Reg. No. [ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]

B.E. / B.TECH. DEGREE EXAMINATIONS, MAY 2023

Second Semester

ME22201 – ENGINEERING MECHANICS

(Common to ME, MN & MR)

(Regulation 2022)

TIME: 3 HOURS   MAX. MARKS: 100

COURSE OUTCOMES	STATEMENT	RBT LEVEL
CO 1	Understand and analyze the various methods to determine the resultant forces and its equilibrium acting on a particle in 2D and 3D.	3
CO 2	Understand and analyze the concept of reaction forces and moment of various support systems with rigid bodies in 2D and 3D in equilibrium.	3
CO 3	Evaluate centroid, Area moment of Inertia and Mass moment of Inertia of cross section of any structural member	3
CO 4	Evaluate the problems in friction and rigid body dynamics	3
CO 5	Correlate the engineering problems dealing with force, displacement, velocity and acceleration equations	3

### PART- A (20 x 2 = 40 Marks)

(Answer all Questions)

		CO	RBT LEVEL
1.	Define parallelogram law of forces. What is the use of this law?	1	2
2.	What is principle of transmissibility of forces and where this principle is used?	1	2
3.	Differentiate between collinear and concurrent forces.	1	2
4.	A force of magnitude 50 kN is acting along the line joining A (2,0,6) and B (3,-2,0) m. Write the vector form of the force.	1	3
5.	How do you reduce a force into an equivalent force-couple system?	2	2
6.	How does the method of joint differs from the method of section in the analysis of pin jointed trusses?	2	2
7.	Why the couple moment is said to be a free vector?	2	2
8.	Find the support reactions of a cantilever beam of span 6 m carrying a UDL of 25 kN/m.	2	3
9.	What do you mean by second moment of area?	3	2
10.	A semicircular area having radius of 100 mm located in the XY plane such that its diameter coincides with the Y-axis. Determine the X-coordinate of the center.	3	3
11.	Find the product of inertia of a rectangle of sides a and b with respect to the axes that lie along its two sides.	3	2
12.	What is the significance of Moment of Inertia?	3	2
13.	State coulomb's laws of dry friction?	4	2
14.	Explain the phenomenon of friction by taking an example of a block placed on a rough surface.	4	2
15.	A person is climbing a ladder leaned against a rough wall and resting on a rough floor. What are the forces are acting on the ladder?	4	2
16.	How the coefficient of friction is related to angle of friction?	4	2
17.	The motion of a particle in rectilinear motion is defined by the relation, $s = 2t^3 - 9t^2 + 12t - 10$ where s is expressed in metres and t in seconds. Find the acceleration of the particle when the velocity is zero.	5	3
18.	What are the parameters that define rectilinear motion? State the relationship between	5	2

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	these parameters.		
19.	State the assumptions made while studying projectile motion.	5	2
20.	What is the importance of impulse momentum method?	5	2

PART- B (5 x 10 = 50 Marks)

		Marks	CO	RBT LEVEL
21. (a)	Four forces act on bolt A as shown in Figure. Determine the resultant and its direction of the forces on the bolt.	(10)	1	3
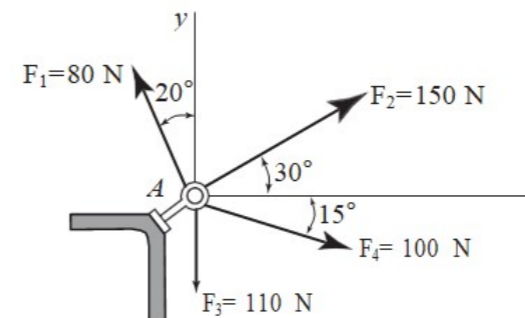
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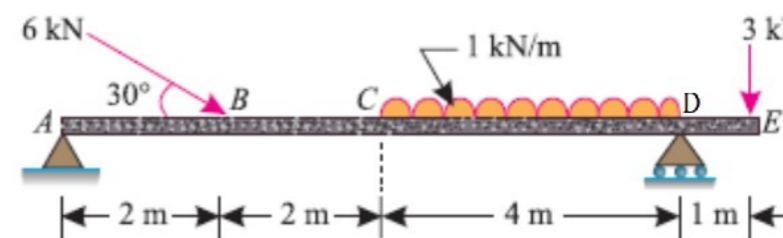
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(b)	A transmission tower is held by guy wire AB and anchored by bolt at B. If the tension in wire *AB* is 2625 N, determine the components of the force exerted by the wire on the bolt at *B*.	(10)	1	3
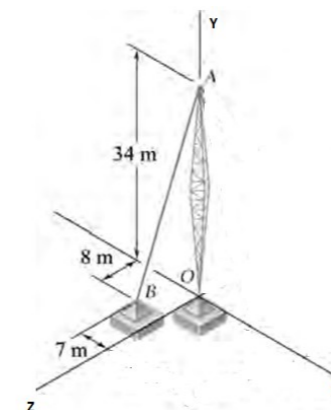
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22. (a)	A beam ABCDE hinged at A and supported on rollers at D, is loaded as shown in Figure. Find the reactions at A and D.	(10)	2	3

