

Printed Pages – 16

Roll No. :

B037313(037)

B. Tech. (Third Semester) Examination, Nov.-Dec. 2020

(AICTE Scheme)

(Mechanical Engineering Branch)

ENGINEERING MECHANICS

Time Allowed : Three hours

Maximum Marks : 100

Minimum Marks : 35

Note : Question no. 1 of each unit is compulsory.

Attempt any two from question no. 2, 3, 4 of each unit.

Unit-I

1. Multiple Choice Questions :

[2]

- (A) Which is the correct statement about law of polygon of forces?
- (a) If any number of forces acting at a point can be represented by the sides of a polygon taken in order, then the forces are in equilibrium
 - (b) If any number of forces acting at a point can be represented in direction and magnitude by the sides of a polygon, then the forces are in equilibrium
 - (c) If a polygon representing forces acting at point is closed then forces are in equilibrium
 - (d) If any number of forces acting at a point can be represented in direction and magnitude by the sides of a polygon taken in order, then the forces are in equilibrium
- (B) The principle of transmissibility of forces states that, when a force acts upon body, its effect is :
- (a) Same at every point on its line of action
 - (b) Different at different points on its line of action
 - (c) Minimum, if it acts at the center of gravity of the body

B037313(037)

[3]

- (d) Maximum, if it acts at the center of gravity of the body
- (C) 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 i.e. whether the force is push or pull
 - (d) All of the above
- (D) In three forces acting in one plane upon a rigid body, keep it in equilibrium, then they must either :
- (a) Meet in a point
 - (b) Be all parallel
 - (c) At least two of them must meet
 - (d) All of the above is correct
2. Find the Resultant of Coplanar Concurrent forces acting at the Point O. Refer Fig.-1.

B037313(037)

PTO

[4]

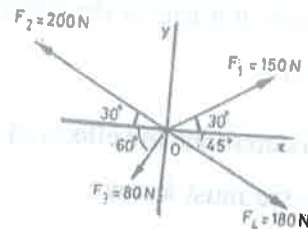


Fig. - 1

3. A force of $P = 5000 \text{ N}$ is applied at the centre C of the Beam AB of Length 5 m . Find the reactions at the Hinge and roller supports. Refer Fig.-2.

8

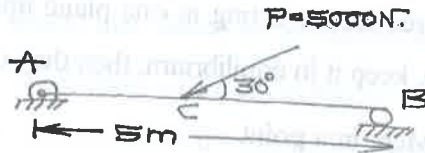


Fig. - 2

4. Three cylinders are piled up in a rectangular channel as shown in Fig. Determine the Reaction R_6 between the cylinder A and the vertical wall of the channel. Refer Fig.-3.

8

[5]

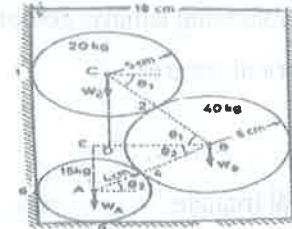


Fig. - 3

Unit-II

1. Multiple Choice Questions :

(A) The ratio of the limiting force of friction (F) to the normal reaction (R) is known as :

1

- (a) Coefficient of friction
- (b) Force of friction
- (c) Angle of friction
- (d) None of the above.

(B) What is β in the equation $T_2 = T_1 e^{\mu\beta}$?

1

- (a) Angle of the belt to surface contact in radians
- (b) Angle of the belt to surface contact in degrees
- (c) Angle of the belt in radians
- (d) Angle of the belt in degrees

[6]

(C) Which of the following laminae do not have centroid at its geometrical centre?

- (a) Circle
- (b) Equilateral triangle
- (c) Right angled triangle
- (d) None of the above

(D) What is the relation between tight side and slack side for a flat belt?

- (a) (Tight side \times slack side) = $e\mu\beta$
- (b) (Tight side / slack side) = $e\mu\beta$
- (c) (Tight side + slack side) = $e\mu\beta$
- (d) None of the above

2. A uniform ladder AB of length $l = 20$ m and weight W is supported by the horizontal floor at A and by a vertical wall at B. It makes an angle 45° with the horizontal. If a man, whose weight is one-half that of the ladder, ascends the ladder, how much length x of the ladder he shall climb before the ladder slips. Assume, $\mu\beta = 1/3$ and $\mu_A = 1/2$ Refer Fig.-4.

