UNIVERSITY of RWANDA

COLLEGE OF SCIENCE AND TECHNOLOGY

SCHOOL OF ENGINEERING (SoE)

DEPARTMENT OF CIVIL, ENVIRONEMNTAL AND GEOMATICS ENGINEERING (CEGE)

TRE1262 MECHANICS OF MATERIALS

Assignment 1

Date: 17/02/2025 **Total Marks: 400**

Deadline of submission is on 03/03/2025 at 10:59 AM at phabimana@ur.ac.rw for soft copies and handing in the hard copies to the lecturer in class.

QUESTION 1 [35 Marks]

Determine the **support reactions** for each structure shown in **Figure 1**, **Figure 2** and **Figure 3** below.

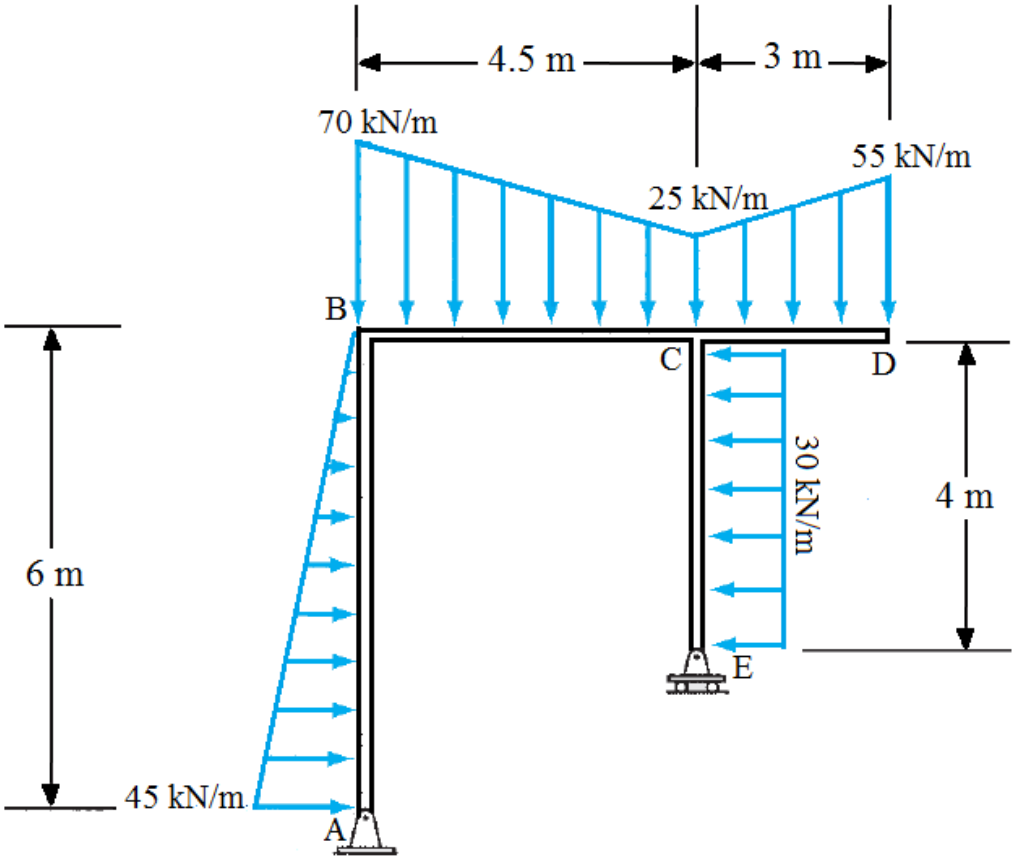

Figure 1.

