(University of Choice)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY SPECIAL/SUPPLEMENTARY EXAMINATIONS 2021/2022 ACADEMIC YEAR

THIRD YEAR SECOND SEMESTER EXAMINATIONS

FOR THE DEGREE OF:
BACHELOR OF SCIENCE IN CIVIL AND STRUCTURAL ENGINEERING
BACHELOR OF TECHNOLOGY IN BUILDING CONSTRUCTION

COURSE CODE: CSE 312

COURSE TITLE: PLASTIC ANALYSIS OF STRUCTURES

DATE: 01ST AUGUST 2022 TIME: 8:00AM – 10:00AM

INSTRUCTIONS:

1. This paper contains **FIVE** questions
2. Answer **QUESTION ONE** and any other **TWO** Questions
3. Marks for each question are indicated in the parenthesis.
4. Examination duration is **2 Hours**

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 4 Printed Pages. Please Turn Over.

QUESTION ONE (*30 MARKS*)

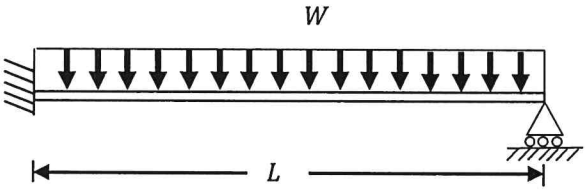
a) Define the following terms as used in plastic analysis of structures. **(5mks)**

(i) Plastic design
(ii) Plastification
(iii) Plastic hinge
(iv) Shape factor
(v) Plastic moment

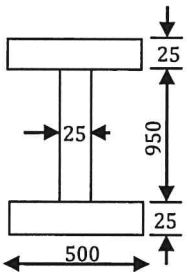
b) State any THREE fundamental differences between elastic analysis and plastic analysis of structures. **(6mks)**

c) A steel beam shown in Figure Q1 is to be used in the construction of a bridge of length, L = 4m.

(i) Determine the shape factor of the structure. **(4mks)**
(ii) Explain the significance of the factor calculated in (i) above. **(2mks)**
(iii) Calculate the collapse load using the kinematic method of plastic analysis. (Assume that the plastic moment is constant throughout the beam, and the yield stress is 500MPa). **(13mks)**



a) Support and loading conditions



b) Beam cross-section (dimensions in mm)

Figure Q1

QUESTION TWO (*20 Marks*)

a) Postulate the collapse mechanisms of the structures under the influence of monotonically increasing static load configurations given in Figure Q2(a). **(4mks)**

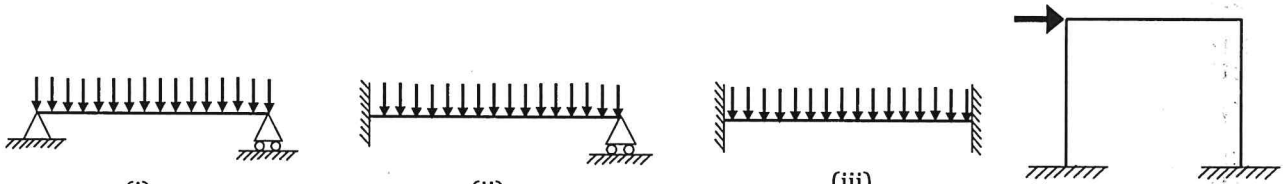


Figure Q2(a)

b) Evaluate using virtual work method, the ultimate load, W_c, required to cause collapse of a beam loaded as shown in Figure Q2(b). The material making the beam has plastic moment, M_p = 100 kNm. **(16mks)**