(OR)

|				
(b)	Four forces act on the machine part is shown in Figure. Determine the resultant force and its direction. Also find the moment of the given forces about the origin O.	(10)	2	3
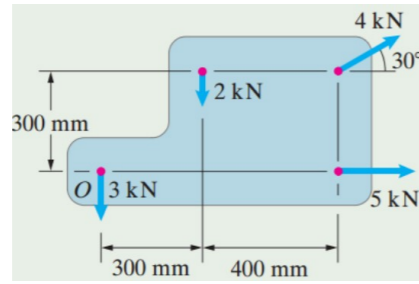
23. (a) A uniform lamina shown in Figure consists of a rectangle, a semicircle and a triangle. Determine the center of gravity of the lamina. **(10)** **3** **3**
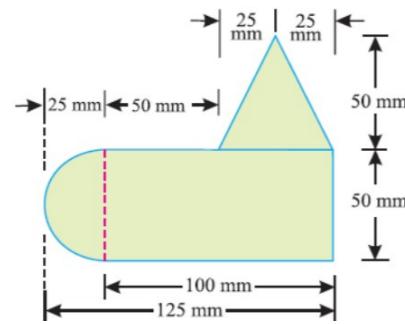

(OR)

(b) Derive an equation for moment of inertia for the right - angled triangular section about its centroidal axes. **(10)** **3** **3**

24. (a) Find the value of 'Θ' if the block 'A' and 'B' shown in Figure have impending motion. Given block A = 20 kg, block B = 20 kg, μ$_A$ = μ$_B$ = 0.25. **(10)** **4** **3**
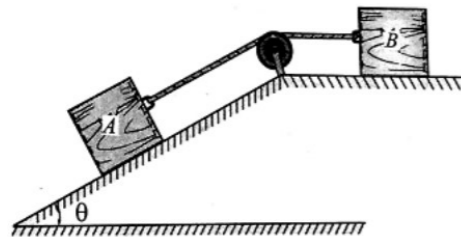

(OR)

(b) A ladder of length 4 m, weighing 200 N is placed against a vertical wall as shown in Figure. The coefficient of friction between the wall and the ladder is 0.2 and that between floor and the ladder is 0.3. The ladder, in addition to its own weight, has to support a man weighing 600 N at a distance of 3 m from A. Calculate the minimum horizontal force to be applied at A to prevent slipping. **(10)** **4** **3**
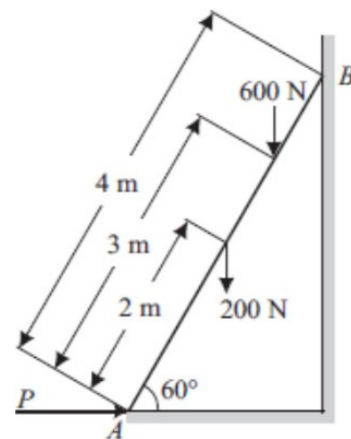
25. (a) During a test, a rocket travels upward at 75 m/s, and when it is 40 m from the ground its engine fails. Determine the maximum height reached by the rocket and its speed just before it hits the ground. While in motion, the rocket is subjected to a constant downward acceleration of 9.81 m/s^2 due to gravity. Neglect the effect of air resistance. **(10)** **5** **3**

(OR)

(b) Two blocks are joined by an inextensible cable as shown in Figure. If the system is released from rest, determine the velocity of block A after it has moved 2 m. Assume that the coefficient of friction between block A and the plane is μ$_k$ = 0.25 and that the pulley is weightless and frictionless. **(10)** **5** **3**
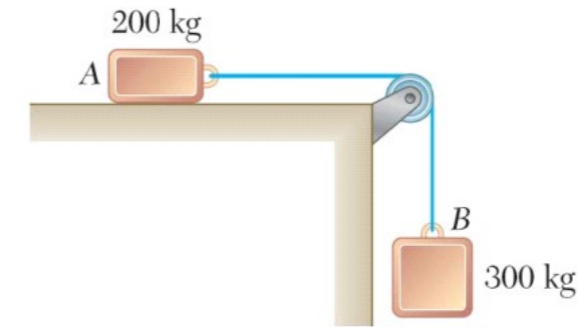
PART- C (1 x 10 = 10 Marks)
(Q.No.26 is compulsory)

	Marks	**CO**	**RBT LEVEL**

26. A sailor is being rescued using a boatswain's chair that is suspended from a pulley that can roll freely on the support cable *ACB* and is pulled at a constant speed by cable *CD*. Knowing that α = 30° and β = 10° and that the combined weight of the boatswain's chair and the sailor is 900 N, determine the tension **(10)** **1** **4**

    (a) in the support cable *ACB*, *(b)* in the traction cable *CD*.