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

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

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

Civil Engineering, Electrical and Electronics Engineering, Geoinformatics, Industrial Engineering, Manufacturing Engineering, Material Science and Engineering, Mechanical Engineering, Mining Engineering, Biomedical Engineering, Printing and Packaging Technology, Aeronautical Engineering, Automobile Engineering, Electronics and Instrumentation Engineering, Production Engineering, Textile Engineering, Rubber and Plastics Technology

II Semester

GE3151 ENGINEERING MECHANICS

(Regulation 2023)

Time: 3 hours

Max. Marks: 100

CO1	To determine the resultant forces acting on a particle in 2D and 3D and to apply methods of equilibrium on a particle in 2D and 3D.
CO2	Evaluate the reaction forces for bodies under equilibrium, to determine moment of a force, moment of a couple, to resolve force into a force-couple system and to analyze trusses.
CO3	Assess the centroids of 2D sections / center of gravity of volumes and to calculate area moments of inertia for the sections and mass moment of inertia of solids.
CO4	Evaluate the frictional forces acting at the contact surfaces of various engineering systems and apply the work-energy principles on a particle. evaluate the kinetic and kinematic parameters of a particle.
CO5	Determine kinetic and kinematic parameters of the rigid bodies subjected to concurrent coplanar forces.

BL – Bloom's Taxonomy Levels

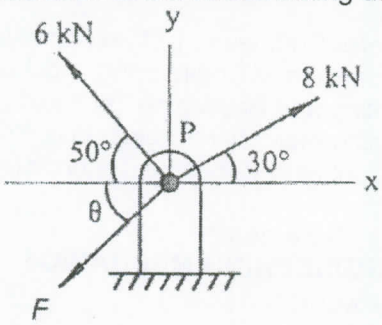
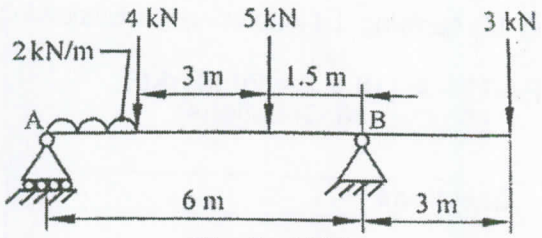
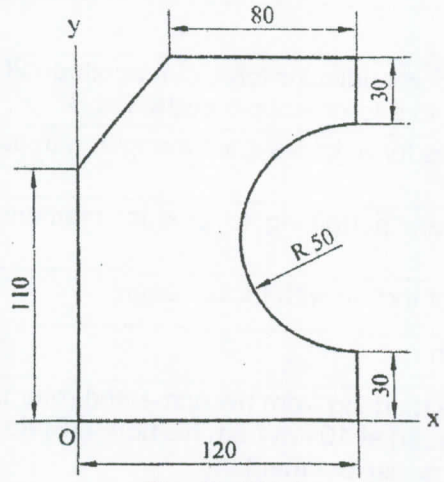
(L1-Remembering, L2-Understanding, L3-Applying, L4-Analysing, L5-Evaluating, L6-Creating)

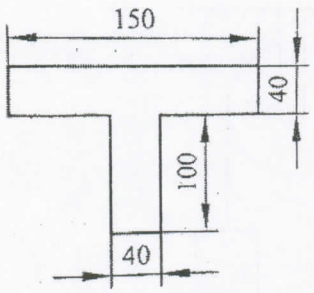
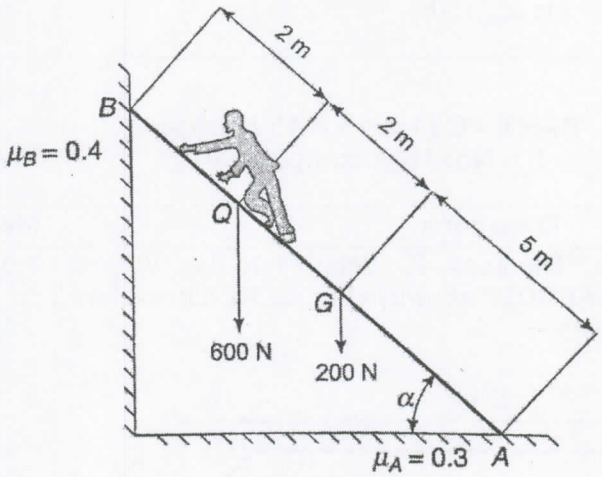
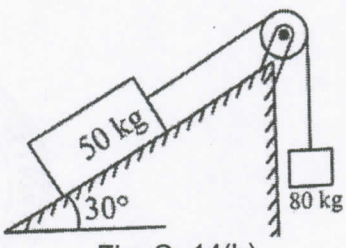
PART - A (10 x 2 = 20 Marks)

