

**COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY**

**B.TECH. DEGREE I & II SEMESTER SUPPLEMENTARY EXAMINATION IN  
MARINE ENGINEERING JUNE 2020**

**MRE 1105 ENGINEERING MECHANICS  
(2013 Scheme)**

Time: 25 Minutes [for Answering and Scanning/Uploading the page of the Answer Sheet]  
per module  
Max. Marks: 11 per module

**INSTRUCTIONS**

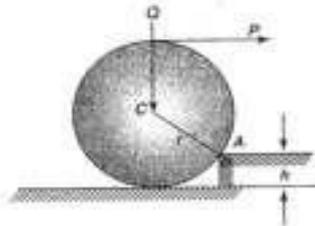
1. You have to be available in Google Meet on demand by the faculty.
2. You have to share your **'live location'** to the faculty before uploading the answer sheet.
3. You have to answer only one question per module.
4. Answer may not exceed one page of an A4 size paper in a standard handwriting, as far as possible.
5. If at all an answer goes beyond one page, (due to your handwriting) another page can also be used. In such a situation, the page number should be given as 1/2, 2/2.
6. You have to put dated signature along with Register Number, Subject Code, Module/Group Number (as given in the Question Paper) in each page.
7. You have to put the Question Number correctly.
8. After answering the question, you have to scan and upload the answer page.

**PART A  
STATICS**

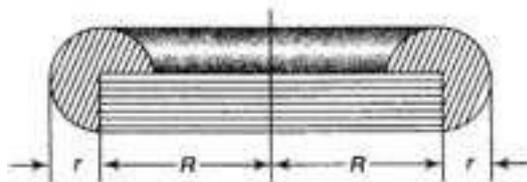
**MODULE - I**

(Answer **ANY ONE** question)

- I(1). (a) A roller of radius  $r = 304.8$  mm and weight  $Q = 2225$  N is to be pulled over a curb of height  $h = 152.4$  mm by a horizontal force  $P$  applied to the end of a string wound around the circumference of the roller as in below. Find the magnitude of  $P$  required to start the roller over the curb. (5)



- (b) Using the second theorem of Pappus, Calculate the volume of the ring shown in the figure if  $R = 250$  mm,  $r = 100$  mm (6)

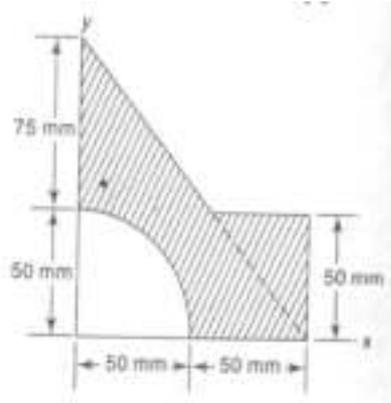


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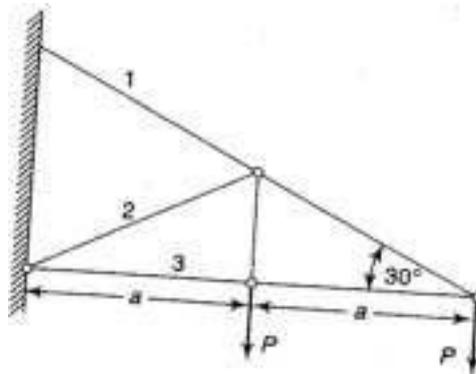
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- I(2). (a) With respect to the coordinate axes  $x$  and  $y$ , locate the centroid of the shaded area shown in figure below: (6)



- (b) Using the method of sections, find the axial force in each of the bars 1,2,3 of the plane truss in figure. (5)

