Reg. No. : | | | | | | | | | | | | |

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.

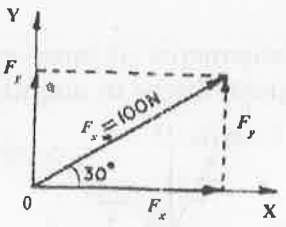

Fig.1

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.

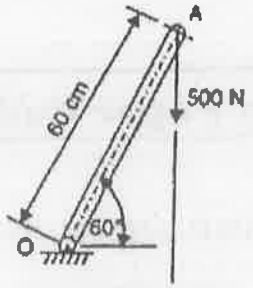

Fig.2

5. Locate the centroid of the lamina shown inFig.3.

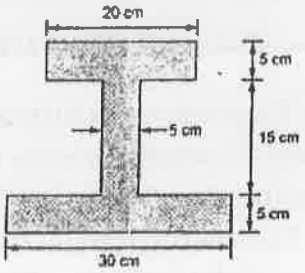

Fig.3

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.

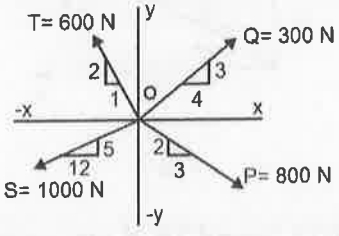

Fig.4

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.

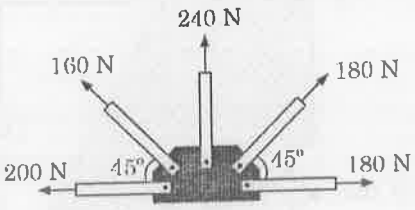

Fig.5

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.

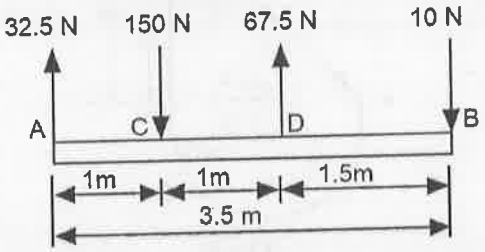

Fig.6

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.

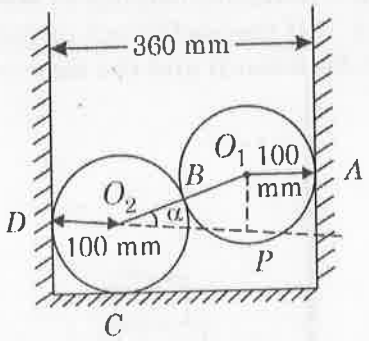

Fig.7

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

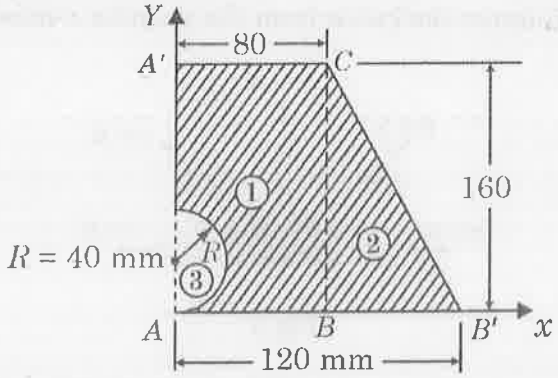

Fig.8

Or

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

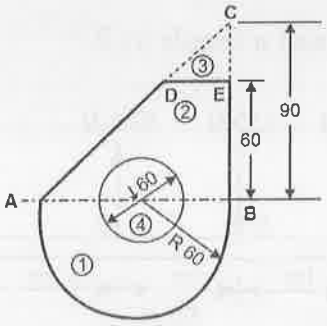

Fig.9

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.

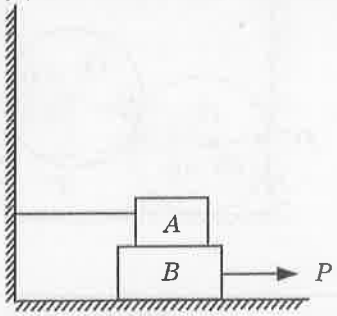

Fig.10

15. (a) Two masses m_1 = 40 kg and m_2 = 30 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.

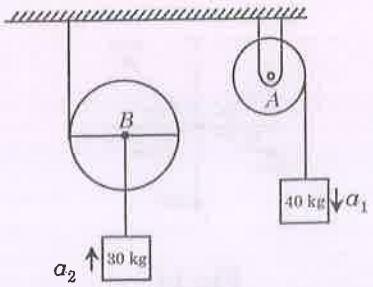

Fig.11

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 μ = 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)

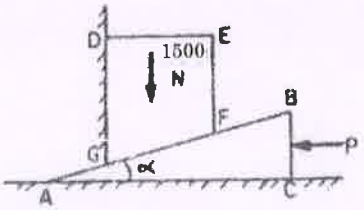

Fig.13

(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)

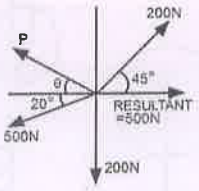

Fig.14

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.

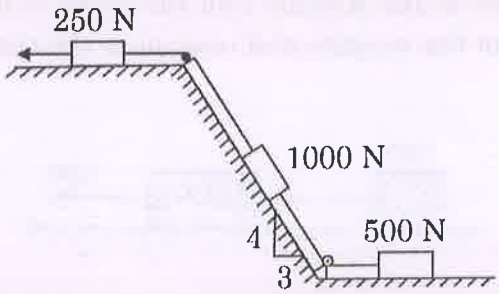

Fig.15