8

B037313(037)

[7]

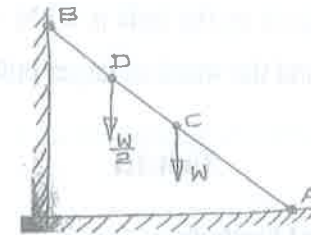


Fig. - 4

3. Block A weighing 1000 N is to be raised by means of a 15° wedge B weighing 500 N. Assuming the Coefficient of friction between all contact surfaces to be 0.2, determine what minimum horizontal force P should be applied to raise the block Refer Fig.-5.

8

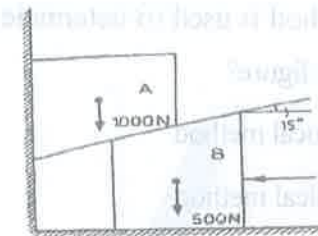


Fig. - 5

4. Find the power transmitted by a cross belt drive connecting two pulleys of 45.0 cm and 20.0 cm diameters which are 1.95 m apart. The maximum

B037313(037)

PTO

[8]

permissible tension in the belt is 1 kN. coefficient of friction is 0.20 and the speed of larger pulleys is 100 rpm. 8

Unit-III

1. Multiple Choice Questions :

(A) What is the centroidal distance of an equilateral triangle of side 2 m?

- (a) 0.866 m
- (b) 0.769 m
- (c) 1.000 m
- (d) 0.577 m

(B) What method is used to determine centroid of a composite figure?

- (a) Analytical method
- (b) Graphical method
- (c) Both (a) and (b)
- (d) None of the above

(C) What is the formula of radius of gyration?

- (a) $k^2 = I/A$
- (b) $k^2 = I^2/A$

[9]

(c) $k^2 = I^2/A^2$

(d) $k^2 = (I/A)^{1/2}$

(D) What is the formula of theorem of perpendicular axis?

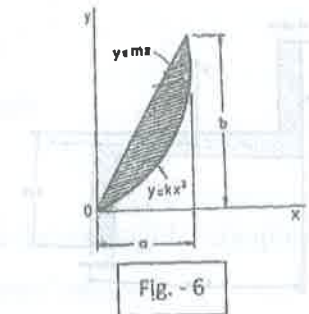
(a) $I_{zz} = I_{xx} + I_{yy}$

(b) $I_{zz} = I_{xx} + Ah^2$

(c) $I_{zz} - I_{xx} = I_{yy}$

(d) None of the mentioned

2. Determine by direct integration the coordinates of the centroid of the shaded area formed by the intersection of a straight line and the curve $y = kx^2$. Refer Fig.-6. 8



3. Determine the moments of inertia of the shaded area about the X-Axis and the Y-Axis. Refer Fig.-7. 8

[10]

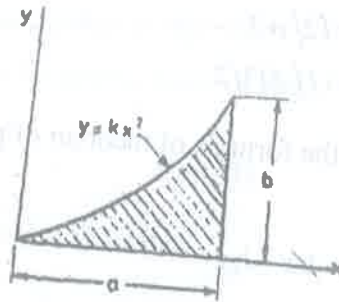


Fig. - 7

4. Find the Product of Inertia of the area shown with respect to the Centroidal x and y axes. Also find the angle Θ defining the directions of principal axes through the Centroid and the principal Moments of Inertia. Refer Fig.-8.

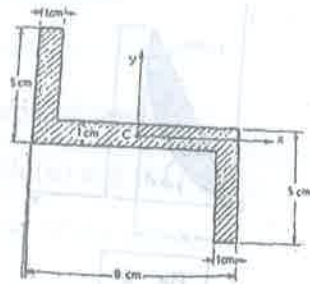


Fig.- 8

B037313(037)

[11]

Unit-IV

1. Multiple Choice Questions :

(A) The rate of change of with respect to time is called as jerk. 1

(a) acceleration

(b) density

(c) displacement

(d) volume

(B) During unidirectional motion, the displacement and distance traveled by a particle with uniform acceleration 1

(a) different

(b) same

(c) variable

(d) none of the above

(C) What are the rectangular components of velocities in curvilinear motion? 1

(a) dx/dt and dy/dt

(b) dr/dt and d^2r/dt^2

B037313(037)

