UNIVERSITY COLLEGE TATI

UNIVERSITY COLLEGE TATI (UC TATI)

FINAL EXAMINATION QUESTION BOOKLET

COURSE CODE	: DTM 1073
COURSE	: STATICS & DYNAMICS
SEMESTER/SESSION	: 1- 2024/2025
TIME	: 3 HOURS

Instructions:

1. This booklet consists of **5** questions. Answer **ALL** questions.
2. All answers should be written in answer booklet.
3. Write legibly and draw sketches wherever required.
4. If in doubt, ask the invigilator / Instructor

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO

THIS BOOKLET CONTAINS 7 PRINTED PAGES INCLUDING COVER PAGE

QUESTION 1

a) Describe the definition of Mechanics. (3 marks)

b) Explain the following:

i) Scalar. (2 marks)

ii) Vector. (2 marks)

c) Describe the second Newton's Law. (2 marks)

d) Explain the concept of moment. (4 marks)

QUESTION 2

a) Three (3) forces act on a point A as shown in Figure 1. Find:

i) Component force F_x and F_y for F_1, F_2 and F_3. (6 marks)

ii) Resultant/magnitude force at A. (2 marks)

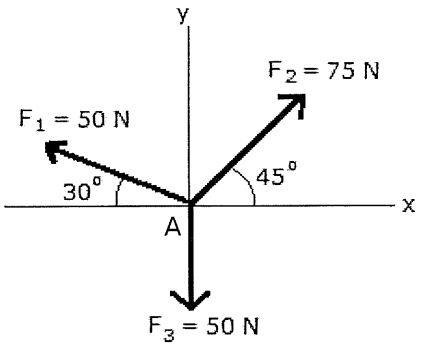


Figure 1

b) Solve the magnitude and direction of the resultant force using parallelogram law of the forces as show in Figure 2. (6 marks)

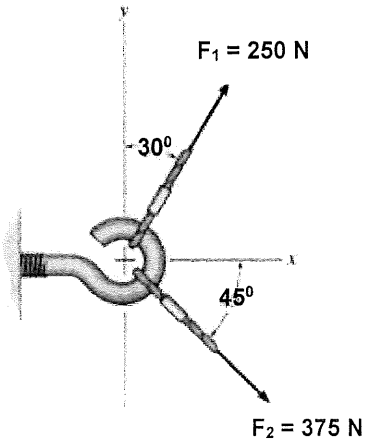


Figure 2

c) Figure 3 show the beam AB is acted upon by two (2) external forces of 100N and 200N and it's in equilibrium. The weight of the beam can be ignored. Use the conditions of equilibrium to solve the reaction force at support A.

(7 marks)

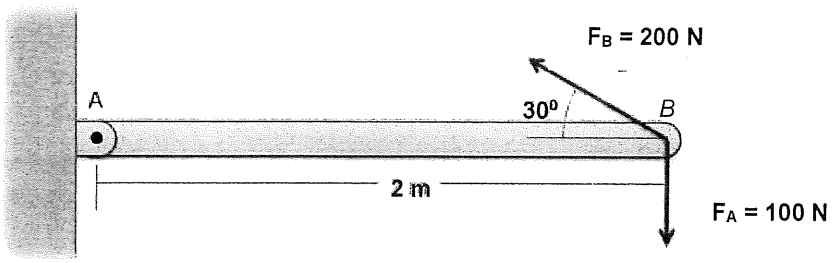


Figure 3

d) Solve the tension in cable CE and reaction force at support A as show in Figure 4. (8 marks)

