NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF ENGINEERING

DEPARTMENT OF INDUSTRIAL AND MANUFACTURING ENGINEERING

BEng (HONS) INDUSTRIAL AND MANUFACTURING ENGINEERING

APPLIED MECHANICS

EIE1206

Second Semester Main Examination Paper

March 2025

This examination paper consists of **5 printed** pages.

Time Allowed:	**3 HOURS**
Total Marks:	**100**
Examiner's Name:	**W. Tumbudzuku**

INSTRUCTIONS AND INFORMATION TO THE CANDIDATE

a) Answer any **FIVE (5)** Questions.

b) Each question carries a total of **20 Marks**.

c) Start the answer to each question on a fresh page.

d) Ensure neatness and legibility of work.

e) Use of scientific calculators is permissible.

QUESTION ONE

a) With the aid of diagrams describe the 6 main principles of engineering mechanics. [10]

b) Give three real-life applications of mechanics and briefly explain each.[6]

c) State the principle of transmissibility on a rigid body. [2]

d) Explain why the principle of transmissibility is valid for rigid bodies but not applicable to deformable bodies in manufacturing applications. [2]

QUESTION TWO

a) Explain the following beams using diagrams.

i. Cantilever Beam. [2]

ii. Simple supported beam. [2]

iii. Point Load. [2]

iv. Uniformly Distributed Load. [2]

v. Uniformly Varying Load. [2]

b) Using the method of joints, determine the force in each member of the truss shown in Figure Q2. Mention whether the members are in tension or compression. [10]

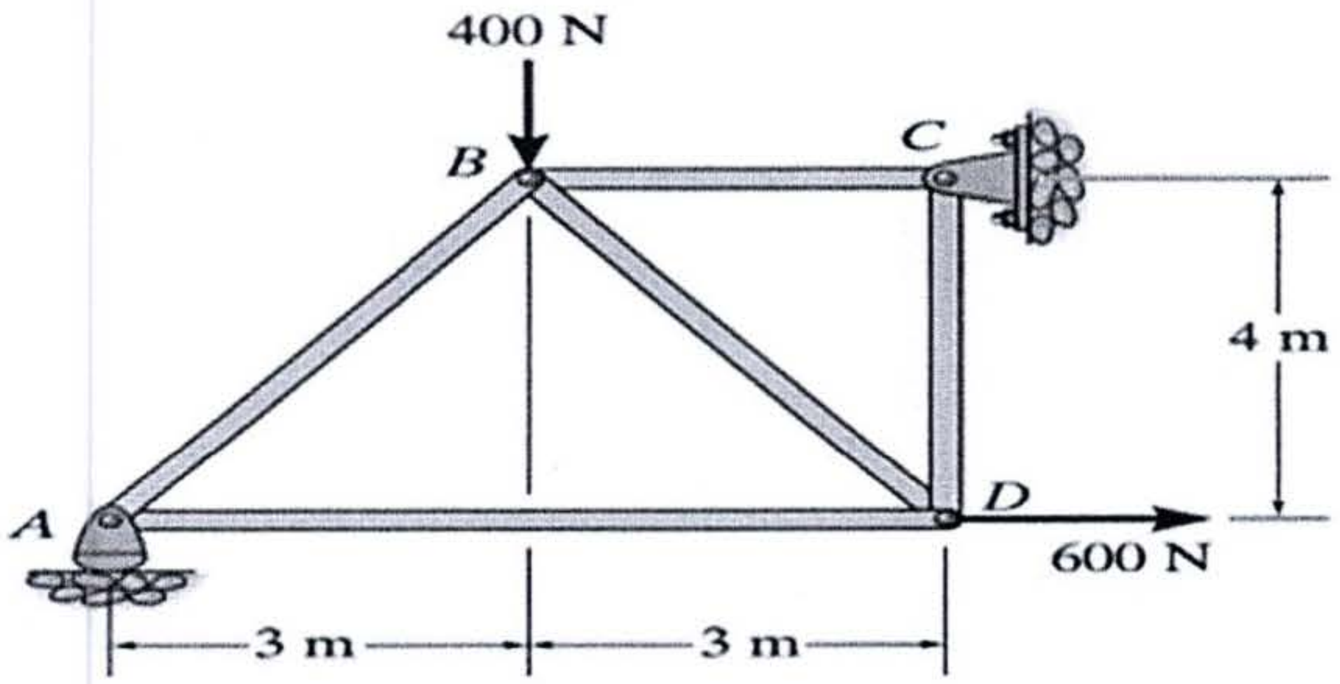

Figure Q2: Truss under loading.

