Roll No. | | | | | | | | | | |

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E. /B.Tech / B. Arch (Full Time) - END SEMESTER EXAMINATIONS, APR / MAY 2024

MECHANICAL ENGINEERING
Semester II
GE7153 - ENGINEERING MECHANICS
(Regulation2015)

Time:3hrs Max.Marks: 100

CO1	Applying the various methods to determine the resultant forces and its equilibrium acting on a particle in 2D and3D.
CO2	Applying the concept of reaction forces (non-concurrent coplanar and noncoplanar forces) and moment of various support systems with rigid bodies in 2D and 3D in equilibrium. Reducing the force, moment, and couple to an equivalent force - couple system acting on rigid bodies in 2D and3D.
CO3	Applying the concepts of locating centroids/center of gravity of various sections / volumes and to find out area moments of inertia for the sections and mass moment of inertia of solids.
CO4	Applying the concepts of frictional forces at the contact surfaces of various engineering systems.
CO5	Applying the various methods of evaluating kinetic and kinematic parameters of the rigid bodies subjected to concurrent coplanar forces.

BL – Bloom's Taxonomy Levels
(L1-Remembering, L2-Understanding, L3-Applying, L4-Analysing, L5-Evaluating, L6-Creating)

PART- A(10x2=20Marks)
(Answer all Questions)

Q.No.	Questions	Marks	CO	BL
1	A force of magnitude 500 N is passing through the origin and a point A (0.2, 1, 0) m. Write the vector form of the force.	2	1	1
2	State- Principles of transmissibility.	2	1	1
3	Define free body diagram and write its applications.	2	2	1
4	List different types of beams and loads.	2	2	1
5	State "pappus guldinus" theorem.	2	3	2
6	State parallel axis theorem.	2	3	2
7	A body of weight 150 N rests on a horizontal plane. If a horizontal force of 50 N can just move it, then what will be the value of coefficient of friction.	2	4	2
8	Define cone of friction and Angle of repose.	2	4	1
9	A flywheel has a mass moment of inertia of 11 kg-m^2 about the axis of rotation. It runs at constant angular velocity of 94.25 red/sec. Find K.E of the flywheel.	2	5	1
10	Define coefficient of restitution.	2	5	1

PART- B(5x 13=65Marks)
(Restrict to a maximum of 2 subdivisions)

Q.No.	Questions	Marks	CO	BL
11 (a)	(i) Determine the magnitude and angle Θ of F so that the particle P, shown in Fig.1, is in equilibrium. (ii) A system of five forces of 4 kN, 5 kN, 6 kN, 7kN and 8 kN are acting at one of the angular points of a regular hexagon and pass through the other angular points as shown in fig.2. Find the magnitude & resultant of the system of forces.	6 7	1	4

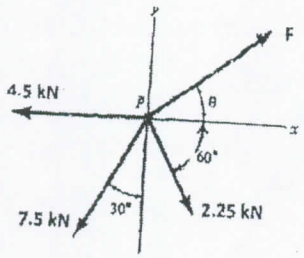


Fig .1

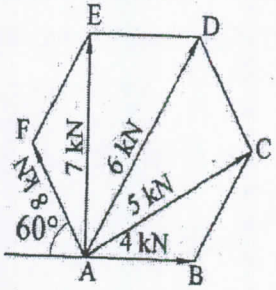


Fig.2

OR

11 (b)	Members OA, OB and OC form a three member space truss shown in fig. 3. A weight of 10kN is suspended at the joint O. Determine the magnitude and nature of the forces included in each of the three members of the truss.	13	1	4

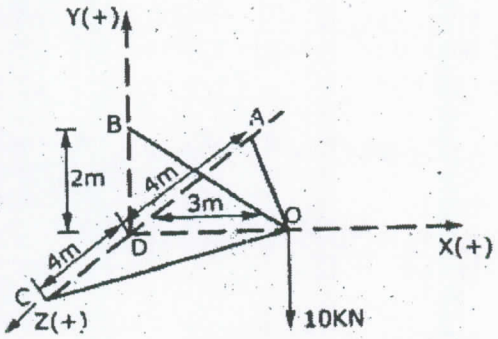


Fig.3

12 (a)	Four forces and a couple are applied to a rectangular plate as shown in fig.4. Determine the magnitude and direction of force-couple system. Also determine the distance from O along x-axis where the resultant intersects.	13	2	4

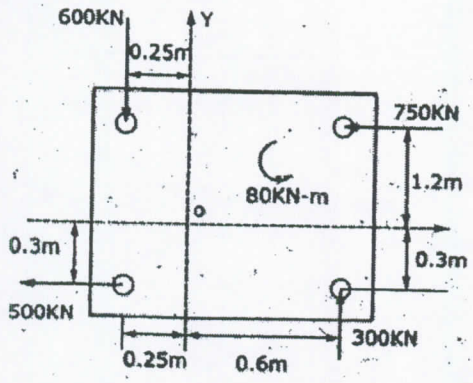


Fig.4

OR

12 (b)	A frame supported at A and B is subjected to force of 500 N as shown in Fig.5. Compute the reactions at the support points for the cases of $\Theta = 0°$, $\Theta = 90°$ and $\Theta = 60°$.	13	2	4

