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BACKLOG

GURU NANAK INSTITUTE OF TECHNOLOGY
An Autonomous Institute under MAKAUT
2022
ENGINEERING MECHANICS
ME201

TIME ALLOTTED: 3 Hrs **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)	Varignon's Principle is based on a. Force b. Moment c. Inertia d. Friction	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)	The unit of area moment of inertia of the section about any axis is expressed in a. mm^2 b. mm^4 c. mm^6 d. mm^8	1	CO2
	(vi)	The ratio of limiting friction and normal reaction is known as a. Coefficient of friction b. Angle of friction c. Angle of repose d. Sliding friction	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) D'Alembert's principle is used for — 1 CO3
a. reducing the problem of kinetics to equivalent statics problem
b. determining stresses in the truss
c. stability of a floating bodies
d. solving kinematic problems

(ix) 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

(x) The unit of angular acceleration is — 1 CO3
a. N-in
b. m/s
c. m/s^2
d. rad/s^2

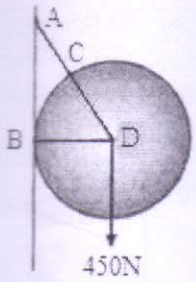
(xi) The acceleration of a particle moving with simple harmonic motion at the mean position is. — 1 CO4
a. Zero
b. Minimum
c. Maximum
d. None of these

(xii) In moment of inertia, $Ixx + I_{YY} = I_{ZZ}$, this mathematical representation resembles: — 1 CO2
a. Theorem of Parallel Axis
b. Theorem of Perpendicular Axis
c. Varignon's Theorem
d. D'Alembert's Principle

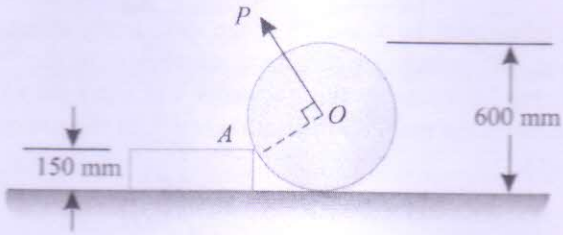
GROUP – B
(Short Answer Type Questions)

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

			Marks	CO No
2.	(a)	State and prove Lami's Theorem	3	CO1
	(b)	A circular roller of weight 450N and radius r=150mm hangs by a tie rod AC=300mm and rests on a smooth vertical wall at B. Determine the tension S in the tie rod and force R_b exerted against the roller as shown in figure	2	CO1



3. A uniform wheel of 600 mm diameter, weighing 5 kN rests against a rigid rectangular block of 150 mm height as shown in figure. Find the least pull, through the centre of the wheel, required just to turn the wheel over the corner A of the block. Also find the reaction on the block. Take all the surfaces to be smooth. — 5 — CO1

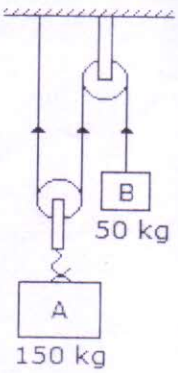


4. (a) Calculate the moment of inertia of the triangular area about its centroidal axis and which is parallel to the base. — 4 — CO2

(b) Distinguish between particle and rigid body. — 1 — CO1

5. A ball of mass 2 kg is moving with velocity of 3 m/s impinges directly on a ball of mass 4 kg at rest. After impact, the 2kg ball comes to rest. Determine the velocity of 4 kg ball after striking and the coefficient of restitution between the two balls. — 5 — CO3

6. Two blocks 'A' and 'B' of masses 150 kg and 50 kg respectively are connected by means of a string as shown in the below figure. Find the tension and acceleration in the strings. — 5 — CO4

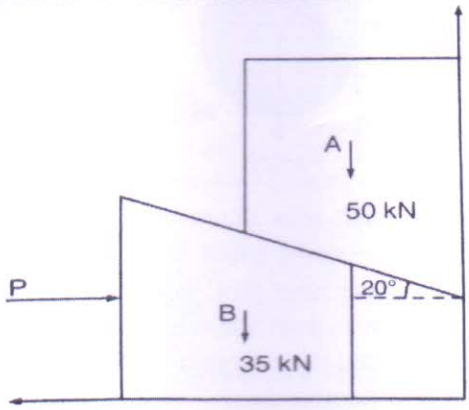


GROUP – C
(Long Answer Type Questions)

