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Question Paper Code : 21293

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2023.

Third Semester

Civil Engineering

ME 3351 — ENGINEERING MECHANICS

(Common to Automobile Engineering/Industrial Engineering/Industrial Engineering and Management/Materials Science and Engineering/Mechanical Engineering/Mechanical Engineering (Sandwich)/Mechanical and Automation Engineering/Mechatronics Engineering/Production Engineering/Robotics and Automation/Safety and Fire Engineering)

(Regulations 2021)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. A force of 100 N is acting at a point making an angle of 30° with the horizontal as shown in Fig.1. Determine the components of this force along X and Y directions.

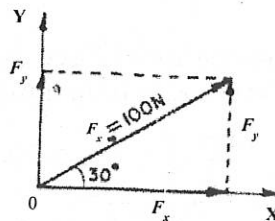


Fig.1

2. Two concurrent forces of 12 N and 18 N are acting at an angle of 60° . Find the resultant force.
3. State the principle of transmissibility of forces with simple sketch.

4. A 500 N vertical force is applied to a 60 cm long bar OA hinged at O and inclined at 60° to the horizontal as shown in Fig.2 Determine the moment of the 500 N force about O.

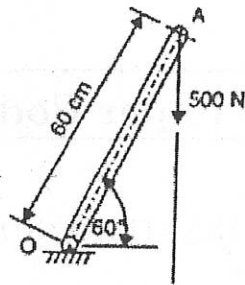


Fig.2

5. Locate the centroid of the lamina shown in Fig.3.

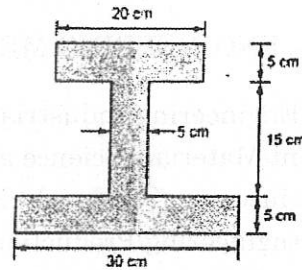


Fig.3

6. State parallel-axis theorem.
 7. A body of weight 100 N is placed on a rough horizontal plane, and pushed by a force of 45 N, to just cause sliding over the horizontal plane. Determine the co-efficient of friction.
 8. Define "Angle of repose".
 9. A train running at 80km/h is brought to halt after 50 seconds. Find the retardation and the distance travelled by the train before it comes to a halt.
 10. State the principle of work and energy.

PART B — (5 × 13 = 65 marks)

11. (a) Find the X and Y components of force system shown in Fig.4. Also find the resultant of the given forces in magnitude and direction.

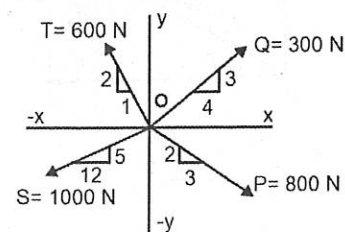


Fig.4

Or

- (b) A gusset plate of roof truss is subjected to forces as shown in Fig.5. Determine the magnitude of the resultant force and its orientation measured counter clockwise from the positive x-axis.

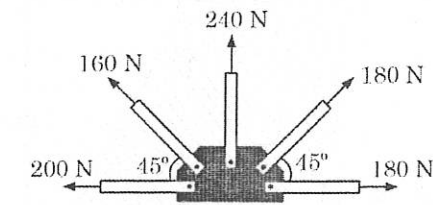


Fig.5

12. (a) A system of parallel forces 32.5N, 150N, 67.5N and 10N are acting on a rigid bar as shown in Fig 6. Reduce this system to:
 (i) a single force
 (ii) a single force and a couple at A
 (iii) a single force and a couple at B.

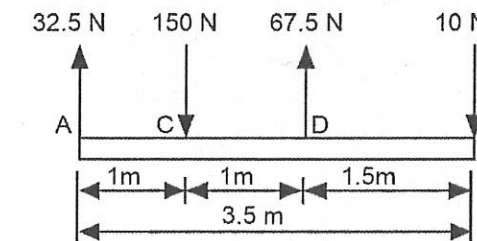


Fig.6

Or

- (b) Two smooth spheres each of radius 100 mm, and weight 100 N, rest in a horizontal channel having vertical walls, the distance between the walls being 360 mm. Find the reactions at the points of contacts A, B, C and D as shown in Fig.7.

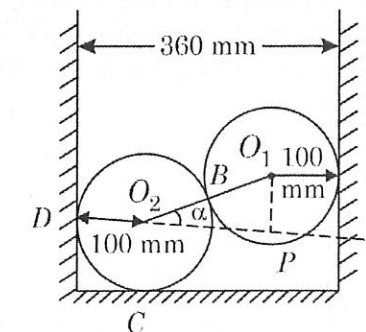


Fig.7

13. (a) Find the moment of inertia for the shaded area shown in Fig.8 about the lines AA' and AB' .