QUESTION THREE

a) For the truss loaded as shown in Figure Q 3, determine the forces in members AF, BF,BC, FE ,CE and DC using method of sections. [14]

b) Derive the relationship between the load intensity, shear force and the bending moment. [6]

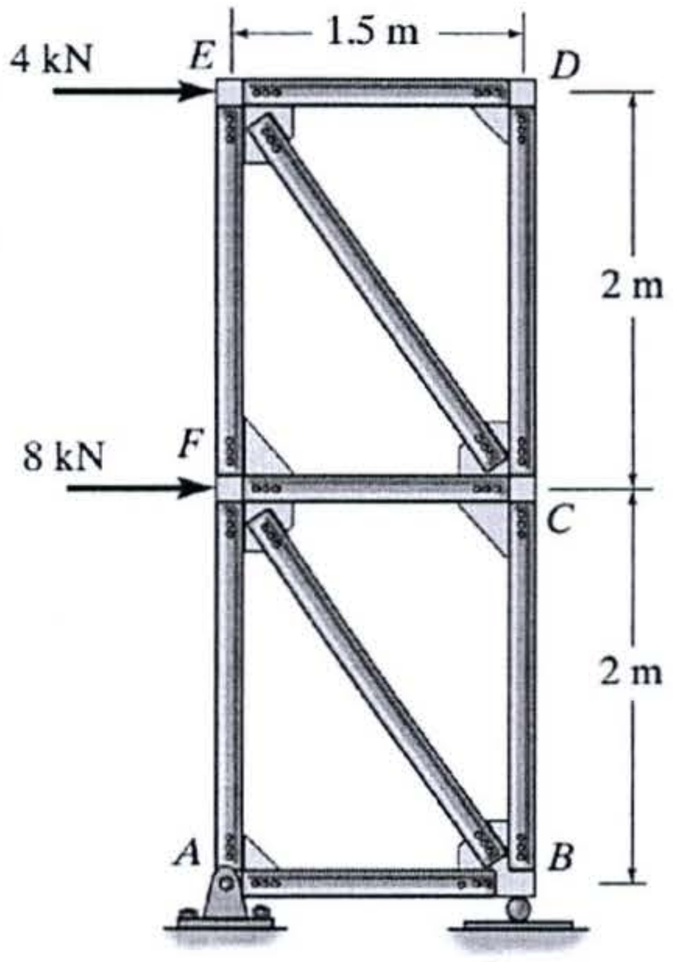

Figure Q3 Truss under loading

QUESTION FOUR

A beam is loaded as shown in Figure Q4,

a) Determine the reactions at the support. [4]

b) Derive differential equations for the beam as the distance varies from point A to point C. [6]

c) Draw the shear force and the bending moment diagrams. [10]

