

INDIAN MARITIME UNIVERSITY
(A Central University, Government of India)
End Semester Examinations December 2018
B. Tech (Marine Engineering)
Semester – I
Engineering Mechanics – I (UG11T2105)

Date: 07.01.2019
Time: 3Hours

Maximum Marks: 100
Pass Marks: 50

Note: (i). Use of approved type of scientific calculator is permitted.
(ii). The symbols have their usual meanings.

Part –A

10 x 3 = 30 Marks

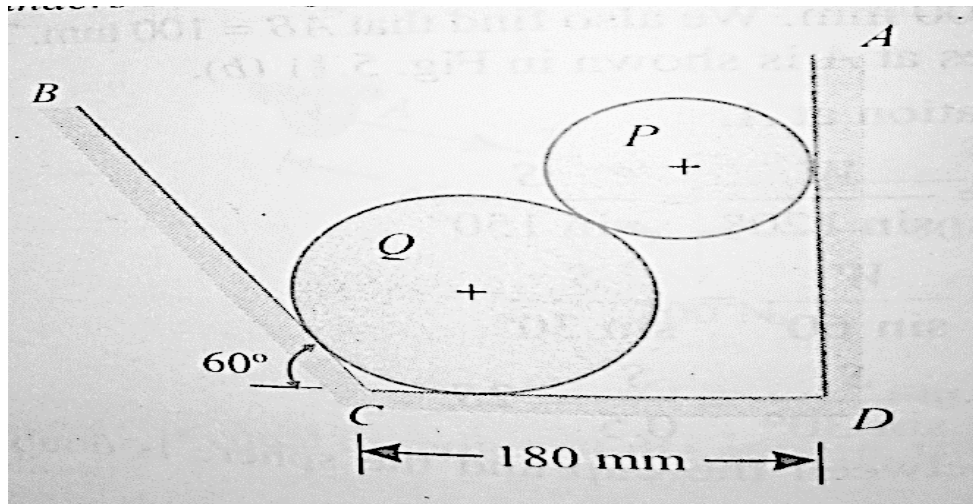
(All Questions are compulsory)

- a) What is **Lami's Theorem**? What is the application?
- b) State clearly the difference between a **perfect frame and an imperfect frame**.
- c) Explain the application of the **principle of virtual work** in case of lifting machines.
- d) Describe the **various methods** of finding out the center of gravity of a body
- e) What is **Routh's rule** for finding out the moment of inertia of an area?
Explain where it is used and why
- f) What is the **moment of inertia**? Explain with Twirling a broom handle
- g) State **D' Alembert's principle**.
- h) A flywheel starts from rest and revolves with an acceleration of 0.5 rad/sec^2 .
What will be its angular velocity and angular displacement after 10 seconds?
- i) What is **Projectile**? Give an example of a Projectile.
- j) What is the difference between **Rocket motion and Projectile motion**?

Part – B
(Answer any 5 of the following 7 Questions)

5 x 14 = 70 Marks

- (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 degrees. **Determine the pressures at all the four points of contact.**

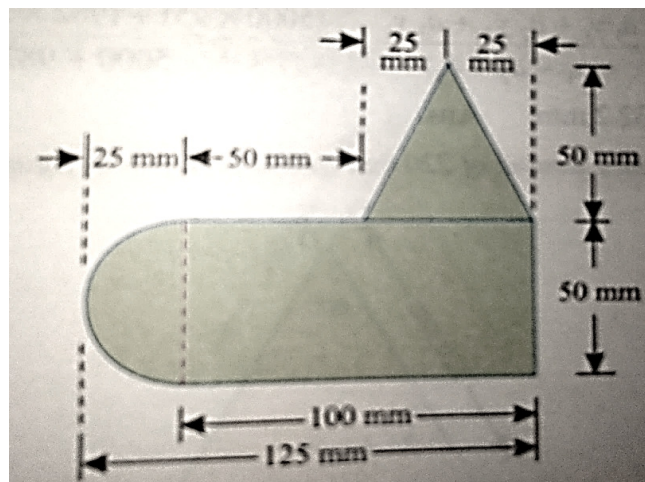


(14 Marks)

- (3) (a) Write short notes on (a) **Curvilinear Motions.** (b) **Rectilinear Motions.**

(4 Marks)

- (b) A Uniform lamina shown in figure consists of a rectangular, a circle and a triangle. **Determine the center of gravity of the Lamina.** All dimensions are in mm.

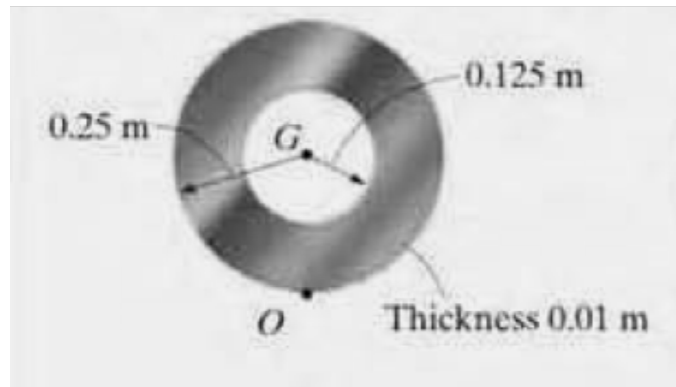


(10 Marks)

- (4) (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 degrees. While it overshoots the mark by 24 meters when the same angle is 45 degrees. **Find the angle of Projection to hit the mark.** Assume no air resistance.

