

--	--	--	--	--	--	--	--	--	--

***B.Tech. Degree I Semester Regular/Supplementary Examination in
Marine Engineering November 2023***

**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,

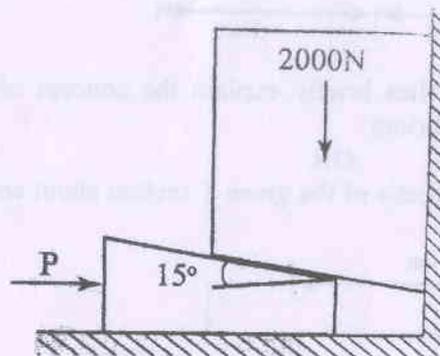
L5 – Evaluate, L6 – Create

PI – Programme Indicators

Answer **ALL** questions

(5 × 15 = 75)

- | | | Marks | BL | CO | PI |
|----|---|-------|----|----|-------|
| I. | (a) To raise a heavy block weighing 2000 N, a wedge of angle 15° and negligible weight is used. Find the minimum horizontal force P necessary to just raise the block, if the coefficient of friction for all surfaces of contact is 0.25. | 10 | L3 | 1 | 2.1.2 |



- | | | | | |
|--|---|----|---|-------|
| (b) Prove that for smaller bodies, which are homogeneous in nature, centroid, center of gravity and center of mass are same. | 5 | L2 | 1 | 1.2.1 |
|--|---|----|---|-------|

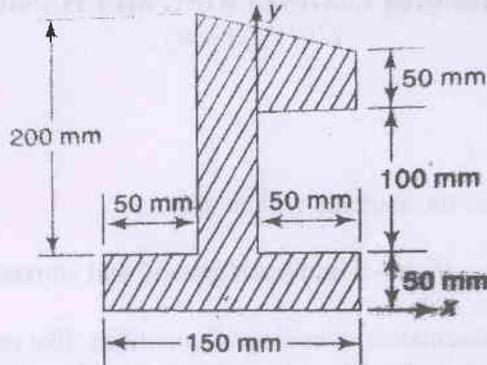
OR

(P.T.O.)

BT MRE-I(R/S)-11-23-3003

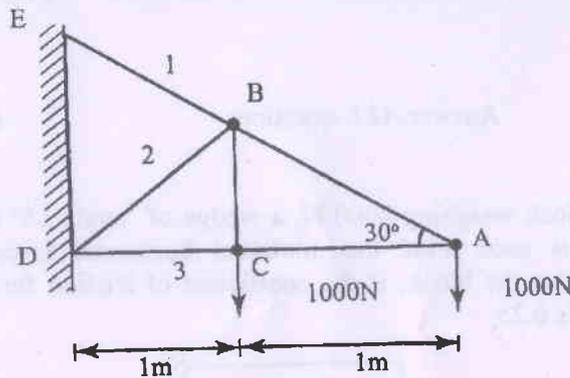
Marks	BL	CO	PI
10	L3	1	2.1.1

- II. (a) With reference to the coordinate axes x and y , locate the centroid of the shaded area of the plane figure shown below.



- (b) The greatest and least resultant of two forces acting at a particle are 35 kN and 5 kN respectively. If 25 kN is the magnitude of the resultant for the given system of forces P and Q . Prove that the forces are at right angle.
- | | | | |
|---|----|---|-------|
| 5 | L2 | 1 | 1.2.1 |
|---|----|---|-------|

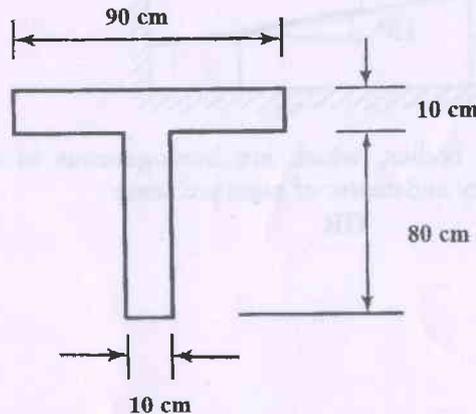
- III. (a) Write the assumptions of analysis of trusses and then find the axial forces in the bars 1, 2 and 3 of the truss shown in the figure.
- | | | | |
|----|----|---|-------|
| 10 | L3 | 2 | 2.1.2 |
|----|----|---|-------|