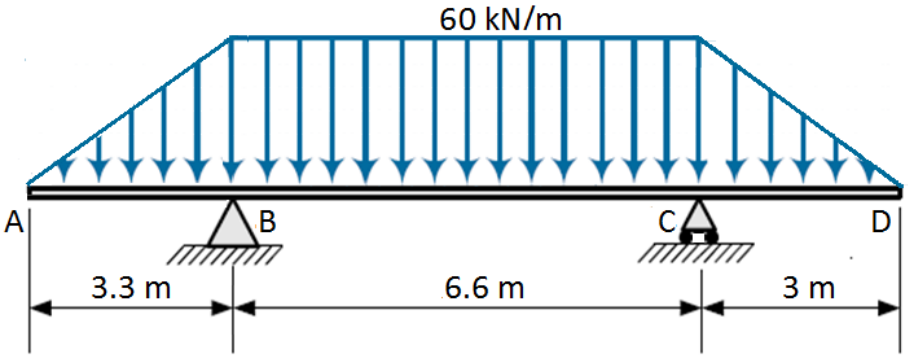

Figure 2.

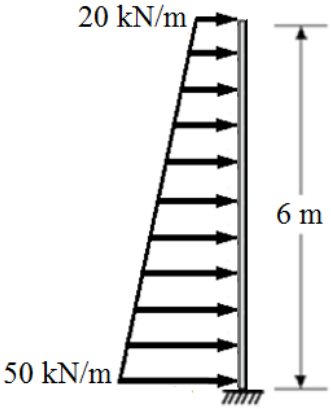

Figure 3.

QUESTION 2 [30 Marks]

The truss is shown in **Figure 4** below.

i. Check the **static determinacy** of the truss.

ii. By considering the **global** equilibrium, determine the force on joints A and E.
Note: Consider the lever to the force at E and ignore its components.

iii. By considering the **local** equilibrium, determine **all** forces on joints A and E.
Please **do not consider** the results obtained in sub-question **ii**.

Hints: Start from joint C and use the method of joints on sub-question **iii**.

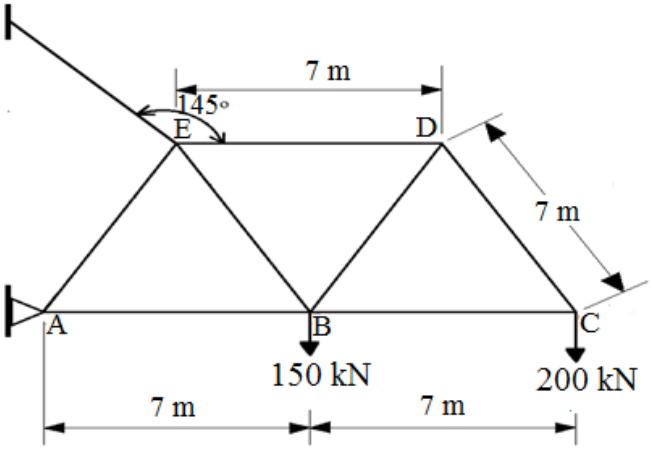

Figure 4.

QUESTION 3 [120 Marks]

a. **[80 Marks]**

A steel plate and concrete cross section are presented on Figure 5 (a) and (b) respectively. All dimensions are in **cm**.

i. Determine the centroidal coordinates of the cross section shown in **Figure 5**.

ii. Determine the static moment of area about the horizontal axis passing through the centre of gravity of the cross section. If possible compare the results obtaining considering the part above and below the centre of gravity.

iii. Determine the section modulus about the horizontal axis passing through the centre of gravity of the cross section.

iv. Determine the radius of gyration about the horizontal axis passing through the centre of gravity of the cross section.