PTO

[12]

(c) d^2x/dt^2 and d^2y/dt^2

(d) none of the above

(D) The radius of curvature of trajectory for a profile is minimum, if

(a) velocity is minimum

(b) acceleration is maximum

(c) both (a) and (b)

(d) none of the above

2. A trolley resting on a horizontal plane starts from rest and is moved to the right with a constant acceleration of 0.18 m/s^2 . Determine (i) acceleration of the block B connected to the trolley (ii) velocities of the trolley and the block after a time of 4 seconds and the distance moved by each of them, Refer Fig.-9.

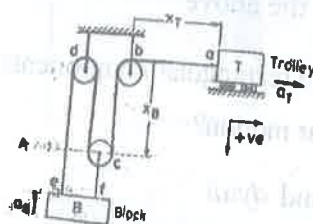


Fig. - 9

B037313(037)

[13]

3. Two blocks of masses M_1 and M_2 are placed on two incline planes of elevation θ_1 and θ_2 and are connected by a string as shown figure. Find the acceleration of the masses. The coefficient of friction between the blocks and the planes is μ . Refer Fig.-10.

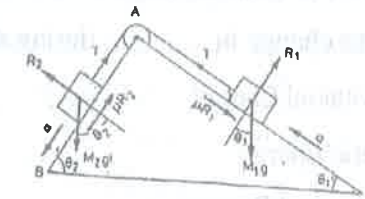


Fig. - 10

4. A car starts from rest on a curved road of 250 m radius and accelerates at a constant tangential acceleration of 0.6 m/s^2 . Determine distance and the time for which that car will travel before the magnitude of the total acceleration attained by it becomes 0.75 m/s^2 .

Unit-V

1. Multiple Choice Questions :

(A) Which of the following is represented by the area under force-displacement diagram?

(a) Impulse

B037313(037)

PTO

- (b) Momentum
 - (c) Power
 - (d) Work done
- (B) According to work energy principle, a particle of mass m when subjected to unbalanced force system, the work done during displacement by all forces is equal to change in during displacement. 1
- (a) Gravitational Energy
 - (b) Kinetic Energy
 - (c) Mechanical Energy
 - (d) Potential Energy
- (C) The force for which work done is independent of is called as conservative force. 1
- (a) distance
 - (b) path
 - (c) time
 - (d) all of the above
- (D) When the speed of an object is doubled, its momentum? 1
- (a) remains unchanged in accord with the conservation of momentum

- (b) doubles
 - (c) quadruples
 - (d) decreases
2. If a system of two masses M_1 and M_2 arranged as shown in Figure are released from rest, find the velocity of the mass M_2 after it has fallen a vertical distance of 2 m. Neglect the inertia of the pulleys. Assume $M_1 = M_2 = 10$ kg. Refer Fig.-11. 8

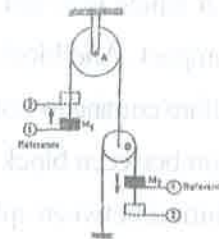


Fig. - 11

3. A 20 gm bullet is fired horizontally into 300 gm block, which rest on smooth surface. After the bullet penetrates into the block, the block moves to the right through 300 mm before momentarily coming to rest. Determine speed of the bullet as it strikes the block. The spring is originally un-stretched and has a constant of 200 N/m. Assume Plastic Impact. Refer Fig.-12. 8

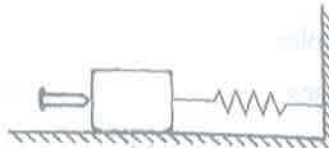


Fig. - 12

4. A 2 kg sphere is released from rest when $\theta = 60^\circ$. It strikes 2.5 kg block B which is at rest. The velocity of sphere is zero after impact. And block moves through a distance of 1.5 m before coming to rest. Determine : (1) Co-efficient of friction between block and surface. (2) Co-efficient of restitution between sphere and block. Refer Fig.-13.

8

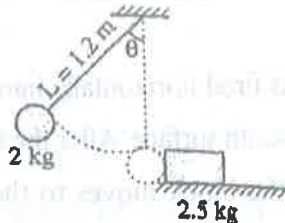


Fig. - 13