Reg. No. ☐☐☐☐☐☐☐☐

A

B.Tech. Degree I Semester Regular/Supplementary Examination in Marine Engineering November 2022

19-208-0104 ENGINEERING MECHANICS
(2019 *Scheme*)

Time: 3 Hours

Maximum Marks: 60

Course Outcome
On successful completion of the course, the students will be able to:

CO1: Understand the basic principles of statics and learn general and conventional procedure to solve problems involving equilibrium of forces.
CO2: Ascertain the physical and mathematical meaning of quantities, like centroid, moment of inertia and their applications in engineering, assimilate the principle of virtual work as a powerful tool in analysis of structures in equilibrium and analyze structures carrying two-force and multi-force members.
CO3: Refresh and reinforce the basics of rectilinear translation and conceive the idea of the D'Alembert's principle as an ideal method to solve kinetic problems.
CO4: Refresh and reinforce the basics of curvilinear translation and rotation of rigid bodies and familiarize their applications in engineering.
CO5: Understand the rotational mechanics and apply them in solving engineering problems.

Bloom's Taxonomy Levels (BL): L1 – Remember, L2 – Understand, L3 – Apply, L4 –Analyze,
L5 – Evaluate, L6 – Create
PO – Programme Outcome

			(5 × 15 = 75)	Marks	BL	CO	PO
I.	(a)	Find the volume of the torus shown in the figure which was formed by revolving the circular region bounded $(x-2)^2 + y^2 = 1$.		5	L3	2	1

|							
	(b)	Two vertical wedges are stacked as shown in figure and a load is applied. What is the minimum force required to pull the block if the coefficient of friction between block A and B is 0.1 and that between block and floor, block and wall are 0.2 respectively.		10	L4	1	1
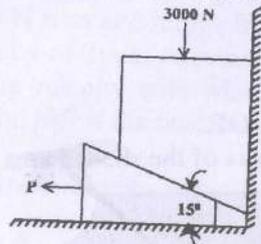
OR

(P.T.O.)

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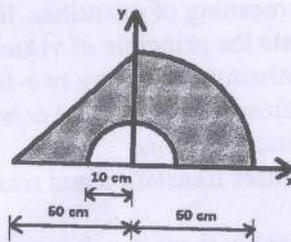|			Marks	BL	CO	PO

II. (a) A rope 9 m long is connected at A and B, two points on the same level, 8 m apart. A load of 300 N is suspended from a point C on the rope, 3 m from A. What load connected to a point D, on the rope, 2 m from B is necessary to keep portion CD parallel to AB.   **4   L3   1   1**
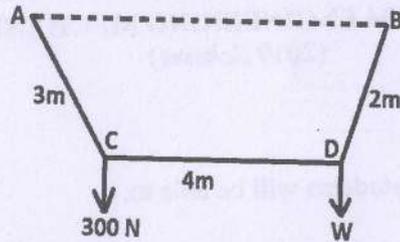
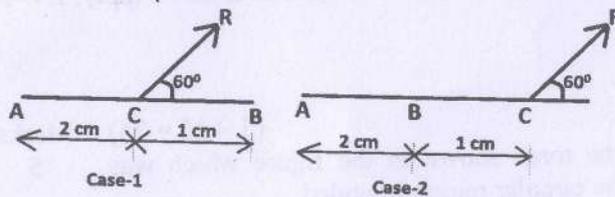(b) Calculate the centroid of the shaded area shown in figure with respect to given x-y axes.   **7   L4   2   1**
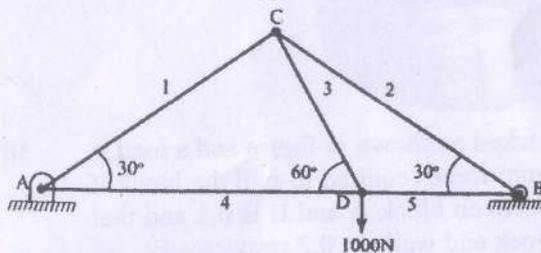

(c) Resolve the given force R = 100N to two other forces at A&B.   **4   L3   1   1**

III. (a) Determine the axial force in members 2, 3 & 4 of the plane truss loaded and supported as shown in the figure. It is given that triangle ABC is isosceles triangle.   **10   L4   1   1**
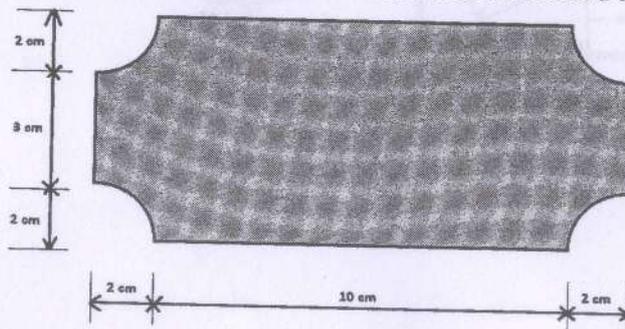

(b) Explain: **5   L2   2   1**
    (i) Radius of Gyration
    (ii) Perpendicular axis theorem.