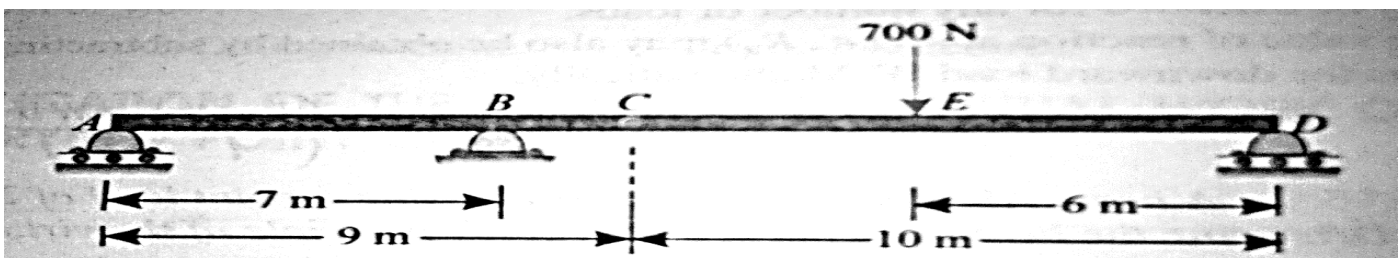
(7 Marks)

- (b) If the plate shown in figure has a density of 8000 Kg /m^3 and a thickness of 10 mm . **determine its mass moment of inertia** about an axis perpendicular to the page and passing through the pin at O.



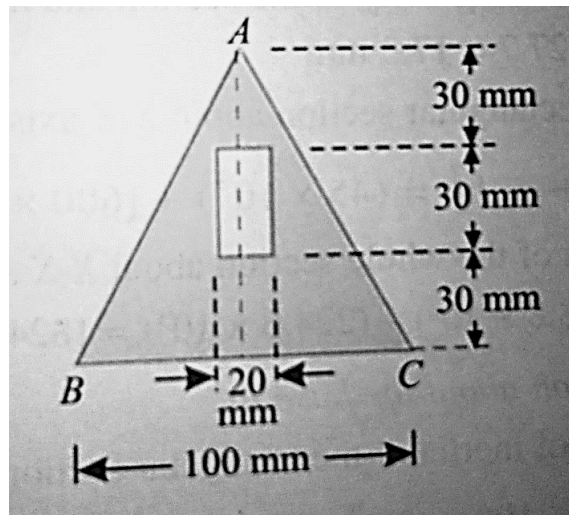
(7 Marks)

- (5) 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.



(14 Marks)

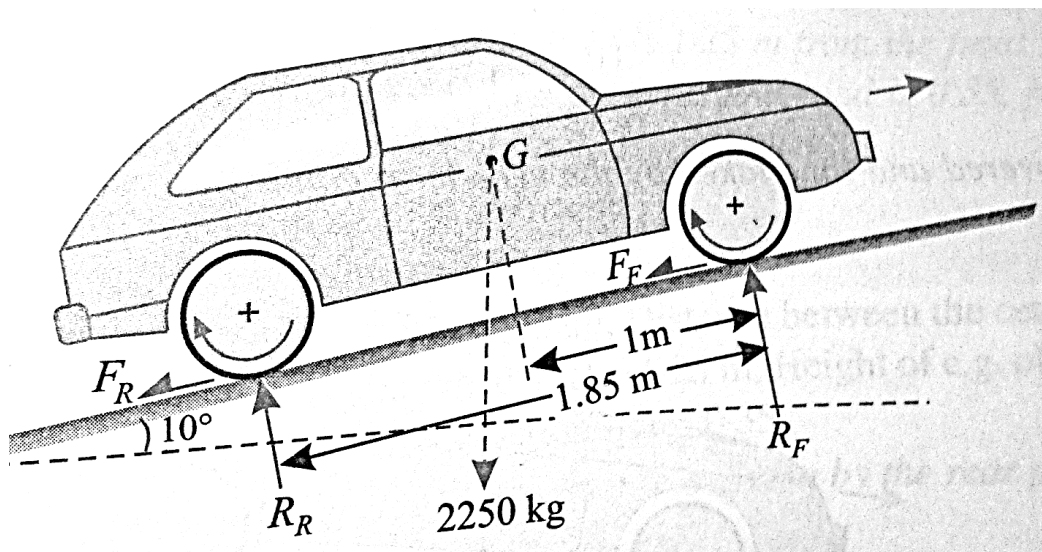
- (6) A rectangular hole is made in a triangular section as shown in figure. **Determine the moment of Inertia** of the section about X-X axis passing through its center of gravity and the base BC.



(14 Marks)

- (7) A Vehicle of mass 2250 kg having its wheel base of 1.8 m is travelling at 10 meter/second on a rough plane inclined at 10 degrees 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 40π 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 θ 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)
