

**INDIAN MARITIME UNIVERSITY**  
(A central University, Government of India)

May/June 2018-END SEMESTER EXAMINATION

**B. Tech (Marine Engineering)**

**Semester: I**

**Engineering Mechanics I (UG11T2105)**

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**Date: 12-07-2018**

**Maximum Marks: 100**

**Time: 3 hrs**

**Pass Marks : 50**

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**SECTION -A**

**(10 X 3 = 30)**

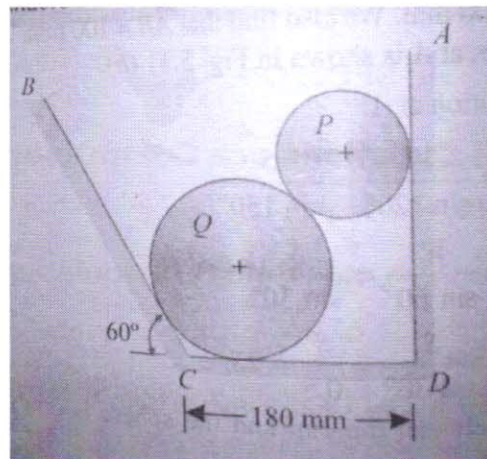
**(All Questions are Compulsory)**

**(1)**

- a) How would you find out the equilibrium of coplanar forces?
- b) What are the characteristics of a Couple?
- c) Explain the following (a) Reversibility of a Machine (b) Self Locking Machine
- d) Explain the applications of the principle of Virtual Work in case of lifting Machines
- e) Distinguish between Centre of gravity and Centroid
- f) What is Routh's rule for finding out the moment of Inertia of an area? Explain where it is used and why?
- g) Explain D'Alembert's Principle.
- h) What is Projectile? Give an example of a Projectile.
- i) A flywheel starts from rest and revolves with an acceleration of  $0.5 \text{ rad/sec}^2$ . What will be its angular velocity and angular displacement after 10 seconds?
- j) Explain the term " Conservation of Energy "

**SECTION - B****(5X14 = 70 )****Answer any five of the following seven questions.**

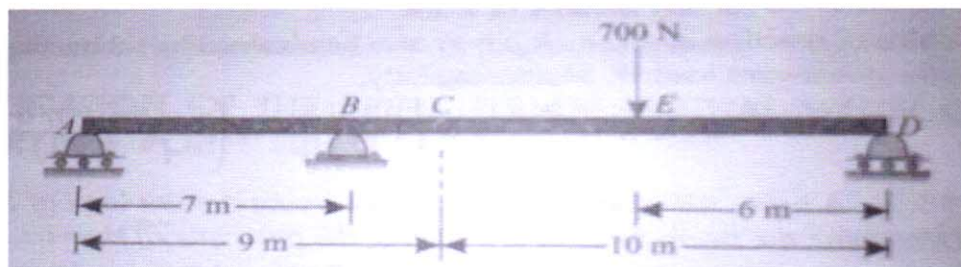
- (2) Two cylinders P and Q rest in a channel as shown in figure. The cylinder P has diameter of 100 mm and weighs 200 N, whereas the cylinder Q has diameter of 180 mm and weighs 500 N. If the bottom width of the box is 180 mm, with one side vertical and the other inclined at 60 degree. Determine the pressures at all the four points of contact.



(14 Marks )

- (3) (a)

Two beams AC and CD of length 9 meter and 10 meter respectively are hinged at C. These are supported on rollers at the left and right ends (A and D). A hinged support is provided at B, 7 meter from A as shown in figure. Using the principle of virtual work, determine the force transmitted by the hinge C and the reaction at the support B, when a load of 700 Newton acts at a point 6 meter from D.



(7 Marks )

(b)

A Single Purchase Crab Winch has the following details :

Length of Lever: 700 mm

Number of pinion teeth: 12

Number of Spur gear teeth: 96

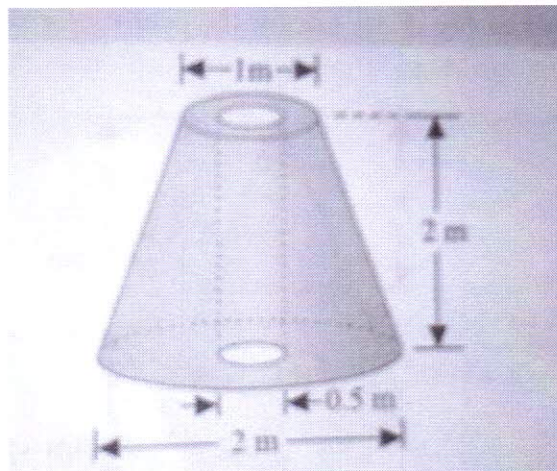
Diameter of the load axle: 200 mm

It is observed that an effort of 60 N can lift a load 1800 Newton and an effort of 120 Newton can lift a load of 3960 Newton . What is the Law of the machine? Also find efficiency of the machine in both the cases

( 7 Marks )

(4)(a)

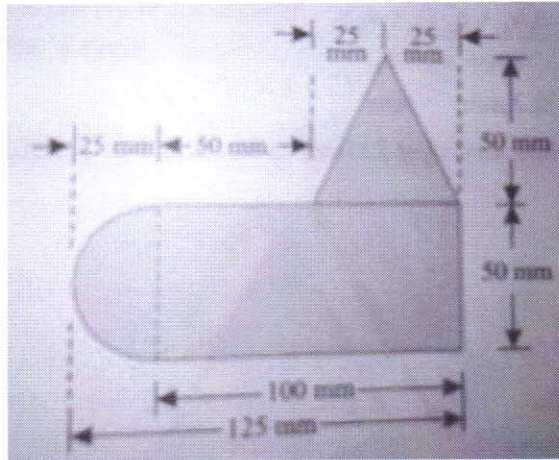
A frustum of a solid right circular cone has an axial hole of 50 cm diameter as shown in figure. Determine the centre of gravity of the body.



