Q. Code:702365

Reg. No. | | | | | | | | | | | | | |

B.E./ B. TECH.DEGREE EXAMINATIONS, MAY 2024

Fourth Semester

AE22401 – APPLIED MECHANIC

(Automobile Engineering)

(Regulation 2022)

TIME:3 HOURS **MAX. MARKS: 100**

COURSE OUTCOMES	STATEMENT	RBT LEVEL
CO 1	Explain the different principles applied to solve engineering problems dealing with forces acting on a rigid body	**4**
CO 2	Applying the different laws to analyze the Moment of forces and couples that cause the body in equilibrium.	**4**
CO 3	Identify and examine the centroid, centre of gravity, area moment of inertia and mass moment of inertia.	**4**
CO 4	Identify and analyze the application of friction force on various belt drives and analyze the motion of vehicles.	**4**
CO 5	Investigate the dynamic forces subjected to a rigid body.	**4**

PART- A(20x2=40Marks)

(Answer all Questions)

		CO	RBT LEVEL
1.	Identify the SI units for the following physical quantities: (a) Force, (b) Pressure, (c) Impulse, (d) Momentum.	**1**	**2**
2.	Define vector quantities and give two examples of physical quantities that are represented by vectors.	**1**	**2**
3.	State the Principle of Transmissibility of Forces and outline its significance in the analysis of mechanical systems, supported by a relevant example.	**1**	**2**
4.	State equilibrium conditions for coplanar concurrent forces.	**1**	**2**
5.	Draw a free-body diagram for the provided figure, considering a smooth surface contact at point A.(Figure 1)	**2**	**3**

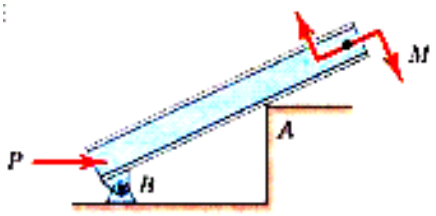

Figure 1

6.	State some engineering applications of moments.	**2**	**2**
7.	Find the magnitude of two like parallel forces acting at a distance of 100 cm apart which is equivalent to a force of 30 N acting at a distance of 20 cm from one of the forces.	**2**	**3**

8.	Find the sum of the moments of the forces shown in figure 1.	**2**	**2**

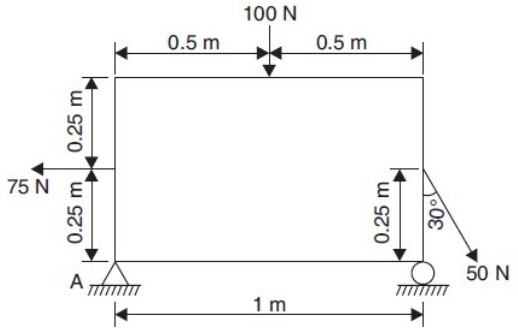

Figure 1.

9.	State the location of the center of gravity (C.G.) for the following regular solids: cylinder, sphere, hemisphere, and right circular cone.	**3**	**2**
10.	How would you find out the moment of inertia of a plane area ?	**3**	**2**
11.	Explain the parallel axis theorem for determining the moment of inertia of areas using a clear diagram	**3**	**3**
12.	Define the concept of 'radius of gyration' in mechanics.	**3**	**2**
13.	State the characteristics of frictional force.	**4**	**2**
14.	Define Angle of repose.	**4**	**2**
15.	A body which weights 1000 N rests on a horizontal plane, the co-efficient of friction between the body and the plane being 0.1. Find the force, which acting at 30° to the horizontal will just move the body.	**4**	**3**
16.	Identify and define the various types of vehicle movements.	**4**	**2**
17.	Motor boat is moving with a steady speed of 10 m/s. If the water resistance to the motion of the boat is 600 N, determine the power of the boat engine.	**5**	**3**
18.	Explain the term ‘conservation of energy’.	**5**	**2**
19.	Define the coefficient of restitution.	**5**	**2**
20.	Enumerate and briefly explain the different types of collisions in physics.	**5**	**2**

PART- B (5x 10=50Marks)

		Marks	CO	RBT LEVEL
21. (a)	Two smooth spheres each of radius 150 mm and weight 250 N rest in a horizontal channel having vertical walls, the distance between which is 560 mm. Find the reaction at the points of contact A, B, C, and D as shown in Figure 2.	**(10)**	**1**	**3**

