GURU NANAK INSTITUTE OF TECHNOLOGY

An Autonomous Institute under MAKAUT

2022

ENGINEERING MECHANICS

EE(ME)301

TIME ALLOTTED: 3 Hours **FULL MARKS: 70**

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable

GROUP – A

(Multiple Choice Type Questions)

Answer any ***ten*** from the following, choosing the correct alternative of each question: **10×1=10**

		Marks	CO No
1. (i)	In order to determine the effects of a force acting on a body, we must know a. Magnitude of the force b. Line of action of the force c. Nature of the force d. All of the above	1	CO1
(ii)	If the resultant of two forces P and Q acting at an angle (α) with P, then a. $tan\alpha = \frac{PSin\theta}{P+QCos\theta}$ b. $tan\alpha = \frac{PCos\theta}{P+QCos\theta}$ c. $tan\alpha = \frac{QSin\theta}{P+QCos\theta}$ d. $tan\alpha = \frac{QCos\theta}{P+QCos\theta}$	1	CO1
(iii)	A couple consists of a. Two like parallel forces of same magnitude. b. Two like parallel forces of different magnitudes. c. Two unlike parallel forces of same magnitude d. Two unlike parallel forces of different magnitudes	1	CO1
(iv)	The centroid of semicircle lies at a distance of .....form its base a. $3r/4\pi$ b. $3\pi/4r$ c. $4r/3\pi$ d. $4\pi/3r$	1	CO2
(v)	Centre of gravity of a thin hollow cone lies on the axis at a height of : a. one-fourth of the total height above base b. one-third of the total height above base c. one-half of the total height above base d. three-eighth of the total height above the base	1	CO2
(vi)	If a body is in equilibrium, we may conclude that a. No force is acting on the body b. The resultant of all the forces acting on it is zero c. The moments of the forces about any point is zero d. Both (b) and (c)	1	CO1

(vii) Equation of motion of a particle is $S=2t^3 - t^2-2$ where S is meters and t in seconds. Acceleration of the particle after 1 sec. will be — 1 CO3

a. $8m/s^2$
b. $9m/s^2$
c. $10m/s^2$
d. $5m/s^2$

(viii) The linear velocity of a rotating body is given by the relation — 1 CO3

a. $v = r.\omega$
b. $v = r/\omega$
c. $v = \omega/r$
d. ω^2/r

where r = Radius of the circular path, and ω = Angular velocity of the body in radians/s

(ix) The moment of inertia of a circular section of diameter (d) is given by the relation — 1 CO2

a. $\frac{\Pi}{16}d^4$
b. $\frac{\Pi}{32}d^4$
c. $\frac{\Pi}{64}d^4$
d. $\frac{\Pi}{96}d^4$

(x) The centre of gravity of an equilateral triangle with each side (a) is ..... from any of the three sides. — 1 CO2

a. $\frac{a\sqrt{3}}{2}$
b. $\frac{a\sqrt{2}}{3}$
c. $\frac{a}{2\sqrt{3}}$
d. $\frac{a}{3\sqrt{2}}$

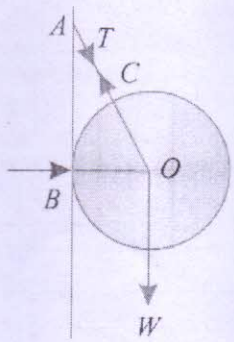
(xi) Centre of gravity of a thin hollow cone lies on the axis at a height of : — 1 CO2

a. one-fourth of the total height above base
b. one-third of the total height above base
c. one-half of the total height above base
d. three-eighth of the total height above the base