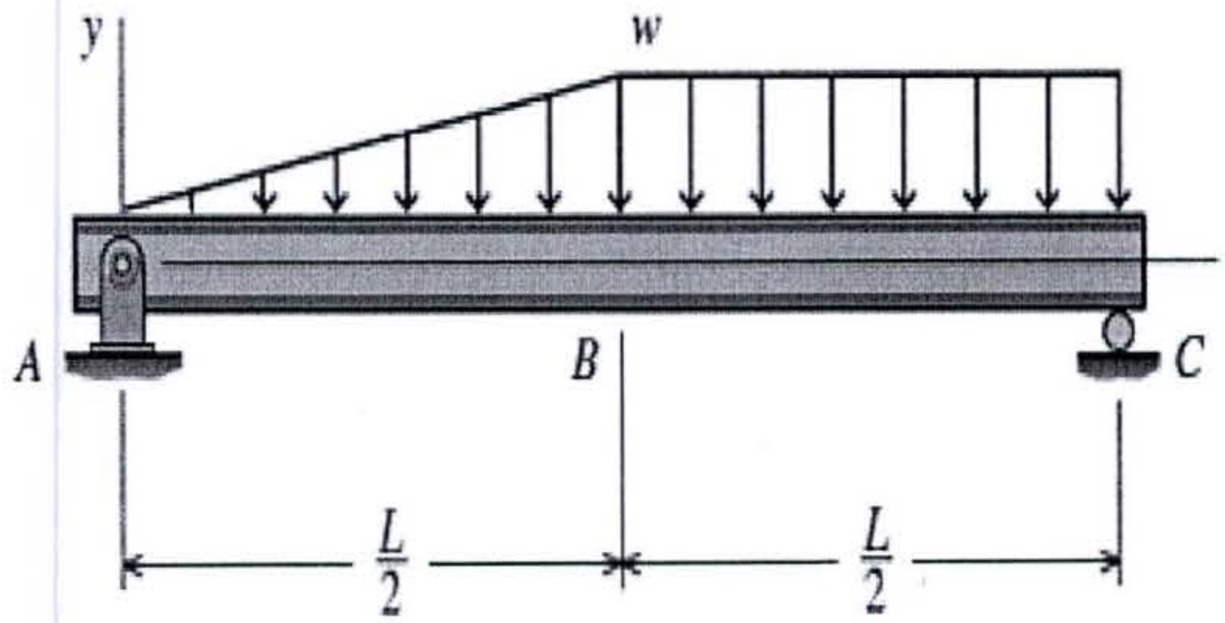

Figure Q4: Beam under loading

QUESTION FIVE

For the cantilever beam loaded as shown in Figure Q5, determine:

a) The point of contraflecture, [2]
b) The shear force at points B, C and D, [6]
c) Draw shear force and bending moment diagrams. [12]

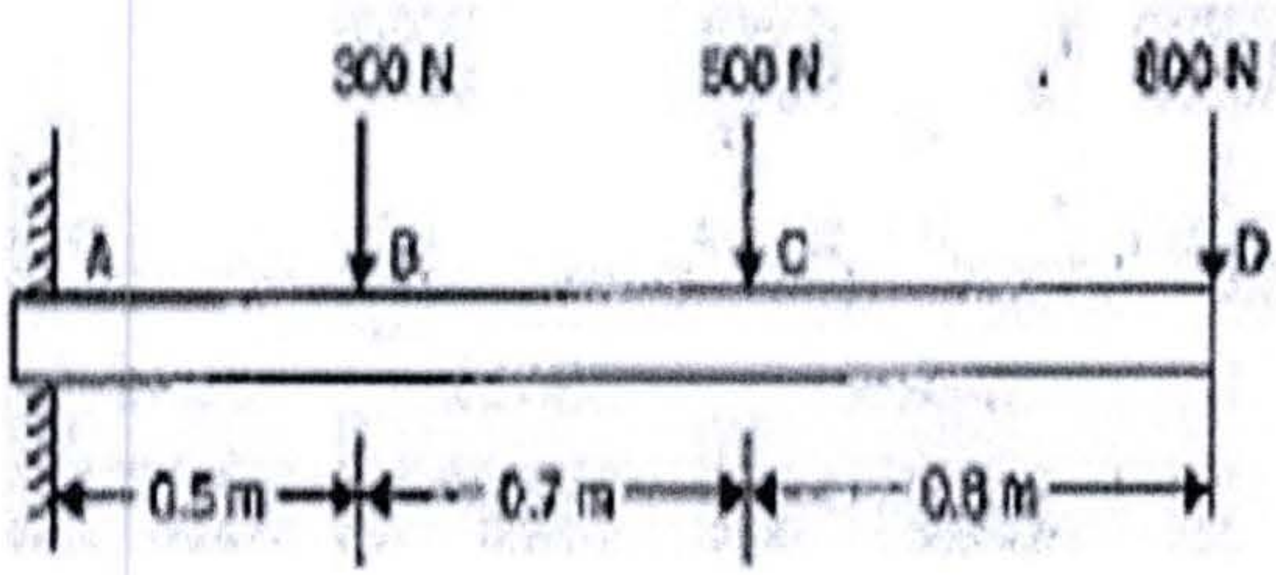

Figure Q 5 Cantilever beam.

QUESTION SIX

a) Describe the following types of friction:
   i. Static, [3]
   ii. Sliding and [3]
   iii. Rolling friction. [3]

b) A rigid body is resting on a rough surface as force P is being applied in the horizontal direction. Using a graph describe the variation of the applied force to the frictional force. [6]

c) In applied mechanics, understanding how forces act on a body is crucial for analyzing its stability and motion. A body is said to be in equilibrium when the net force and net moment acting on it are both zero.
What are the two conditions of equilibrium in applied mechanics? Explain why these conditions are essential in engineering structures like bridges or cranes. [5]

QUESTION SEVEN

a) Inertia plays a crucial role in mechanics and motion.

i. Define inertia and explain its significance in Newton's First Law of Motion. [2]

ii. Differentiate between mass moment of inertia and area moment of inertia, providing one practical application of each. [4]

b) Determine the centroid of a triangle from first principles. [8]

c) A uniform thin rod of length 1.5 m and mass 4 kg is rotated about an axis perpendicular to its length:

Determine its moment of inertia when rotated about its center and its moment of inertia when rotated about one of its ends. [5]

End of examination