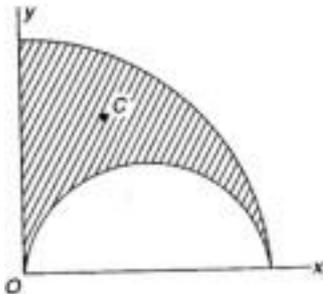


**PART A  
STATICS**

**MODULE - II**

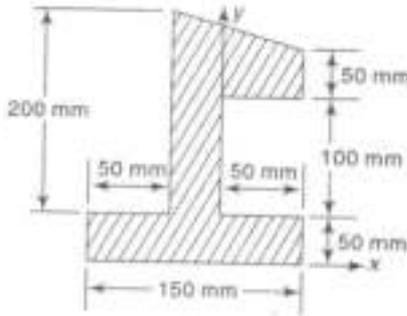
(Answer *ANY ONE* question)

- II(1). (a) State and prove theorem of parallel axis. (5)
- (b) Determine  $I_{xx}$  and  $I_{yy}$  for the shaded area obtained by cutting a semicircle of diameter 10 cm from the quadrant of a circle of radius 10 cm as shown in figure below. (7)



**OR**

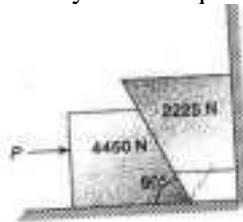
- II(2). Determine the  $I_{xx}$  about the centroidal axes of the figure shown below: (12)



**PART A**  
**STATICS**  
**MODULE - III**

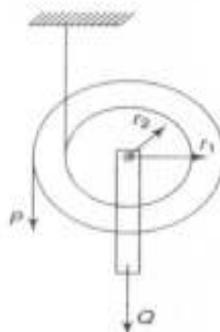
(Answer *ANY ONE* question)

- III(1). Referring to figure, the coefficients of friction are as follows; 0.25 at the floor, (12)  
at the wall and 0.2 between blocks. Find the minimum value of a horizontal force  $p$   
applied to the lower block that will hold the system in equilibrium



**OR**

- III(2). (a) A screw-jack has a square thread, 7.5 cm mean diameter and 1.5 cm pitch. The (6)  
load on the jack revolves with the screw. The co-efficient of friction at the  
screw threads is 0.05.  
(i) Find the tangential force to be applied to the jack at 36 cm radius so as  
to lift a load of 600 N  
(ii) State whether the jack is self-locking. If it is find the torque necessary  
to lower the load. If not find the torque, which must be applied to keep  
the load from descending.
- (b) The pulley arrangement shown in figure below is used for hoisting a load  $Q$ . (6)  
Find the ratio between the forces  $P$  and  $Q$  in the case of equilibrium of the  
system. The radii of the two steps of the pulley are  $r_1$  and  $r_2$  as shown in the  
figure below. Neglect friction.



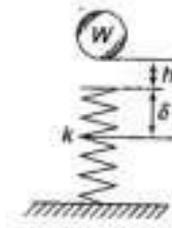
**PART B  
DYNAMICS**

**MODULE - IV**

(Answer **ANY ONE** question)

IV(1). (a) Water drips from a pipe at the uniform rate of  $n$  drops per second. Find the distance  $x$  between any two adjacent drops as a function of the time  $t$  that the trailing drop has been in motion. Neglect air resistance and assume  $g = 9.81m/s^2$ . (5)

(b) When a ball of weight  $W$  rests on a spring of constant  $k$  shown as in figure, it produces a static deflection of 25 mm. How much will the same ball compress the spring if it is dropped from a height  $h = 0.3$  m? Neglect the mass of the spring. (6)

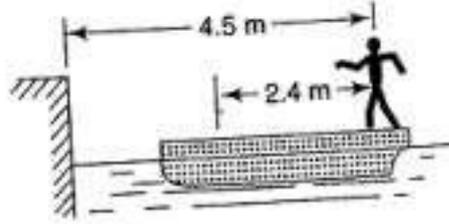


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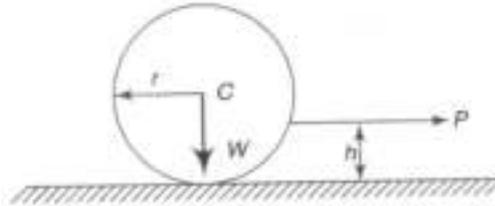
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- IV(2). (a) A man weighing 712 N stands in a boat so that he is 4.5 m from a pier on the shore as in figure. He walks 2.4 m in the boat towards the pier and then stops. How far from the pier will he be at the end of walking ? The boat weighs 890 N and there is assumed to be no friction between it and the water. (5)