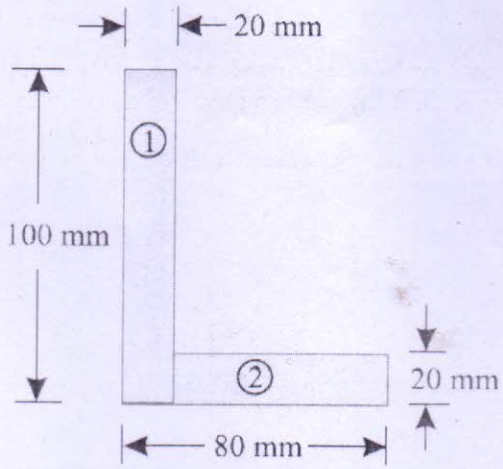
GROUP – B
(Short Answer Type Questions)

Answer any ***three*** from the following: **3×5=15**

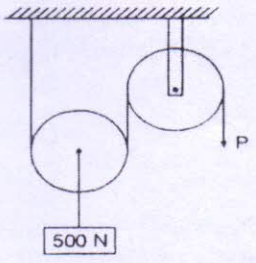
		Marks	CO No
2. a.	State Lami's Theorem.	2	CO1
b.	A smooth sphere of weight W is supported by a string fastened to a point A on the smooth vertical wall, the other end is in contact with point B on the wall as shown in Fig.	3	CO1



3.	A car moves along a straight line whose equation of motion is given by $s = 12t + 3t^2 - 2t^3$, where (s) is in metres and (t) is in seconds. calculate i. Velocity and acceleration at start, and ii. Acceleration, when the velocity is zero.	5	CO4
4. a.	Find the centroid of an unequal angle section 100 mm × 80 mm × 20 mm.	4	CO2



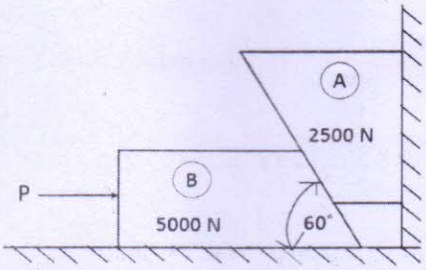
b.	Distinguish between particle and rigid body.	1	CO1
5. a	Define Angle of Friction and Coefficient of Friction.	3	CO2
b.	Write down the Laws of Static Friction.	2	CO1
6.	Using the principle of virtual work, determine the effort P required to hold the weight 500 N in equilibrium in a system of two frictionless pulleys of the same diameter as shown in Fig.	5	CO4



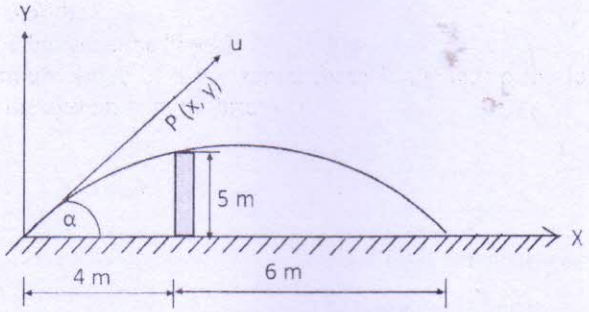
GROUP – C
(Long Answer Type Questions)

Answer any *three* from the following: **3×15=45**

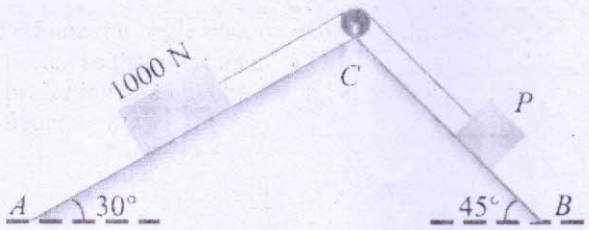
		Marks	CO No
7. a.	Referring to the figure below, the coefficients of friction are as follows i) 0.25 at the floor ii) 0.3 at the wall iii) 0.2 between the blocks Find the minimum value of a horizontal force P applied to the lower block that will hold the system in equilibrium.	8	CO1



b.	Determine the angle of projection and the velocity with which a projectile is projected so that it clears a wall of 5 m height at a distance 4 m from the point of projection and hits the ground at a distance 6 m beyond the wall as shown in figure.	7	CO4

