

Name:

Enrolment No:



UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

Supplementary Examination, Dec 2023

Course: Engineering Mechanics

Program: B.Tech /ASE, ASE-AVE, EE, CHEMICAL(R & P), CIVIL

Course Code: MECH1002/MECH2032

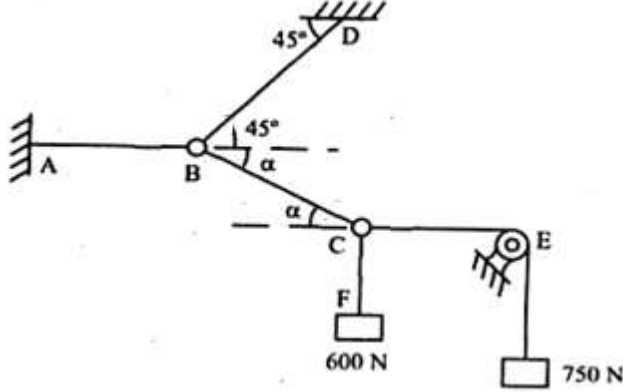
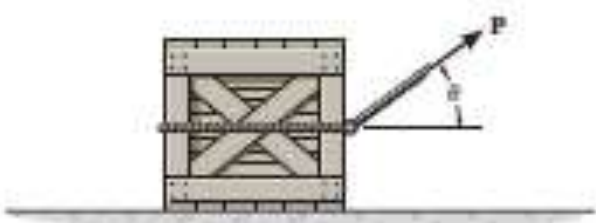
Semester: III

Time: 03 hrs.

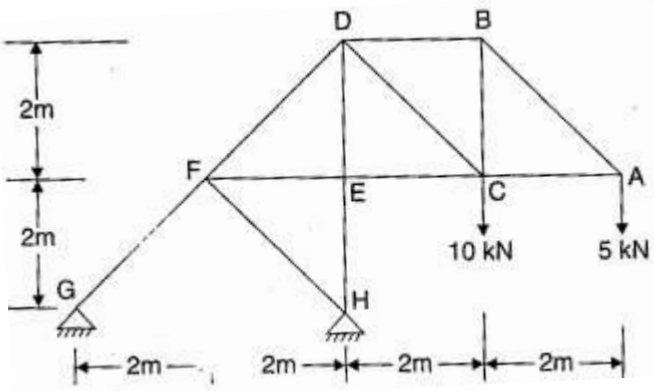
Max. Marks: 100

Instructions: Attempt all the questions. Assume suitable data if missing.

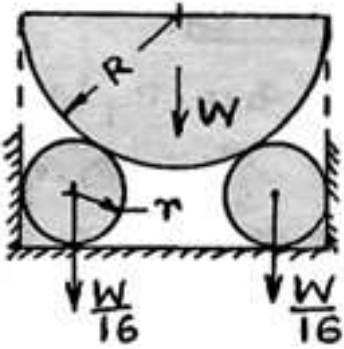
SECTION A

		Marks	CO
Q 1	<p>Two rings B and C are held by cables AB, BD, BC and CE as shown in the Fig. Determine the forces transmitted by cables BD and BC.</p> 	4	CO1
Q 2	<p>Enlist the assumption made in analyzing a frame.</p>	4	CO1
Q 3	<p>The crate has a weight <math>W=100\text{ N}</math> and the coefficient of static friction at the surface is 0.3. Find the smallest possible force <math>P</math> that has to be applied to the cord so that the crate is on the verge of moving. The line of action of the force <math>P</math> is inclined at an angle <math>15^\circ</math> with positive x-axis.</p> 	4	CO1