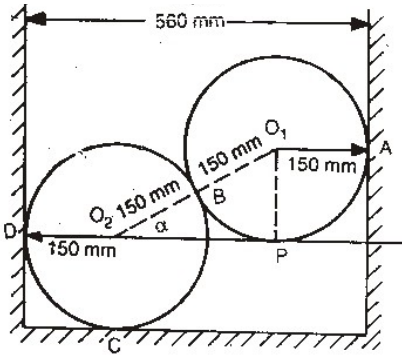

Figure 2

(OR)

(b) A horizontal line PQRS is 12 m long, where PQ = QR = RS = 4 m. Forces of 1000 N, 1500 N, 1000 N and 500 N act at P, Q, R and S respectively with downward direction. The lines of action of these forces make angles of 90°, 60°, 45° and 30° respectively with PS. Find the magnitude, direction and position of the resultant force. (Figure 3) **(10)** **1** **3**

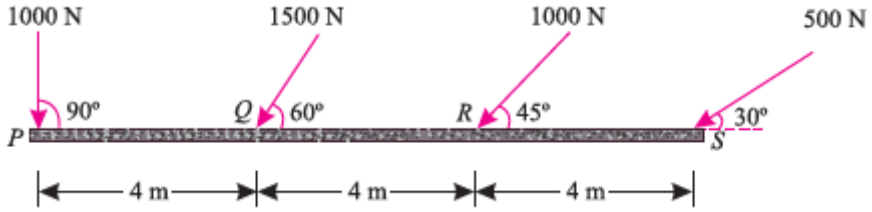

Figure 3

22. (a) Member AB is supported by a cable BC and at A by a square rod which fits loosely through the square hole in the collar fixed to the member as shown. Determine the components of reaction at A and the tension in the cable needed to hold the rod in equilibrium. (Figure 4) **(10)** **2** **4**

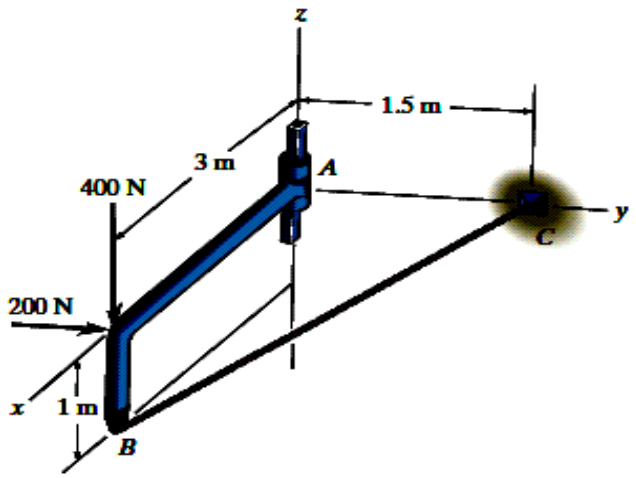

Figure 4

(OR)

(b) A simply supported overhanging beam 15 meters long carries a system of loads as shown in Figure. Determine the reactions at the supports. (Figure 5) **(10)** **2** **4**

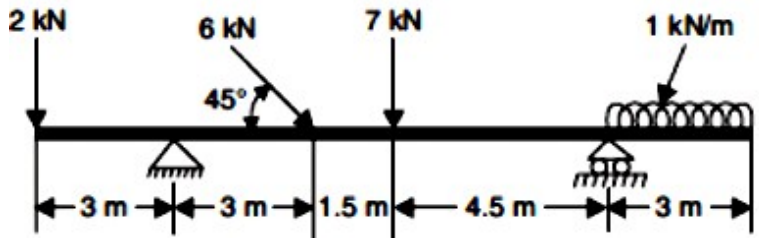

Figure 5

23. (a) Determine the location of the centroid of the plane figure shown in Figure 6 **(10)** **3** **4**

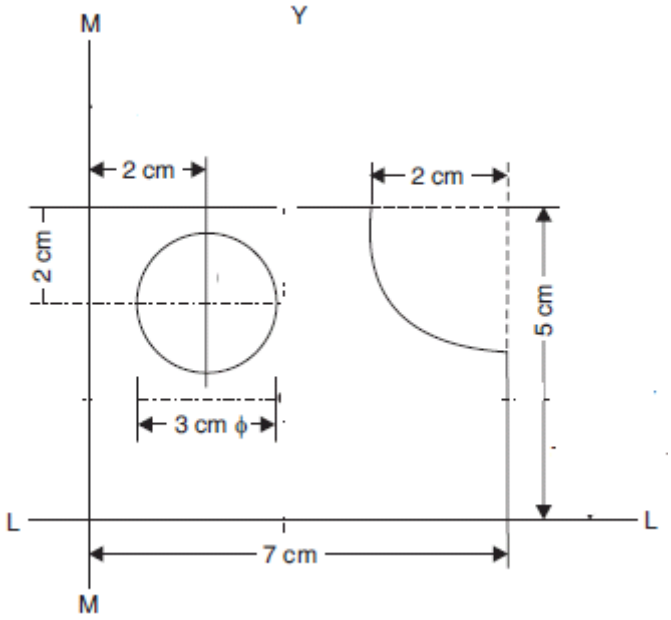

Figure 6

(OR)

(b) For the shaded area shown in Figure 7 , find the following : **(10)** **3** **4**
(i) The position of the centroid
(ii) The second moment of area about the base
(iii) The radius of gyration about the base.