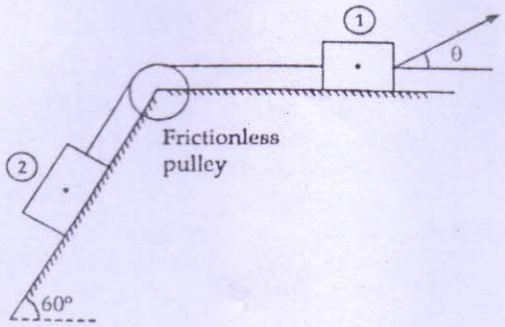


8. a.	A weight of 1000 N resting over a smooth surface inclined at 30° with the horizontal is supported by an effort (P) resting on a smooth surface inclined at 45° with the horizontal as shown in Fig.	8	CO4

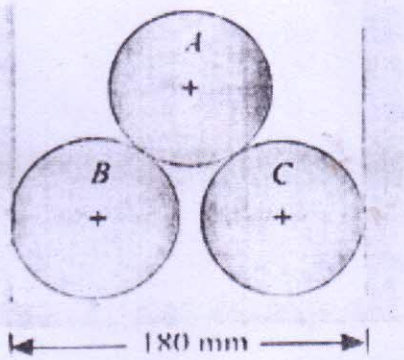


b.	A motor car while rushing at a linear velocity of 20m/s, finds an obstacle on the middle of the road 75 metres ahead. He immediately applies brakes and stops the car 15 metres ahead of the obstacle. Calculate (i) acceleration & (ii) time required to stop the car.	7	CO3

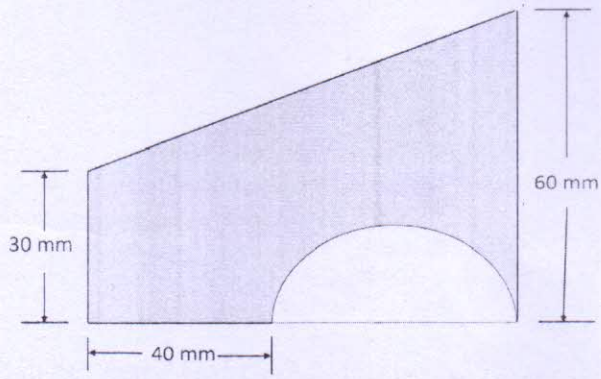
9. a. Two blocks of weight 200 N and 300 N and connected by a string passing over a frictionless pulley rest on rough surfaces; block of weight 200 N on horizontal surface and the other on an inclined surface as shown in figure. For both the surfaces the coefficient of friction = 0.25. Find out the minimum value of force, both in magnitude and direction, for the motion to impend. 8 CO1



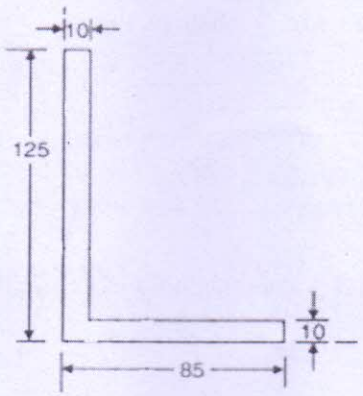
b. Three cylinders weighting 100N each and 80 mm diameter are placed in a channel of 180 mm width as shown in figure. Determine the pressure exerted by (i) the cylinder A on B at the contact point, (ii) the cylinder B on the base and (iii) the cylinder B on the wall. 7 CO1



10. a. A semicircular area is removed from a trapezium as shown in figure below. Determine the centroid of the remaining area (**shaded area**) 7 CO2



b. Determine the moment of inertia of the L-section shown in the Figure about its centroidal axis parallel to the legs. Also find out the polar moment of inertia. 8 CO2



All dimensions are in mm

11. Write Short note: (Any three) 3×5=15

a. Varignon's Theorem 5 CO1
b. Parallel Axis Theorem 5 CO2
c. Polar Moment of Inertia 5 CO2
d. Principle of Conservation of Momentum 5 CO3
e. Virtual Work 5 CO4