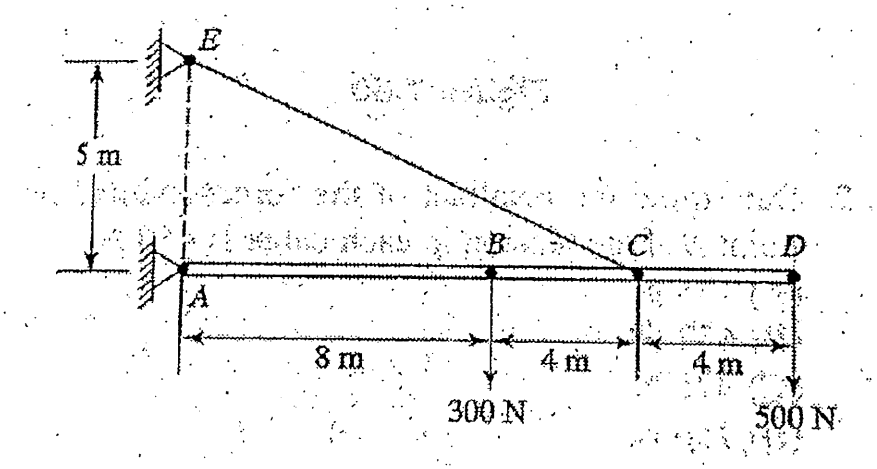


Figure 4

QUESTION 3

a) By using method of joint, compute the force in each member *AB* and *AD* of the truss shown in Figure 5 and state either the members are in tension (T) or in compression (C). (9 marks)

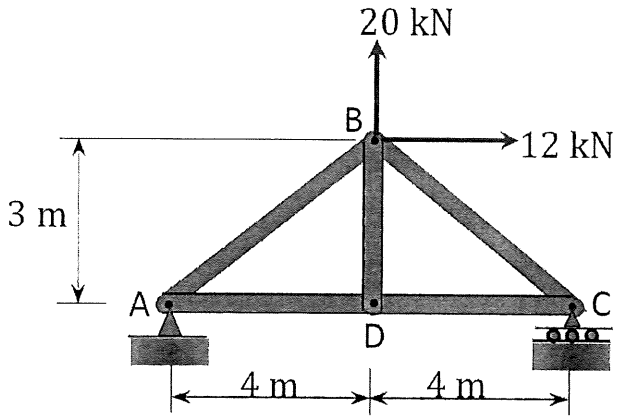


Figure 5

b) By using method of section, compute the force in member DF, DG and EG of the truss shown in Figure 6 and state either the members are in Tension (T) or in Compression (C). (9 marks)

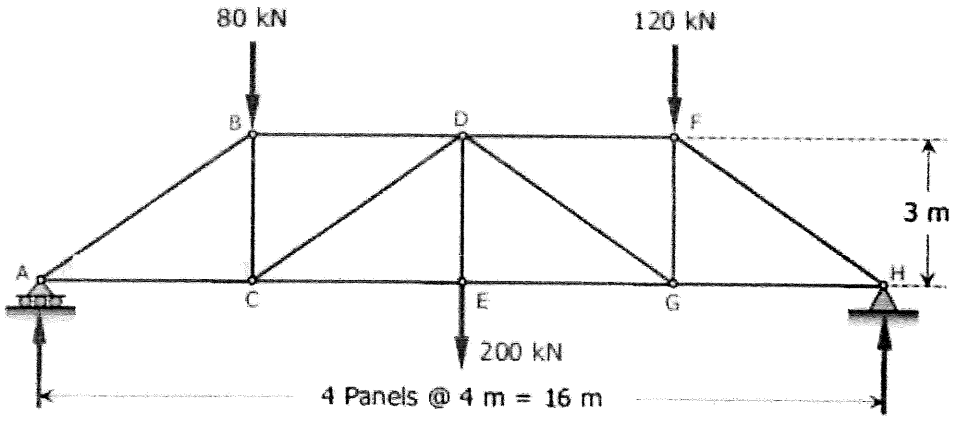


Figure 6

QUESTION 4

A 10 kg box m_1 pulls a 8 kg box m_2. A lightweight, flexible cable is connected both boxes over frictionless and mass less pulley as shown in Figure 7 The coefficient of friction between table and box m_2 is 0.25.