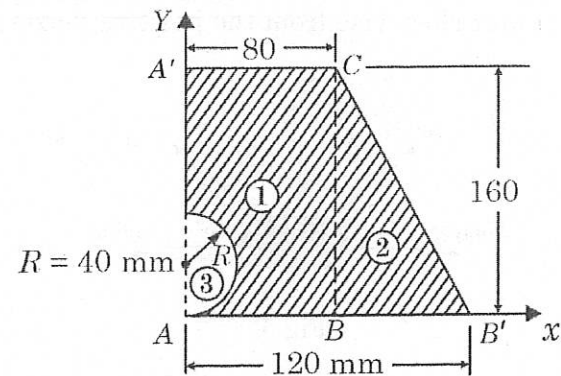


Fig.8

Or

- (b) Find the moment of inertia of the area shown in Fig.9 about line AB parallel to the centroidal axis.

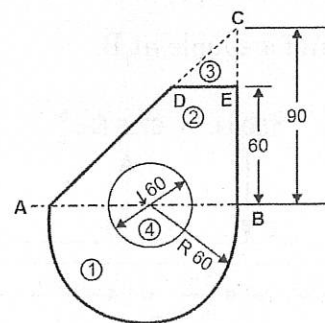


Fig.9

14. (a) A uniform ladder of weight 1000N and of length 4m rests on a horizontal ground and leans against a smooth vertical wall. The ladder makes an angle of 60° with horizontal. When a man of weight 750N stands on the ladder at a distance of 3m from the top of the ladder, the ladder is at the point of sliding. Determine the co-efficient of friction between the ladder and the floor.

Or

- (b) Block A weighing 1000N rests over block B, which weighs 2000N. Block A is tied to wall with a horizontal string as shown in Fig 10. Find the value of P to move Block B if the coefficient of friction between A and B is 0.5 and the coefficient between B and the floor is 0.33.

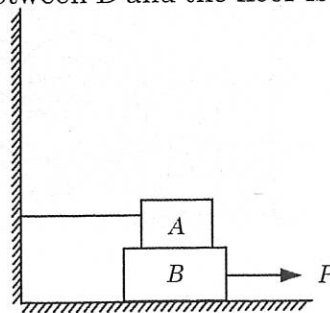


Fig.10

15. (a) Two masses $m_1 = 40 \text{ kg}$ and $m_2 = 30 \text{ kg}$ are interconnected with a pulley system as shown in the Fig.11. Neglecting inertial and frictional effect of pulleys and cord, find the acceleration of 40 kg mass.

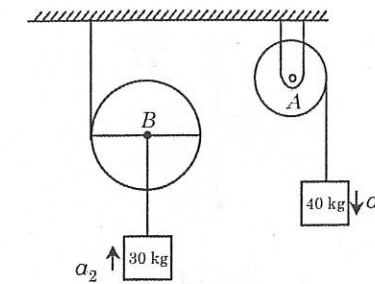


Fig.11

Or

- (b) Weights 800N and 400N are connected by a thread and move along a rough horizontal plane under the action of a force of 500N applied to 800N weight as shown in Fig 12. The coefficient of friction between the sliding surface of the weights and the plane is $\mu = 0.25$. Determine the acceleration of the weights and tension in the thread, using work-energy equation.

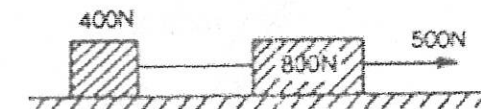


Fig.12

PART C — (1 × 15 = 15 marks)

16. (a) (i) A block placed over a 10° wedge on a horizontal floor and leaning against a vertical wall as shown in Fig 13, and weighing 1500N is to be raised by applying a horizontal force to the wedge. Assuming co-efficient of friction between all the surfaces in contact to be 0.3, Determine the minimum horizontal force to be applied to raise the block. (8)

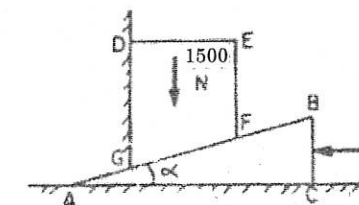


Fig.13

- (ii) The four coplanar forces are acting at a point as shown in Fig.14. One of the forces is unknown and its magnitude is shown by P. The resultant is having a magnitude of 500N and is acting along x-axis. Determine the unknown force P and its inclination with x-axis. (7)

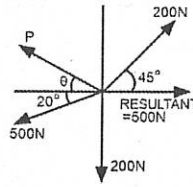


Fig.14

Or

- (b) Determine the constant force P that will give the system of bodies shown in Fig.15., a velocity of 3m/s after moving 4.5 m from rest. Coefficient of friction between the blocks and the plane is 0.3. Pulleys are smooth. Use work-energy method.

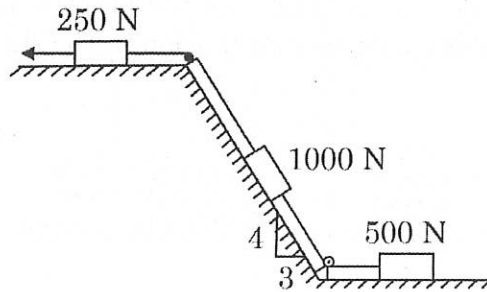


Fig.15