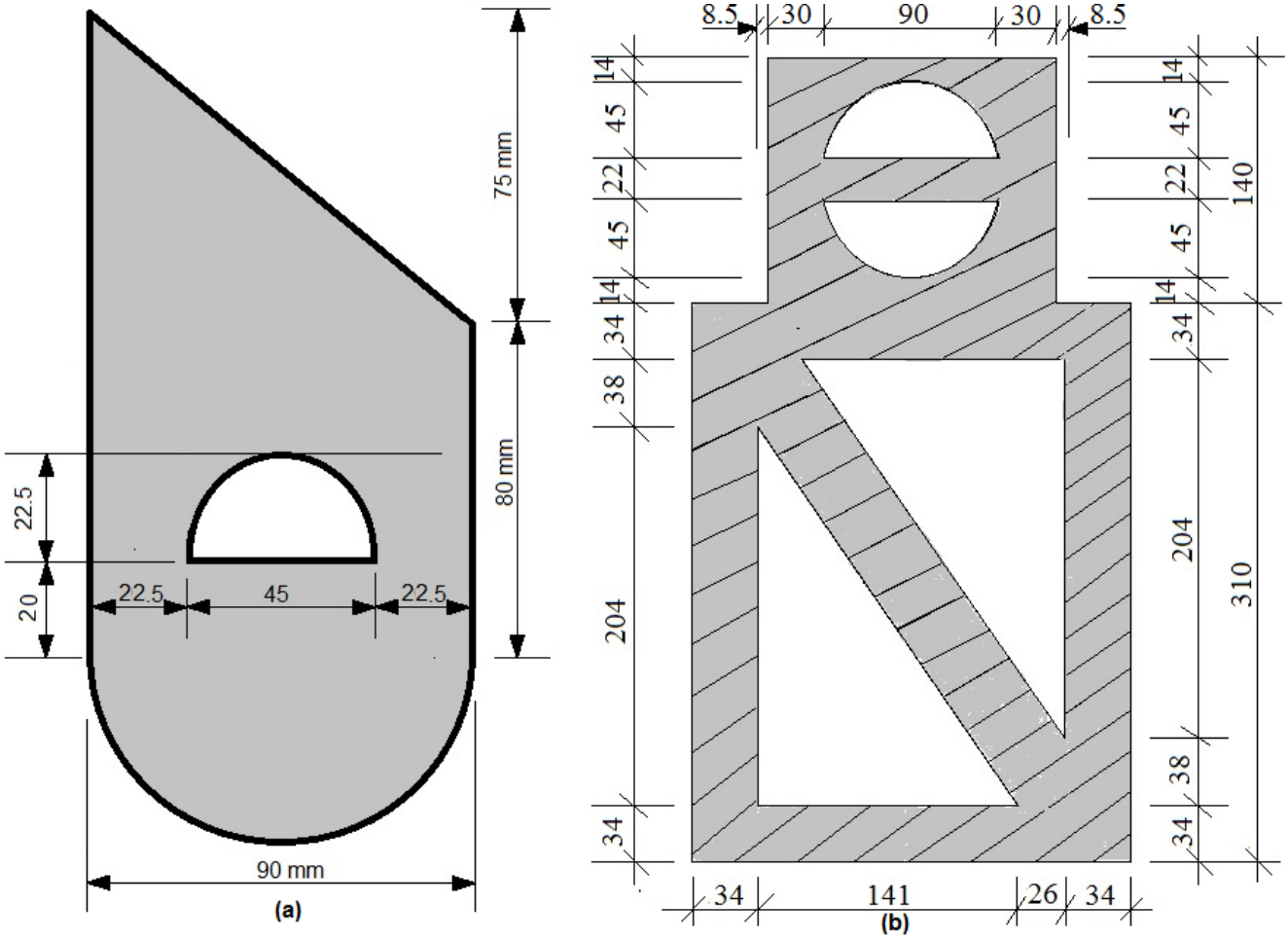

Figure 5.

b. **[40 Marks]**

Develop a **template** in **excel software** to calculate **all the properties** of area of the section presented in **Figure 5 (a)** above. **Submit the template** with all steps displayed clearly from the **formula** to the **result**. Also **summarize the process** that you have followed while **developing the template**.

QUESTION 4 [60 Marks]

The cross section of a I-beam made with steel is shown in **Figure 6** below with all dimensions in **mm**.

i. Determine the centroidal coordinates of the cross section shown in **Figure 6**.
ii. Determine the elastic section modulus about the horizontal axis passing through the centre of gravity of the cross section.
iii. Determine the position of the plastic neutral axis (an axis which divides the cross section of the I-beam into two (2) equal areas).
iv. Determine the plastic section modulus about the plastic neutral axis of the cross section.
v. Determine the shape factor.