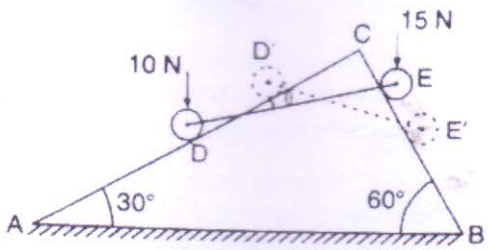
Answer any ***three*** from the following: **3×15=45**

Marks **CO No.**

7. (a) Determine the support reactions and the force P required to start the movement of the wedge as shown in figure. The co-efficient of friction between all the contact surfaces is 0.3. 9 CO1



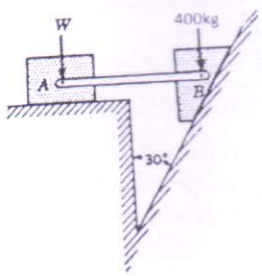
(b) Two sphere of weights 10 N and 15 N can slide freely along the base AC and BC which are arranged as shown in Fig. An extensible string DE connects these spheres. Calculate the value of θ which defines the position of equilibrium. Use the principle of virtual work. 6 CO4



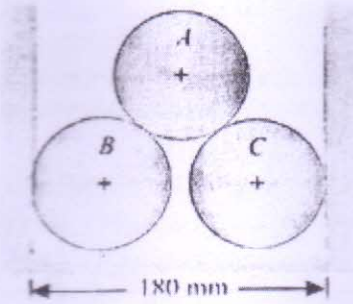
8. (a) Derive the general equation of a projectile and derive the expression for (i) time of flight, (ii) horizontal range, (iii) maximum height and (iv) time taken to reach maximum height. Take usual notations. 9 CO3

(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. 6 CO3

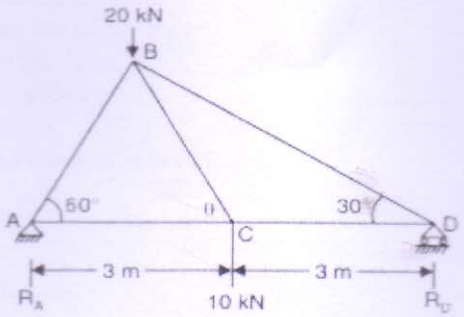
9. (a) Two blocks connected by a horizontal link AB are supported on two rough planes as shown. The co-efficient of friction for block A on the horizontal plane is $\mu = 0.4$. The angle of friction for block B on inclined plane is 15°. What is smallest weight of block A for which equilibrium will exist? 8 CO1



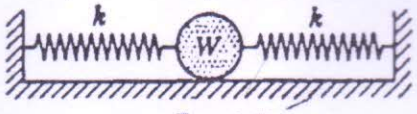
(b) Three cylinders weighting 100N each and 80 mm diameter are placed in a channel of 180 mm width as shown in figure. Determine the pressure exerted by (i) the cylinder A on B at the contact point, (ii) the cylinder B on the base and (iii) the cylinder B on the wall. 7 CO1



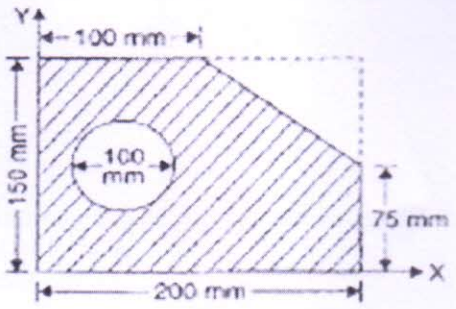
10. (a) Determine the forces in all the members of the truss shown in Figure. 8 CO1



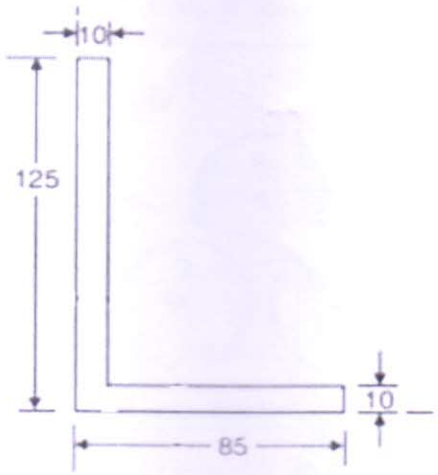
(b) The two springs shown in figure each have spring constant k=1N/cm, and the attached ball has the weight W=2N. If the ball is initially displaced 1 cm. to the right, find the period of oscillation of the ball and the velocity with which it passes through its middle position. Neglect friction. 7 CO4



11. (a) Determine the coordinate $\bar{x}$ and $\bar{y}$ of the centre of a 100 mm diameter circular hole cut in a thin plate so that this point will be the centroid of the remaining shaded area shown in figure. 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