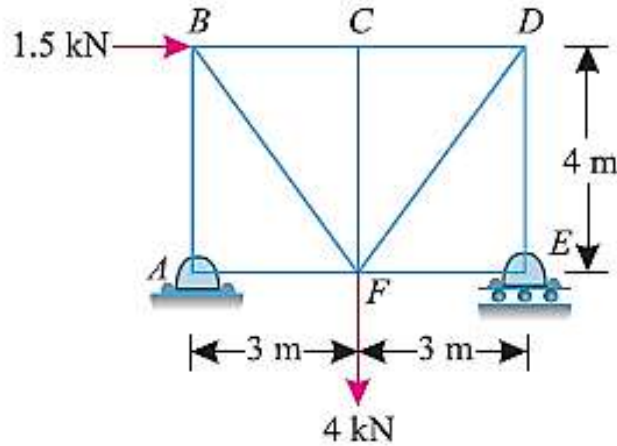
Q 4	<p>A body moves along a straight line and its acceleration (<math>a</math>) which varies with time (<math>t</math>) is given by <math>a = 2 - 3t</math>. After 5 seconds, from the start of observations, its velocity is observed to be 20 m/s. After 10 seconds, from the start of observation, the body was 85 metres from the origin.</p> <p>Determine</p> <p>(a) its acceleration and velocity at the time of start</p> <p>(b) distance from the origin at the start of observations</p>	4	CO1
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Q 5	<p>Prove that the frame is the perfect one.</p> 	4	CO1
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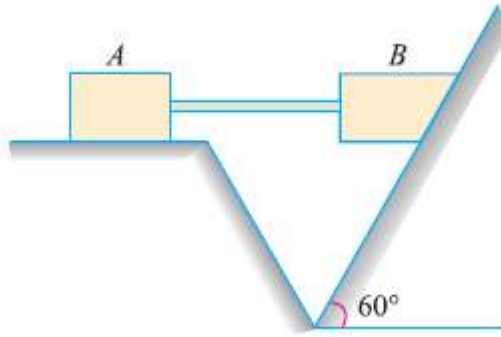
**SECTION B**

Q 6	<p>A semi – cylinder of radius <math>R</math> and weight <math>W</math> is placed over two small cylinders each of radius <math>r</math> and weight <math>W/16</math> inside a glass box as shown in figure. Find the maximum value of <math>r</math>, as a function of <math>R</math>, for which the force exerted on the side walls does not exceed a limiting value of <math>0.4 W</math>.</p> 	10	CO2
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Q 7	<p>Find the forces in members <math>CD</math>, <math>DF</math>, and <math>EF</math> of truss in magnitude and direction only by method of section.</p>	10	CO2
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Q 8 Two blocks A and B, connected by a horizontal rod and frictionless hinges are supported on two rough planes as shown in Fig. below. The coefficients of friction are 0.3 between block A and the horizontal surface, and 0.4 between block B and the inclined surface. If block B weighs 100 N, determine the smallest weight of block A, that will hold the system in equilibrium?



10

CO2

Q 9 Two stations, P and Q, are 5.2 km apart. An automobile starts from rest from station P and accelerates uniformly to attain a speed of 48 kmph in 30 seconds. This speed is maintained until the brakes are applied. The automobile comes to rest at station Q with a uniform retardation of  $1 \text{ m/s}^2$ . Determine the total time required to cover the distance between these two stations.

OR

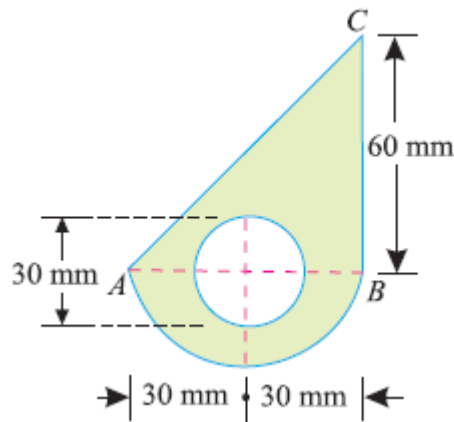
A projectile is aimed at a mark on the horizontal plane through the point of projection. It falls 20 metres short when the angle of projection is  $25^\circ$ ; while it overshoots the mark by 30 metres when the same angle is  $55^\circ$ . Find the angle of projection to hit the mark. Assume no air resistance.

10

CO3

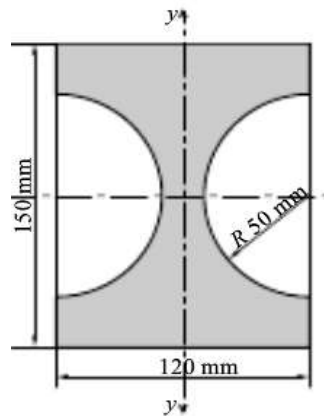
**SECTION-C**

**Q 10** A square hole is punched out of circular lamina, the diagonal of the square being the radius of the circle as shown in figure. Find the moment of inertia of the figure about its centroidal axes parallel to the horizontal and vertical axes.



**OR**

- a) Find the moment of inertia of the lamina about its base and a vertical axis passing through the left most portion of the figure. **(12 marks)**



- b) Starting from the first principle, derive an expression for moment of inertia of a triangle about its base. **(8 marks)**

**20**

**CO3**

**Q 11** Find the acceleration of a solid body A of mass 10 kg, when it is being pulled by another body B of mass 5 kg along a smooth horizontal plane as shown in Fig. Also find the tension in the string, assuming the string to be inextensible. Take  $g = 9.8 \text{ m/s}^2$ .

**20**

**CO3**