OR

IV. (a) Calculate the centroidal moment of inertia of the shaded area.   **10   L4   2   1**
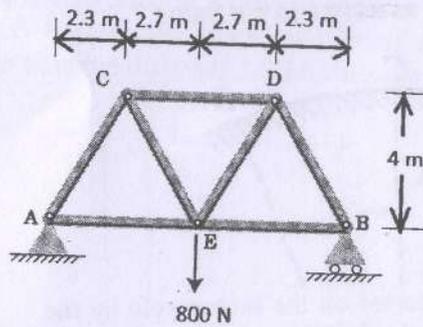
			Marks	BL	CO	PO
(b)	Determine the force in member CD by using the method of virtual work.		5	L4	1	2

800 N

V.	(a)	A block of weight 44.5 N is projected with an initial velocity of 9.5 m/s along a horizontal plane made of same material. The block travelled 13.725 m before coming to rest. Find the coefficient of friction between the two surfaces.	4	L4	3	1
	(b)	Explain the terms Kinematics and Kinetics.	3	L2	3	1
	(c)	Two small cars of weights W_1 = 890N and W_2 = 445N, by a flexible but inextensible string overrunning a pulley C and are free to roll on an inclined plane as shown in the figure. If the cars are released from rest in the position shown, find the time t required for them to exchange the positions. Neglect rolling resistance and friction in the pulley.	8	L4	3	1
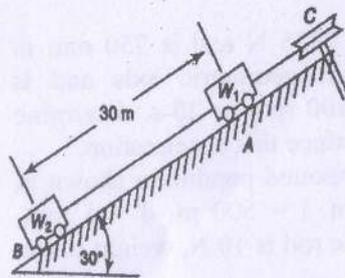
OR

|						
VI.	(a)	State the principle of conservation of momentum.	3	L4	3	1
	(b)	A 31.15 N weight produces a static elongation of 30 mm in a given spring. Determine the period of vibration of a weight W = 44.5N suspended by the same spring.	4	L3	3	1
	(c)	A man weighing 667.5 N runs and jumps from a pier into a boat with a horizontal velocity of 3m/s. Assuming that the impact is entirely plastic, find the velocity with which the man and boat will move away from the pier if the boat weighs 890 N.	8	L4	3	1
VII.	(a)	Can a body have a constant velocity and still be accelerating? Explain.	3	L2	4	1
	(b)	The maximum range of a projectile is 2700 m. What should be the angle of elevation α, so as to obtain a range of 2450 m if the initial velocity remains unchanged?	6	L3	4	1

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		Marks	BL	CO	PO

(c) A motorcycle and rider of total weight W = 2225 N travels in a vertical plane with constant speed V = 2 kmph along a circular curve AB of radius r = 300 m, as shown in the figure.
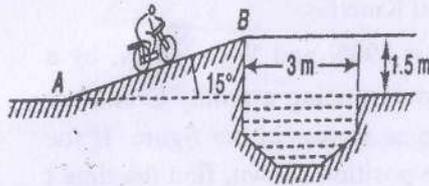
Marks 6 BL L4 CO 4 PO 1
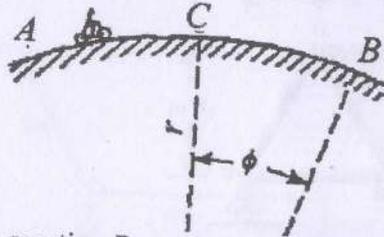
(i) Find the reaction R exerted on the motorcycle by the track as it passes the crest C of the curve.

(ii) At point B on the vertical curve as defined by the angle Φ, will the road reaction R become zero.

OR

VIII. (a) Calculate the minimum velocity with which a motorcycle stunt rider must leave the 15° ramp at B in order to clear the ditch.

8 L4 4 2

(b) Explain work-energy principle in curvilinear motion.

5 L2 4 1

(c) Define Moment of momentum.

2 L2 4 1

IX. (a) A right circular disk which weighs 1335 N and is 750 mm in diameter is free to rotate about its geometric axis and is constantly accelerated from rest to 300 rpm in 20 s. determine the constant torque M required to produce this acceleration.

7 L3 5 1

(b) Calculate the time period of the compound pendulum shown in figure. The following data are given. l = 500 m, d = 5 mm, r = 100 mm, h = 25 mm, weight of the rod is 10 N, weight of the disc = 60N.

8 L4 5 1

OR
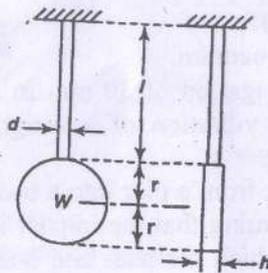
X.	A homogeneous square plate of side a = 0.30 m and weight W = 100 N is supported in a vertical plane as shown in figure. If the pin at B is removed, calculate the angular velocity of the plate by the time the diagonal AC becomes vertical.	Marks	BL	CO	PO
		15	L4	5	2
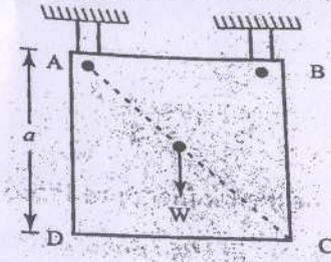
Bloom's Taxonomy Levels
L2 = 12%, L3 = 20%, L4 = 68%,

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