- (b) A homogeneous sphere of radius  $r$  and weight  $W$  slides along the floor under the action of a constant horizontal force  $P$  applied to a string, as shown in figure below. Determine the height  $h$  during this motion if the coefficient of friction between sphere and floor is  $\mu$ . (6)

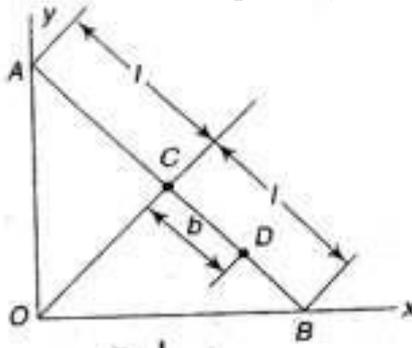


**PART B  
DYNAMICS**

**MODULE - V**

(Answer *ANY ONE* question)

- V(1). (a) Prove that the ends A and B of a bar AB of length  $2l$  as in figure are constrained to move along the y and x axes, respectively its mid-point C describes a circle of radius  $l$  with centre at O while any intermediate point D describes an ellipse with major and minor semiaxes  $l+b$  and  $l-b$ , respectively. (5)



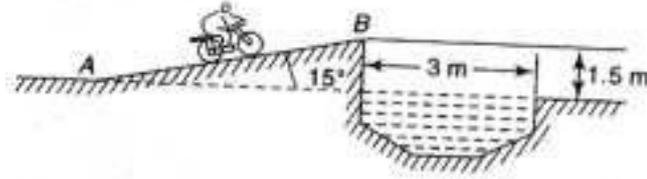
- (b) Show that the path of a projectile is parabola. (7)

**OR**

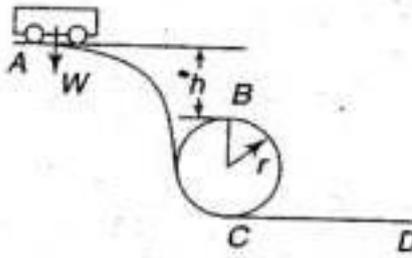
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- V(2). (a) Referring to figure calculate the minimum speed  $v_0$  with which a motorcycle stunt rider must leave the  $15^\circ$  ramp at B in order to clear the ditch. (6)



- (b) A small car of weight  $W$  starts from rest at A and rolls without friction along the loop ACBD as in the figure. What the least height  $h$  above the top of the loop at which the car can start without falling off the track at point B, and for such a starting position what velocity will the car have along the horizontal portion CD of the track? Neglect friction. (6)

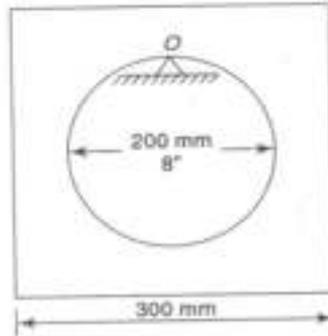


**PART B  
DYNAMICS**

**MODULE - VI**

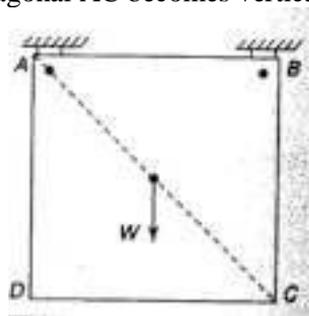
(Answer *ANY ONE* question)

- VI(1). A homogeneous square plate with a centered circular hole is supported as a compound pendulum as shown in figure below. Determine the period of small oscillations of the compound pendulum in the vertical plane of the plate. (12)



**OR**

- VI(2). A homogeneous plate 0.3 m square is supported in a vertical plane as shown in figure. If the pin at B is removed, what angular velocity  $\omega$  will the plate acquire by the time the diagonal AC becomes vertical. (12)



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