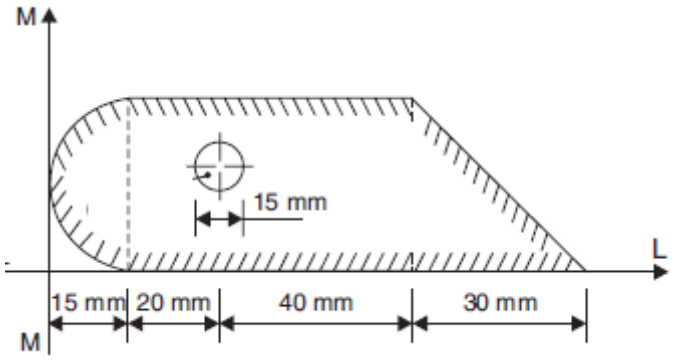

Figure 7

24. (a)	A uniform ladder of 4 m length rests against a vertical wall with which it makes an angle of 45°. The coefficient of friction between the ladder and the wall is 0.4 and that between ladder and the floor is 0.5. If a man, whose weight is one-half of that of the ladder ascends it, how high will it be when the ladder slips?	**(10)**	**4**	**4**
	(OR)			
(b)	A block weighing 10 kN is to be raised by means of a 20° wedge. Determine what minimum horizontal force P, should be applied to raise the block, the angles of friction at the contact surfaces AC, AB and DE are 11°, 14° and 10° respectively. (Figure 8)	**(10)**	**4**	**4**

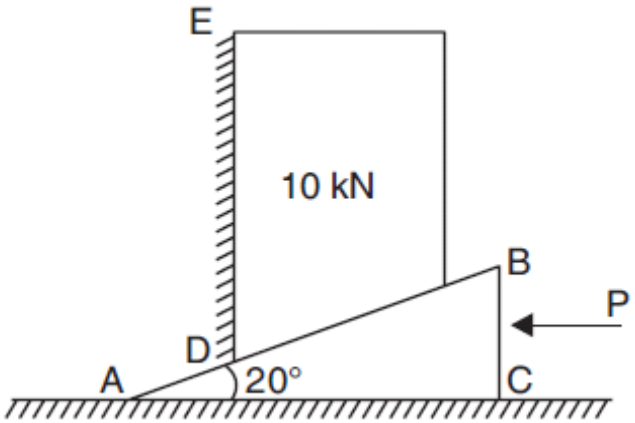

Figure 8

25. (a)	A truck is moving down a 10º incline when the driver applies brakes, with the result that the truck decelerates at a steady rate of 1 m/s^2. Investigate whether a 500 kg placed on the truck will slide or remain stationary relative to the truck. Assume the coefficient of friction between the truck surface and the load as 0.4. What will be the factor of safety against slipping for this load? (Figure 9)	**(10)**	**5**	**4**

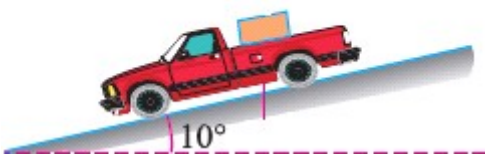

Figure 9

(OR)

		Marks	CO	RBT LEVEL
(b)	A solid cylindrical pulley of mass 800 kg, having 0.8 m , radius of gyration and 2 m diameter, is rotated by an electric motor, which exerts a uniform torque of 60 kN-m. A body of mass 3 t is to lifted by a wire wrapped round the pulley. Find (i) acceleration of the body; and (ii) tension in the rope.	**(10)**	**5**	**4**

PART- C (1x 10=10Marks)

(Q.No.26 is compulsory)

		Marks	CO	RBT LEVEL
26.	A flywheel with a radius of gyration 0.9 m is fitted to a multicylinder engine, which runs at a mean speed of 360 r.p.m. If the speed varies from 2% above the mean to 2% below it and the fluctuation energy is 30 kN-m, find (i) moment of inertia of the wheel and (ii) mass of the flywheel.	**(10)**	**5**	**4**

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