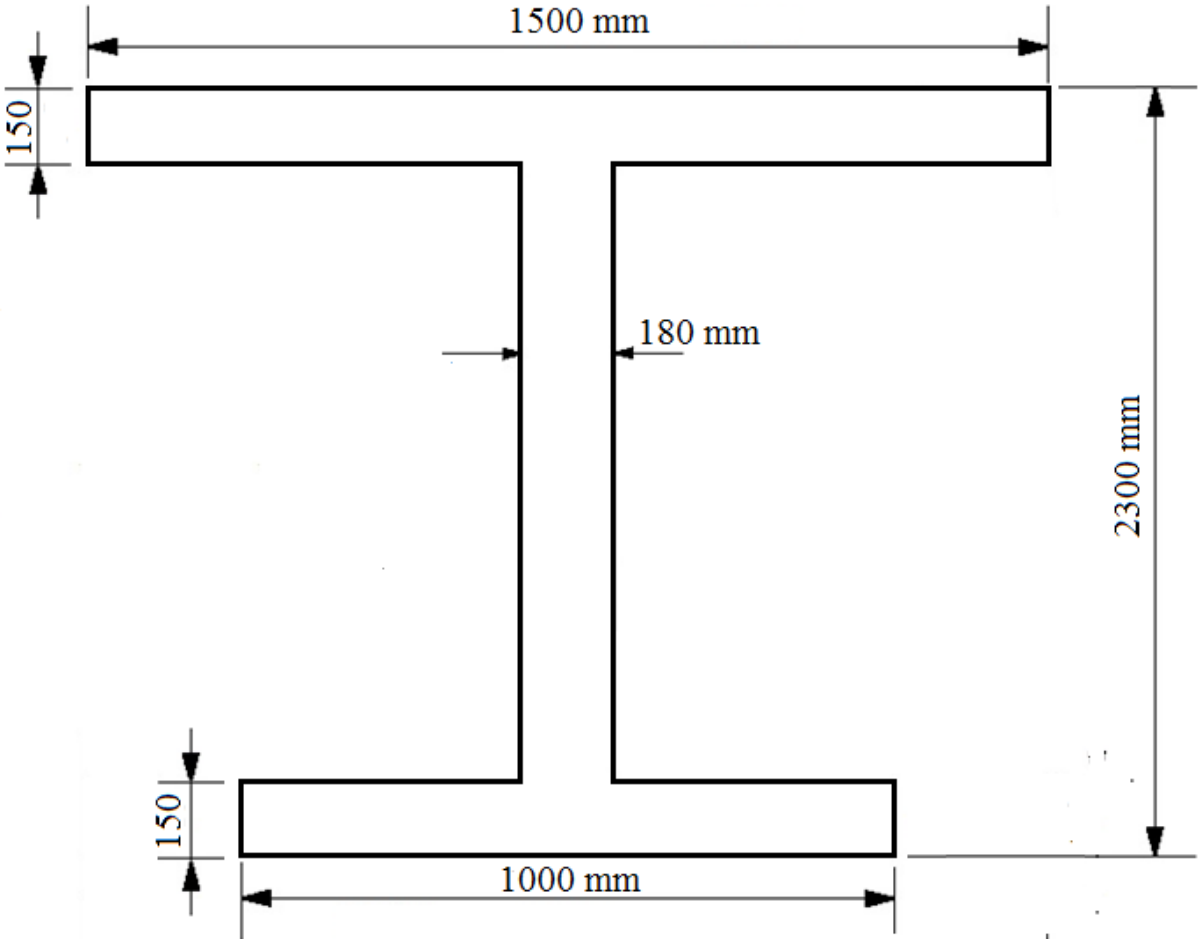

Figure 6.

QUESTION 5 [50 Marks]

Determine the support reactions of the frame shown in **Figure 7** below:
i. By considering the resultant forces on the inclined member.
ii. By considering the horizontal and vertical component of the resultant forces on the inclined member.

Note: **1.** Show clearly those two resultant forces on inclined member of the frame.
2. Show clearly the components of the two resultant forces previously found on the inclined member of the frame.
3. Check the answers by taking moment at the point where the horizontal member of the frame met the inclined member of the frame, i.e., at B.