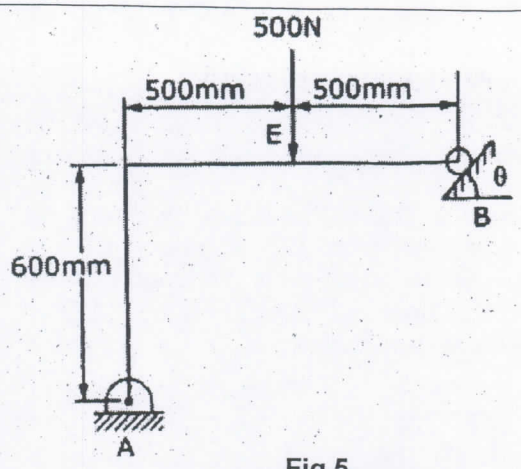
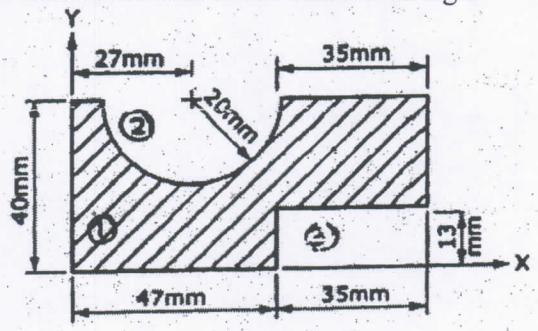
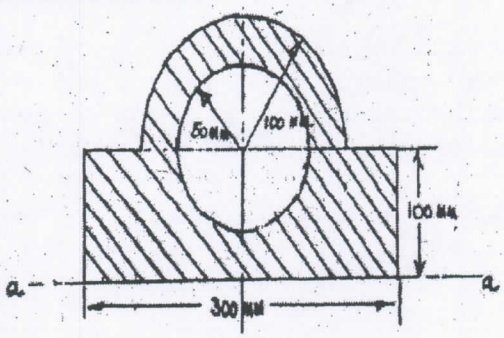
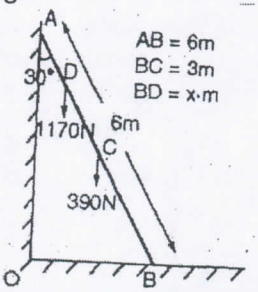
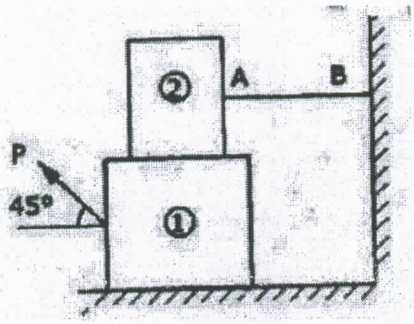


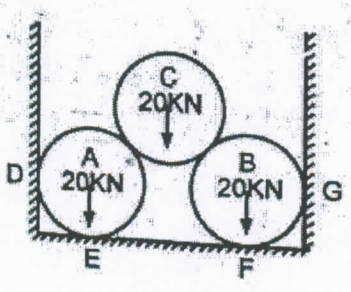
Fig.5

13 (a)	Find the centroid of the shaded area shown in fig.6  Fig.6	13	3	5
	OR			
13 (b)	Determine the second moment of area of the section shown in fig.7 about its base axis a-a.  Fig.7	13	3	5
14 (a)	A ladder of weight 390 N and 6m long is placed against a vertical wall at an angle of 30° as shown in fig. 8 . The coefficient of friction between the ladder and the wall is 0.25 and between the ladder and floor is 0.38. Find how high a man of weight 1170 N can climb without sliding. 	13	4	4

	OR			
14 (b)	Block (2) rests on block (1) and is attached by a horizontal rope AB to the wall as shown in fig.9. What force P is necessary to cause motion of block (1) to impend? The co-efficient of friction between the blocks is ¼ and between the floor and block (1) is 1/3. Mass of blocks (1) and (2) are 14kg and 9 kg respectively.  Fig.9	13	4	5
15 (a)	(i) A car of mass 500 kg moving at a speed of 80 km /hr to the right collides with a lorry of mass 1500 kg which is at rest. After the impact, the lorry moves at a speed of 36 km/hr to the right. Find the velocity of the car after impact. Also find the coefficient of restitution. (ii) A boy drops a stone from the top of well vertically downwards into it. The splash is heard by him after 3.63 seconds. Find the depth of the well taking sound velocity as 331 m/s.	7 6	5	4
	OR			
15 (b)	A ball of mass 2 kg, moving with a velocity of 3 m/s, impinges on a ball of mass 4 kg moving with a velocity of 1 m/s. The velocities of the two balls are parallel and inclined at 30° to the line of joining their centers at the instant of impact. If the coefficient of restitution is 0.5, find (i) Direction, in which the 4 kg ball will move after impact; (ii) Velocity of the 4 kg ball after impact; (iii) Direction, in which the 2 kg ball will move after impact; (iv) Velocity of the 2 kg ball after impact.	13	5	4

PART- C(1x 15=15Marks)

(Q.No.16 is compulsory)

Q.No.	Questions	Marks	CO	BL
16.	Three smooth pipes each weighing 20 kN and of diameter 60 cm are to be placed in a rectangular channel with horizontal base as shown in the fig.10. Calculate the reactions at the point of contact between the pipes and between the channel and the pipes. Take the width of the channel as 160 cm.  	15	2	6