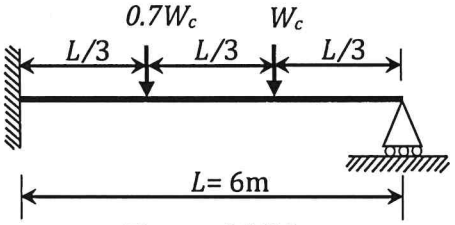
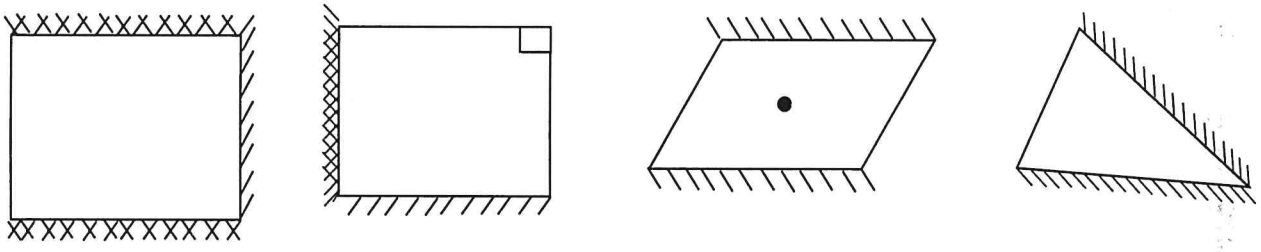


Figure Q2(b)

QUESTION THREE (*20 Marks*)

a) State and explain the THREE theorems of plastic collapse. **(6mks)**

b) Postulate the yield line pattern for the slab configurations shown in Figure Q3. **(6mks)**



(i) Square slab (ii) Square slab (iii) Rhombus (iv) Triangle

Figure Q3

c) Evaluate the ultimate load for a square concrete slab which is simply supported on all four edges, isotropically reinforced, side length L and moment of resistance m per unit length. **(8mks)**

QUESTION FOUR (*20 Marks*)

a) Differentiate between plastic hinge and mechanical hinge. **(4mks)**

b) An isotropically reinforced rectangular slab is simply supported along all four sides and subjected to a uniformly distributed load of w kN/m^2 as shown in Figure Q4. Show that the ultimate load that the slab can carry using mechanism method of plastic analysis is given by: **(16mks)**

$$W_u = \frac{24m}{\alpha^2 L^2}\left(\frac{1}{\sqrt{3+\mu\alpha^2}-\alpha\sqrt{\mu}}\right)^2$$

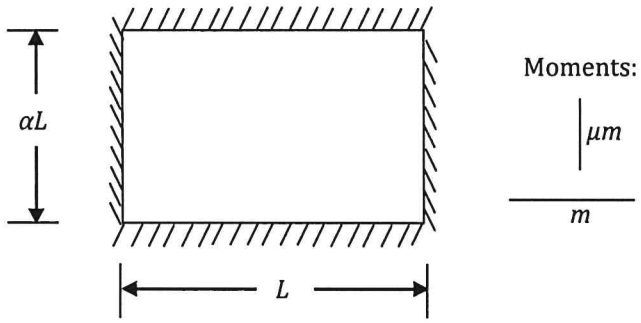


Figure Q4

QUESTION FIVE (*20 Marks*)

A rigid-jointed frame with the relative M_P values and the applied collapse load is as shown in Figure Q5. Determine the required M_P value, the value of the support reactions and sketch the bending moment diagram at collapse. **(20mks)**

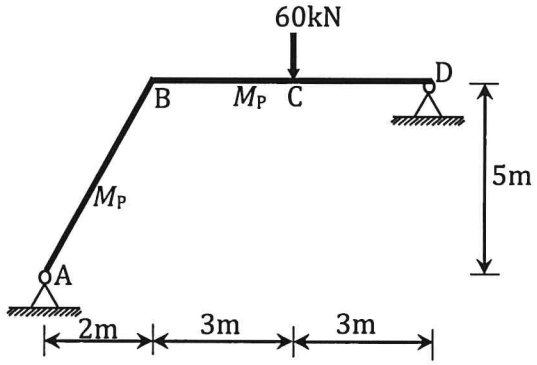


Figure Q5

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