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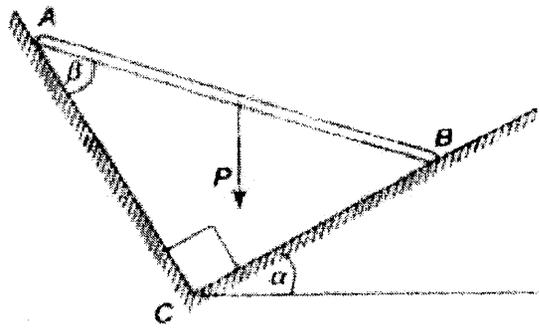
**B. Tech. Degree I & II Semester Examination in  
Marine Engineering May 2016**

**MRE 1105 ENGINEERING MECHANICS**

Time: 3 Hours

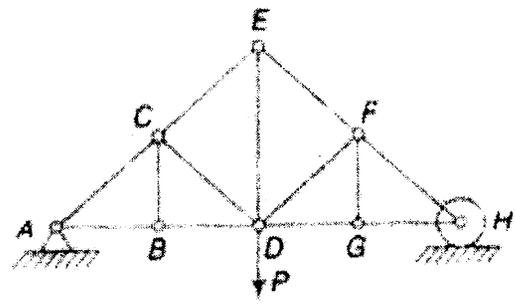
Maximum Marks: 100

- I. (a) State and explain the Theorem of Varignon. (4)  
 (b) A prismatic bar AB of weight  $P$  lies in a vertical plane with its ends resting against the smooth surfaces AC and BC as shown in figure. Find the relation between the angles  $\alpha$  and  $\beta$ , when the bar is in equilibrium. (12)

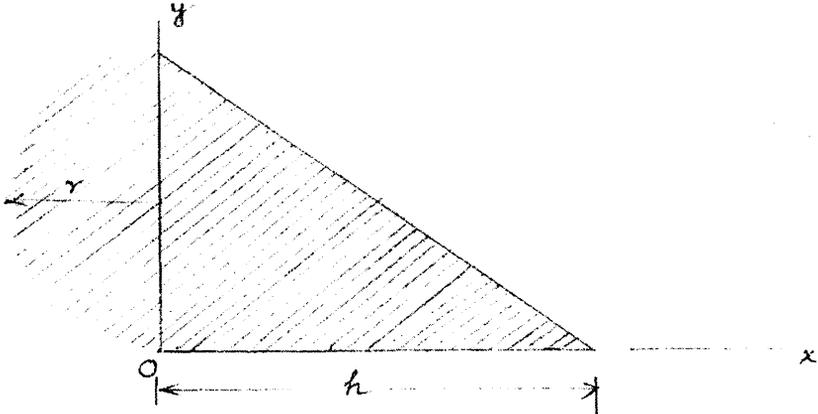


OR

- II. (a) State and explain the Theorems of Pappus. (4)  
 (b) Prove that a tensile force equal to the applied load  $P$  is produced in the bar DE of the truss shown in figure. (12)



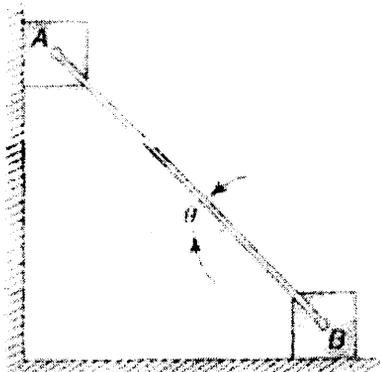
- III. (a) Derive an expression for the moment of inertia of a triangular section about an axis passing through the C.G. of the section and parallel to the base. (5)
- (b) Referring to figure, find the necessary relation between  $r$  and  $h$  so that  $x$  and  $y$  will be the principal axes for the composite area. (12)



OR

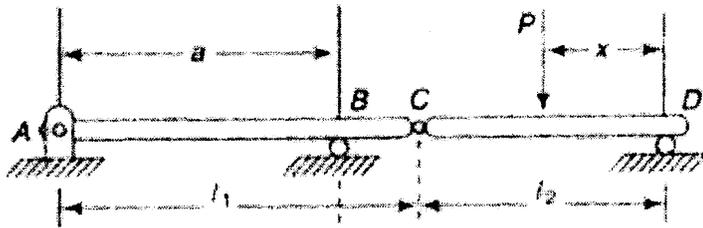
- IV. (a) What is meant by product of inertia? Explain. (5)
- (b) Calculate the moment of inertia of a homogenous rectangular lamina of dimensions  $a$  and  $b$  with respect to a diagonal of the rectangle. The weight of the lamina is  $W$ . (12)

- V. (a) What are the laws of friction? (5)
- (b) Two identical blocks A and B are connected by a rod and rest against vertical and horizontal planes respectively, as shown in figure. If sliding impends when  $\theta = 45^\circ$ , determine the coefficient of friction  $\mu$ , assuming it to be same at both floor and wall. (12)



OR

- VI. (a) Determine the efficiency of a simple lifting machine. (5)  
 (b) Two beams AC and CD hinged together at C are supported and loaded as shown in figure. Using the principle of virtual work, find the magnitude of the reaction at B for any position of the load P. (12)



- VII. (a) State and explain D'Alembert's principles. (4)  
 (b) The acceleration of a particle moving along a straight line is defined by  $a = 8 - x$ . The particle starts from rest at  $t = 0$  and origin  $x = 0$ . Determine (i) velocity of the particle when  $x = 10$  m, (ii) the position of the particle when velocity becomes zero and (iii) velocity of the particle when acceleration becomes zero. (12)

OR

- VIII. A golf ball dropped from rest onto a cement sidewalk rebounds eight-tenths of the height through which it fell. Neglecting air resistance, determine the coefficient of restitution. (16)

- IX. (a) Prove that the time to reach the highest point is half the time of flight of a projectile. (5)  
 (b) A mortar having a muzzle velocity of 250 m/s fires for maximum range across a level plain. Neglecting air resistance, calculate the time of flight of the shell. (12)

OR

- X. (a) A locomotive of weight  $W = 600$  kN goes around a curve of radius  $r = 300$  m at a uniform speed of 70 km/hr. Determine the total lateral thrust on the rails. (8)  
 (b) At the instant  $t = 0$ , a locomotive starts to move with uniformly accelerated speed along a circular curve of radius  $r = 700$  m and acquires by the end of the first 60 s of motion a speed equal to 25 km/hr. Find the tangential and normal accelerations at the instant  $t = 30$  s. (9)

- XI. (a) Determine the equivalent length of a compound pendulum. (5)  
 (b) A homogeneous circular disc of radius  $r$  and weight  $W$  hangs in a vertical plane from a pin  $O$  at its circumference. Determine the period  $\tau$  for small angles of swing in the plane of the disc. (12)

OR

- XII. A right circular drum of radius  $r$  and weight  $W$  rotating at 600 rpm is braked by the device as shown in figure. Develop a formula for the time  $t$  required to bring the drum to rest if the coefficient of friction between the drum and the braking bar is  $\mu$ . The following data are given:  $l = 1.2$  m,  $a = 0.75$  m,  $r = 375$  mm,  $\mu = 0.25$ ,  $W = 1780$  N and  $P = 445$  N. (17)