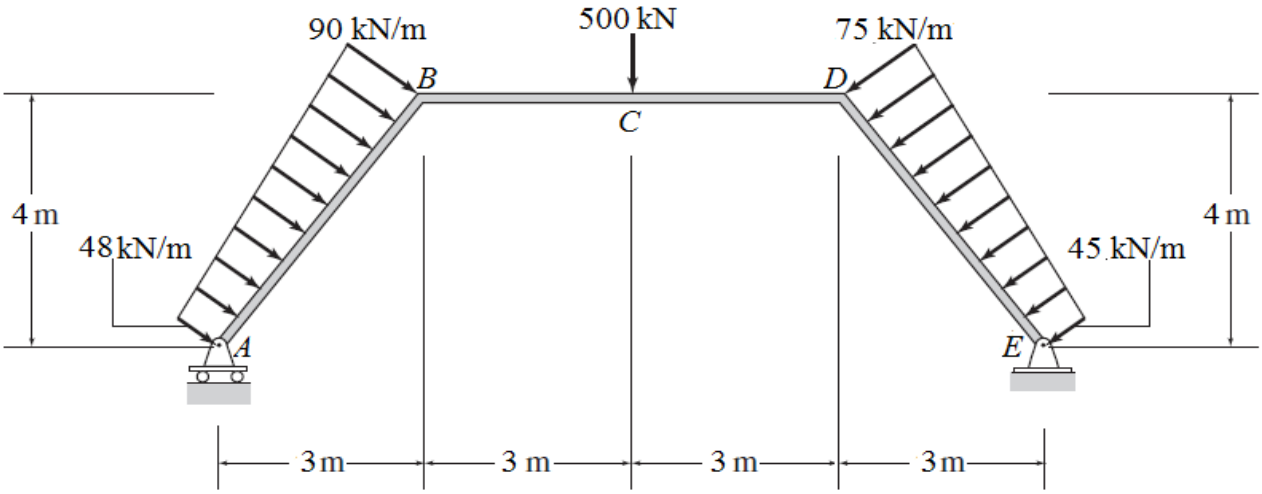

Figure 7.

QUESTION 6 [65 Marks]

i. Check the **static determinacy** of the truss shown in **Figure 8**. **[5]**

ii. By considering the **global** equilibrium, determine the force on joints A and E. **[5]**

iii. By considering the **local** equilibrium, determine **all** forces on joints A and E.

1. By using the **method of joints**. **[25]**
   (Neglect the answer obtained in sub-question **ii**)
2. By using the **method of sections** (**one (1)** section is enough) and consider **only one (1) condition of equilibrium**. **[15]**
   (Neglect the answer obtained in sub-question **ii**, and in sub-question **iii. 1.**)
3. By using **both method of sections** (**one (1)** section is enough) and the **method of joints** (**two (2)** joints are enough). **[15]**
   (Neglect the answer obtained in sub-question **ii**, in sub-question **iii. 1.**, and sub-question **iii. 2.**)

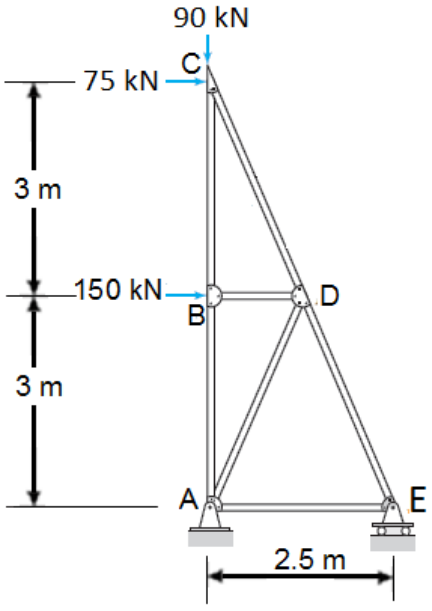

Figure 8.

QUESTION 7 (40 Marks)

Consider the **local equilibrium** and **without calculating** the support reactions, determine **all** forces on joints **A** and **B** (See **Figure 9**); this task can be done through the **following steps**:

i. Just by applying the **method of sections** and taking into account **only one (1) condition of equilibrium** to determine the force in member **AC**, **CB** and **BD**.

ii. By applying the **method of joints** to determine **all** the force on joint **A** and **B.**

Hints: A **FBD** with support reactions and **horizontal distances**, **another FBD** with **slopes** and **section** in members of interests and the **last FBD** with **angles** of interest and **lever arms**. The steps in question can be followed afterwards.