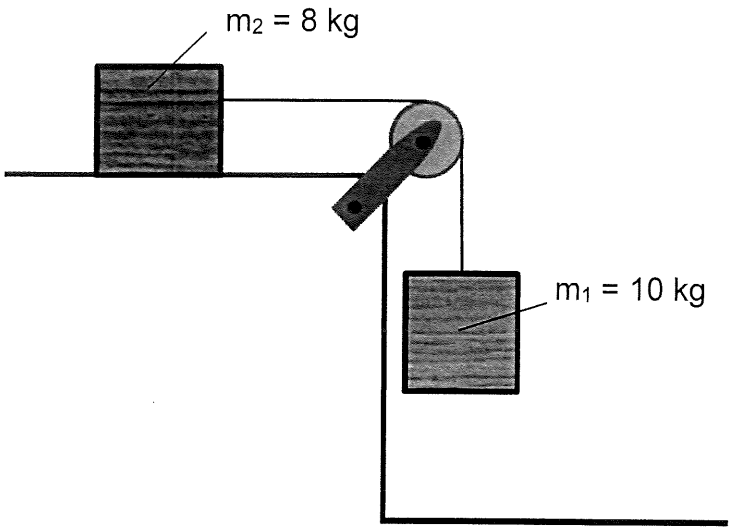


Figure 7

i. Explain the frictional force (F_f) (4 marks)

ii. Sketch the free body diagram (FBD) for both boxes. (4 marks)

iii. Compute the friction force (F_f) acts on the box m_2. (5 marks)

iv. If the boxes are initially at rest, compute acceleration and the tension in the cable. (6 marks)

v. Start from rest, find the distance that m_2 moves with constant acceleration in t = 2.5 sec (3 marks)

QUESTION 5

a) Julie is walking around a track at a 2m/s for some exercise. She then decides to start jogging so she accelerates at a rate of 0.5m/s² for 3 seconds. Compute the distance that Julie travel from the time she started to accelerate to the end of the 3 seconds. (4 marks)

b) A locomotive is accelerating at 1.6 m/s^2. It passes through a 20.0 m wide crossing in a time of 2.4 s. After the locomotive leaves the crossing, compute the time is required until its speed reaches 32 m/s. (6 marks)

c) Jenny throws a ball directly up in the air. She notices that it changes direction after approximately 3 seconds. Compute the initial velocity of the ball. (4 marks)

d) The safe take-off velocity of a particular passenger plane is set at 21 km/h. Compute the minimum acceleration (in m/s^2) that the airplane needs to move on a 2.2 km runaway. (4 marks)

----------**End of question**----------

FORMULA

Static Equilibrium:

$$\sum F_X = 0$$
$$\sum F_Y = 0$$
$$\sum M = 0$$

Newton's 2nd Law:

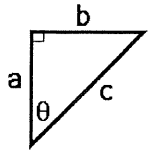
$$\sum F = ma$$

Friction Force:

$$F_f = \mu F_N$$

Equation of Linear Motion:

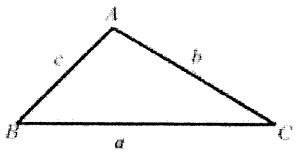
$v = v_0 + at$
$v^2 = v_0^2 + 2as$
$s = v_0 t + \frac{1}{2} at^2$
$s = \frac{1}{2} (v_0 + v)t$



a=side adjacent to angle Θ
b=side opposite to angle Θ
c=hypotenuse of triangle

$$\sin\Theta = \frac{b}{c} \quad \cos\Theta = \frac{a}{c} \quad \tan\Theta = \frac{b}{a}$$

Cosine Rule



$$a^2 = b^2 + c^2 - 2bc\cos A$$
$$b^2 = a^2 + c^2 - 2ac\cos B$$
$$c^2 = b^2 + a^2 - 2ab\cos C$$

Which one to use depends whether the unknown is a length or an angle

The formula can be rearranged to:

$$\cos A = \frac{b^2 + c^2 - a^2}{2bc}$$
$$\cos B = \frac{a^2 + c^2 - b^2}{2ac}$$
$$\cos C = \frac{a^2 + b^2 - c^2}{2ab}$$