder strength of  $30 \text{ N/mm}^2$  and that the baseplate is made of S275 steel (10 marks)