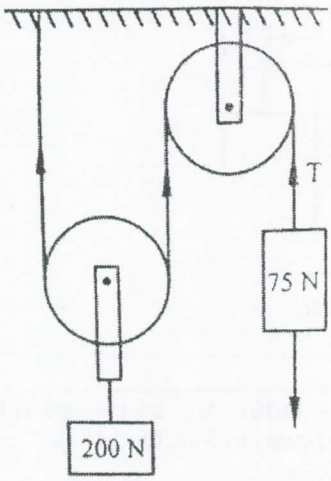
(Answer all Questions)

Q. No.	Questions	Marks	CO	BL
1	State Lami's theorem.	2	1	2
2	Two equal forces are acting at a point with an included angle of 60° between them. What is the magnitude of the force components, if their resultant has a magnitude of $5\sqrt{3}$ N?	2	1	2
3	State Varignon's theorem.	2	2	2
4	On a line AB of length 3 m, a perpendicular force of magnitude 20 N acts at A. Reduce this system to a force-couple system at B.	2	2	2
5	Mark the centroidal coordinates for a right-angled triangle, with base width *b* and height *h*.	2	3	2
6	State the parallel axis theorem pertaining to product moment of inertia.	2	3	2
7	Derive and relate coefficient of friction with friction angle.	2	4	2
8	Define coefficient of restitution.	2	4	2
9	A person goes to office in the morning from his home and returns in the evening. The office is located at 10 km from his home. State the total distance travelled and the displacement.	2	5	2
10	Define instantaneous centre of rotation in general plane motion.	2	5	2

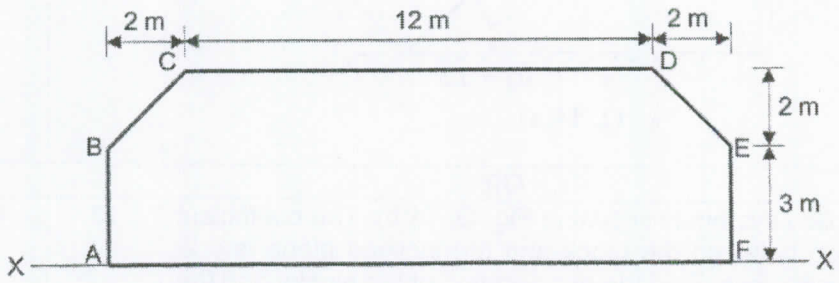
PART - B (5 x 13 = 65 Marks)

Q. No.	Questions	Marks	CO	BL
11(a)	Find the magnitude and the direction of the force *F* shown in Fig. Q. 11(a), so that the resultant of the forces acting at P is zero.  Fig. Q. 11(a)	**13**	1	3
	OR			
11(b)	A force *F* acts at the origin of a three-dimensional system, with θ_x and θ_z to be 60° and 50°, respectively. If its *y*-direction component is equal to −100 N, find (i) θ_y (ii) magnitude of *F* and (iii) the force components along a line through the origin and point A (4,3,3).	**13**	1	3
12(a)	Forces F_1 = 25 N, F_2 = 15 N and F_3 = 20 N meet at the origin and pass through P (1,−1,2), Q (2,1,3) and R (3,−2,2), respectively. Find the magnitude and direction of the resultant.	**13**	2	4
	OR			
12(b)	Find the support reactions of the beam shown in Fig. Q. 12(b).  Fig. Q. 12(b)	**13**	2	4
13(a)	Locate the centroid of the area shown in Fig. Q. 13(a). The dimensions are in mm.  Fig. Q. 13(a)	**13**	3	4

	OR			
13(b)	Determine the polar moment of inertia of the T-section shown in Fig. Q. 13(b) about an axis passing through its centroid. The dimensions are in mm.  Fig. Q. 13(b)	**13**	3	4
14(a)	Find the least value of α at which the ladder will be placed without slipping, for the position of the man shown in Fig. Q. 14(a).  Fig. Q. 14(a)	**13**	4	4
	OR			
14(b)	A block-and-pulley system is shown in Fig. Q. 14(b). The coefficient of kinetic friction between the block and the inclined plane is 0.2. The pulley is frictionless. Find the acceleration of the blocks and the tension in the cable when the system starts from rest. Also, find the time required for the 80 kg block to come down by 1.5 m.  Fig. Q. 14(b)	**13**	4	4
15(a)	A car is accelerated at a constant rate of 0.4 m/s^2, and it travels 500 m in 30 seconds. Determine the initial and the final velocity. Also find the distance travelled in the initial 10 seconds.	**13**	5	4

	OR			
15(b)	For the frictionless pulley system shown in Fig. Q. 15(b), find the acceleration and the string tension.  Fig. Q. 15(b)	**13**	5	4

PART - C (1 x 15 = 15 Marks)
(Q. No. 16 is compulsory)

Q. No.	Questions	Marks	CO	BL
16	Using Pappus-Guldinus Theorem 2, determine the volume generated by the section ABCDEF shown in Fig. Q. 16, if it revolves around the marked X-X axis.  Fig. Q. 16	**15**	2	5