- (b) With help of simple sketches briefly explain the concept of stable, unstable and neutral equilibrium.
- | | | | |
|---|----|---|-------|
| 5 | L2 | 2 | 1.2.1 |
|---|----|---|-------|

OR

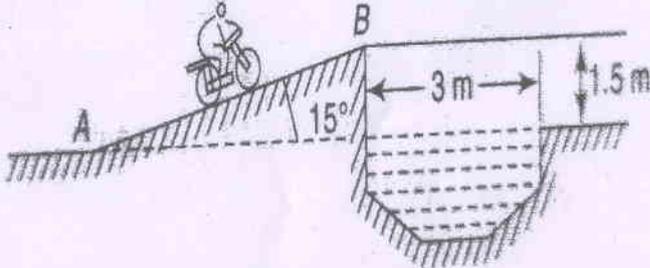
- IV. (a) Calculate the moment of inertia of the given T section about centroidal axis.
- | | | | |
|----|----|---|-------|
| 10 | L3 | 2 | 2.1.2 |
|----|----|---|-------|



- (b) What is principle of virtual work? With help of a simple example, explain how virtual work method is applied to solve problems in statics.
- | | | | |
|---|----|---|-------|
| 5 | L2 | 2 | 1.2.1 |
|---|----|---|-------|

(Continued)

BT MRE-I(R/S)-11-23-3003

		Marks	BL	CO	PI
V.	(a) A pile hammer weighing 28000 N drops from a height of 800 mm on a pile of 15000 N. The pile penetrates 120 mm per blow. Assuming the motion of pile to be resisted by constant force, find the resistance to penetration of ground.	10	L3	3	2.1.2
	(b) An athlete reaches his maximum speed in 2.5 seconds from rest with constant acceleration. He then maintains that speed and finishes the 100 m race in 9.6 seconds. Find his maximum speed.	5	L2	3	1.2.1
OR					
VI.	(a) When a ball of weight W rests on a spring of constant k , it produces a static deflection of 2.5 cm. How much will same ball compress the spring if it is dropped from a height of 30.5 cm? Neglect the mass of the spring.	10	L3	3	2.1.2
	(b) A stone is dropped into a well and falls vertically with constant acceleration $g = 9.81 \text{ m/s}^2$. The sound of impact of the stone on the bottom of the well is heard 6.5 seconds after it is dropped. If the velocity of sound is 340 m/s, how deep is the water surface?	5	L2	3	1.2.1
VII.	(a) A race car travels around a horizontal circular track that has a radius of 90 m. If the car increases its speed at a constant rate of 2.1 m/s^2 , starting from rest, determine the time needed for it to reach a resultant acceleration of 2.4 m/s^2 . What is its speed at this instant?	10	L3	4	2.1.2
	(b) A gun fires 2 bullets at 30° and 60° with the horizontal. If they have same range, find the ratio of their maximum heights.	5	L2	4	1.2.1
OR					
VIII.	(a) Calculate the minimum speed V_0 with which a motorcycle stunt rider must leave the 15° ramp at B in order to clear the ditch.	10	L3	4	2.1.2
					
	(b) Explain D'Alembert's principle in curvilinear motion.	5	L2	4	1.2.1
IX.	(a) A disc weight $W = 100 \text{ N}$ and radius $r = 0.25 \text{ m}$ supported at its centre is acted upon by a constant couple of moment 6 Nm and a force of 50 N is applied to a cord wrapped around its periphery. Determine the angular velocity of the disc 2 seconds after starting from rest.	10	L3	5	2.1.2
	(b) Explain principle of angular momentum.	5	L2	5	1.2.1
OR					
X.	(a) A wheel is attached to the shaft of an electric motor of rated speed of 2000 rpm. When the power is switched on, the unit attains the rated speed in 10 seconds and when the power is switched off, the unit comes to rest in 100 seconds. Assume uniformly accelerated motion and determine: (i) the number of revolutions the unit turns to attain the rated speed (ii) to come to rest.	10	L3	5	2.1.2
	(b) Show that the change in kinetic energy of a body rotating through an angle Θ is equal to the work done by the external moment over the angular displacements Θ .	5	L2	5	1.2.1

Bloom's Taxonomy Levels
L2 = 33%, L3 = 67%.