(7 Marks)

b)

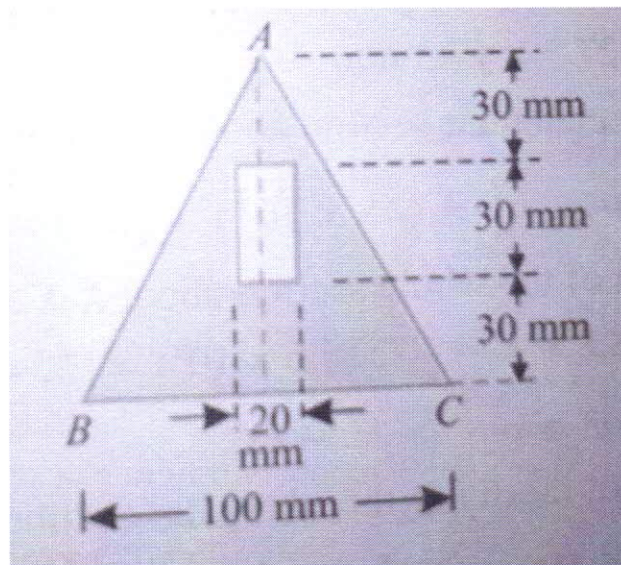
A Uniform lamina shown in figure consists of a rectangular, a circle and a triangle .Determine the centre of gravity of the Lamina. All dimensions are in mm.



(7 Marks )

(5)

A rectangular hole is made in a triangular section as shown in figure .Determine the moment of Inertia of the section about X-X axis passing through its centre of gravity and the base BC .



(14 Marks)

(6)(a)

A Projectile is aimed at a mark on the horizontal plane through the point of Projection. It falls 12 meters short when the angle of projection is 15

degree. While it overshoots the mark by 24 meters when the same angle is 45 degree. Find the angle of Projection to hit the mark. Assume no air resistance.

(7 Marks)

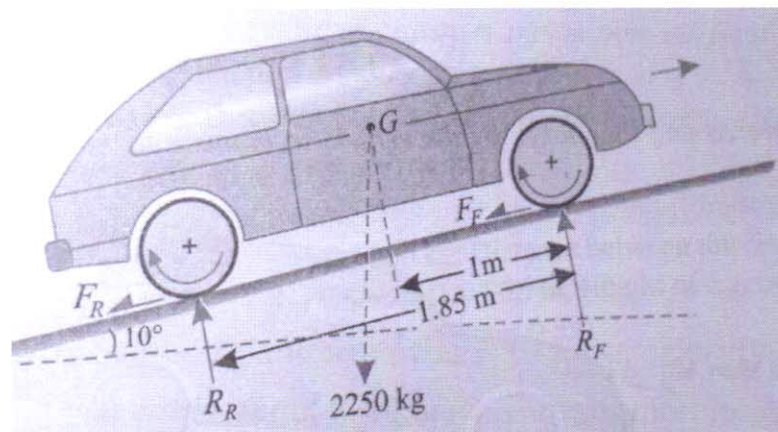
(b)

A bullet is fired upwards at an angle of 30 degree to the horizontal from a point P on a hill. and it strikes a target which is 80 meter lower than P . The initial velocity of bullet is 100 meters /second. Calculate the actual velocity with which the bullet will strike the target.

(7 Marks )

7) A Vehicle of mass 2250 kg having its wheel base of 1.85 m is travelling at 10 meter/second on a rough plane inclined at 10 degree with the horizontal . The centre of gravity of the vehicle is 1 meter behind the front wheel and 90 cm above the ground.

Find the distance covered by the automobile to stop and also time taken to do so , when the brakes are applied on both the pairs of wheels and the vehicle is (i) going up the plane . And (ii) coming down the plane . Take coefficient of friction offered by brakes as 0.5.



(14 Marks)

(8) (a) A flywheel rotates with a constant retardation due to braking . From  $t = 0$  to  $t = 10$  seconds. It made 300 revolutions. At time  $t = 7.5$  seconds .Its angular velocity was  $40\pi$  radians /seconds. Determine (i) value of constant

retardation: (ii) total time taken to come to rest and (iii) total revolutions made till it comes to rest.

(7 Marks)

(b)

The equation for angular displacement of a particle moving in a circular path (radius 200 mm) is given by

$$\theta = 18t + 3t^2 - 2t^3$$

Where  $\theta$  is the angular displacement at the end of  $t$  seconds. Find (i) angular velocity and acceleration at start, (ii) time when the particle reaches its maximum angular velocity and (iii) maximum angular velocity of the particle

(7 Marks)

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