TECHNICAL UNIVERSITY OF MOMBASA

SCHOOL OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF BUILDING & CIVIL ENGINEERING
UNIVERSITY EXAMINATION FOR:

BACHELOR OF SCIENCE IN CIVIL ENGINEERING

ECV 4505: THEORY OF STRUCTURES V

END OF SEMESTER EXAMINATION
SERIES: JANUARY 2025
TIME: 2 HOURS

Instructions to Candidates
You should have the following for this examination
-Answer Booklet, calculator, examination pass and student ID
This paper consists of **five** questions.
Attempt question ONE (Compulsory) and any other TWO questions.
Do not write on the question paper.

QUESTION ONE (COMPULSORY) 30 Marks

(i) Find the load factor at collapse for the prismatic beam shown in Figure Q(i) if Mp = 86kNm. **(15 Marks)**

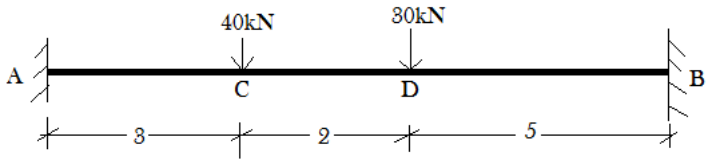


Figure Q1(i)

(ii) Calculate the plastic section modulus, shape factor and plastic moment of the I-beam section shown in figure Q1(ii). **(15 Marks)**

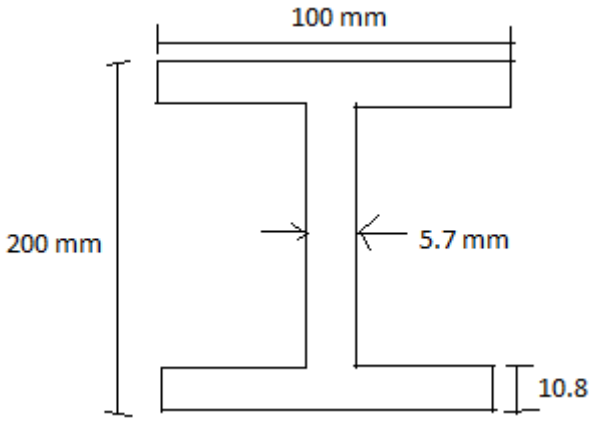


Figure Q1(ii)

QUESTION TWO

The rigid-jointed frame shown in figure Q2 is loaded with working loads as shown. Find the value of the collapse load factor when Mp = 120kNm. (**20 Marks**)

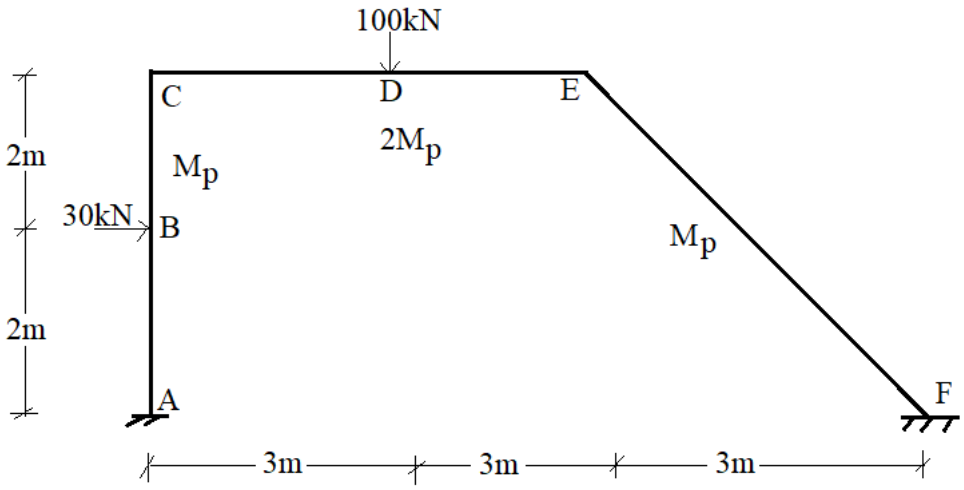


Figure Q2

QUESTION THREE

i. List five guidelines that are followed in predicting the position of yield lines and their axes of rotation in slabs. **(5 Marks)**

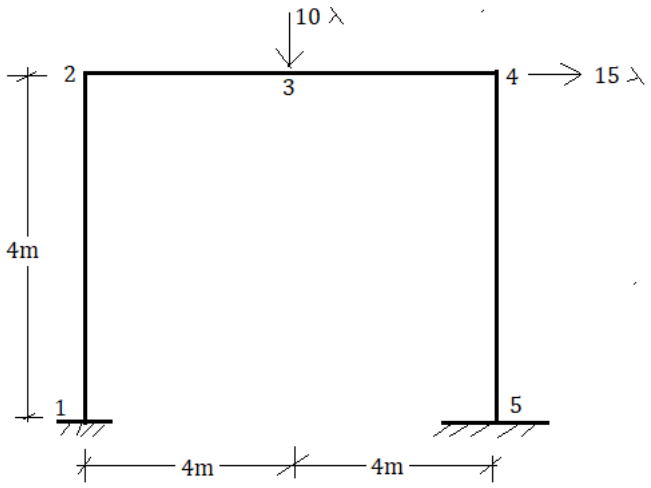
ii. Briefly explain the following theorems of plastic analysis of structures
   a) Kinematic theorem (2 marks)
   b) The lower bound theorem (2 marks)
   c) Uniqueness theorem (2 Marks)

iii. With aid of diagrams discuss three elementary mechanisms that can occur in plastic analysis of frames. (**9 Marks**)

QUESTION FOUR

(i) One of the spans of a continuous one-way slab has been so reinforced that the ultimate moment capacities at the left end, right end and in the span are 1400, 1200 and 900 kg.m/m respectively. The centre-to-centre distance of supports is 3m and the beam is uniformly loaded. Compute the collapse load of the slab and determine the position of the yield line. **(11 Marks)**

(ii) Each member of the frame shown below is uniform and has a plastic moment of 25kNm. Find the collapse load factor considering the kinematic theorem. **(9 marks)**



QUESTION FIVE

Calculate the plastic section modulus, shape factor and plastic moment of the section shown in Figure Q5. Assume $Z_{xx} = 223.5\ cm^2$. **(20 Marks)**

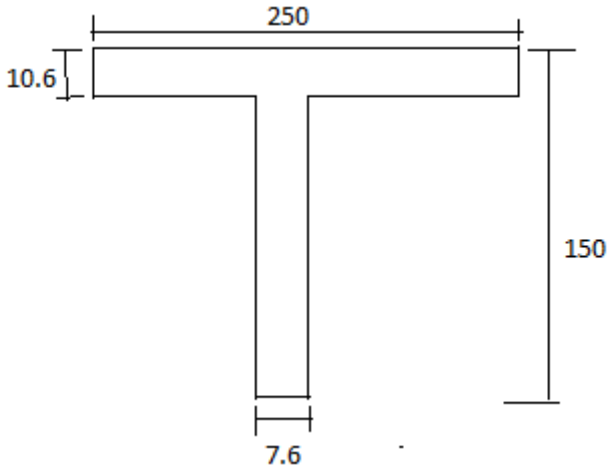


Figure Q5