Note: Each step with appropriate FBD has its own marks.

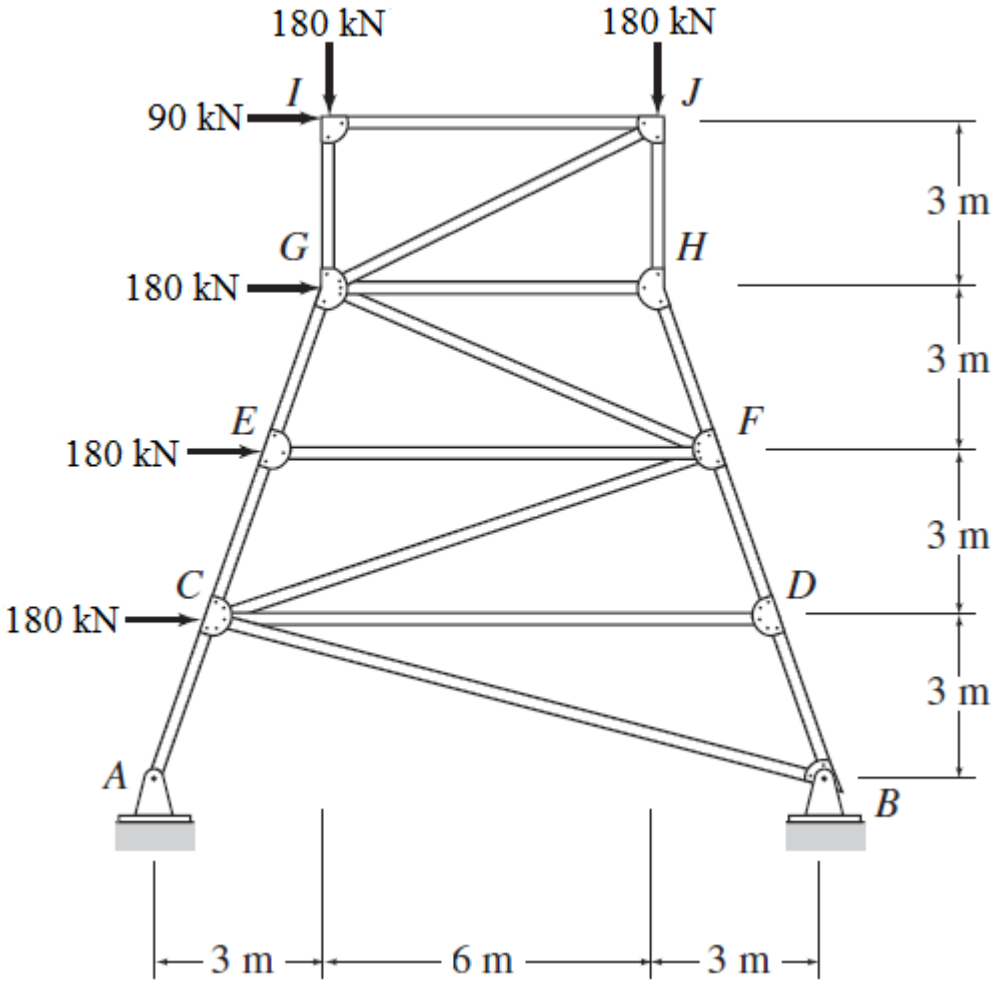

Figure 9.

Instructions:

1. ***You should work in small groups of students, and please do not exceed the maximum number of 7 students for each group.***
2. ***The report should be simple, concise and clean.***
3. ***Present your work in a legible writing and organized format.***
4. ***Submit the soft copies on phabimana@ur.ac.rw by 10:59 AM on 03/03/2025.***
5. ***Under no circumstances a late submission can be accepted.***
6. ***Submit the hard copies by 10:59 AM in class (Muhazi – 0R05).***