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

Question Paper Code : 80835

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2021.

Second Semester

Civil Engineering

ME 2151/CE 1151/10122 ME 205/080120002/ME 25 – ENGINEERING MECHANICS

(Common to all Branches)

(Regulations 2008/2010)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Name the principle that is applicable for the conditions represented in Fig.1.

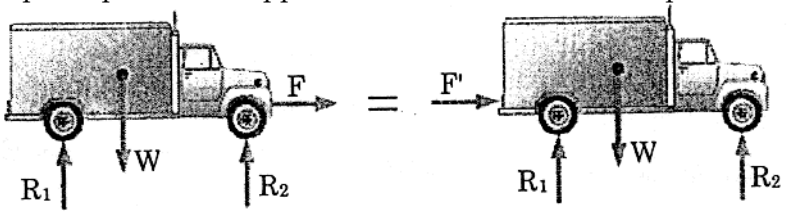

Fig.1

2. Calculate the moment of the 250-N force on the handle of the monkey wrench about the center of the bolt (Fig. 2).

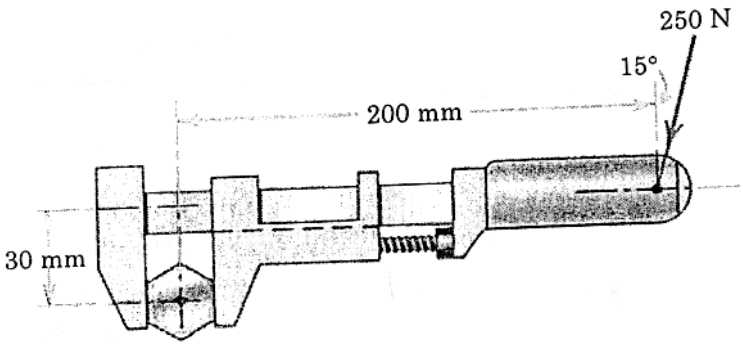

Fig. 2

3. What is meant by free body diagram of a rigid body?

4. Write the conditions of equilibrium of a system of parallel forces acting in a plane.

5. Distinguish between centroid and centre of gravity.

6. Define principal axes and principal moment of inertia.

7. A car moves on a circular path of radius 25 m, with a uniform speed of 9 m/s. Determine the total acceleration on the car.

8. What is D' Alembert's principle?

9. Give the causes of rolling resistance.

10. What is general plane motion?

PART B — (5 × 16 = 80 marks)

11. (a) (i) Determine the resultant of the concurrent force system shown in figure. (8)

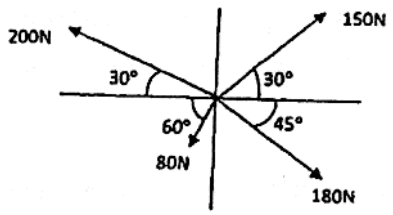

Fig. 11(a) (i)

(ii) Figure shows a 10 kg lamp supported by two cables AB and AC. Find the tension in each cable. (8)

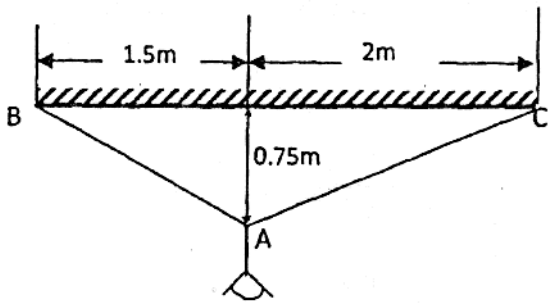

Fig. 11(a) (ii)

Or

(b) Forces 32 kN, 24 kN, 24 kN and 120 kN are concurrent at origin and are respectively directed through the points whose coordinates are A (2, 1, 6), B (4 –2, 5), C (–3, –2, 1) and D (5, 1, –2). Determine the magnitude of the resultant and the angles it makes with coordinate axes. (16)

12. (a) A 50-kg crate (Fig. 12(a)) is attached to the trolley-beam system shown. Knowing that a = 1.5 m determine (i) the tension in cable CD, (ii) the reaction at B?

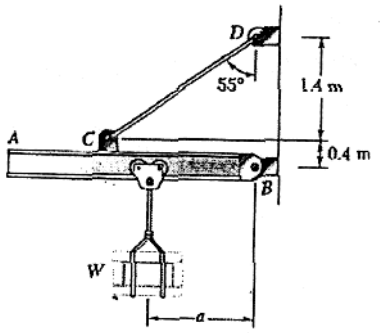

Fig. 12(a)

Or

(b) A roller or radius r = 304.8 mm and weight = 2225 N is to be pulled over a curb of height h = 152.4 mm by a horizontal force P applied to the end of a string wound around the circumference of the roller (Fig. 12(b)).

Find the magnitude of P required to start the roller over the curb.

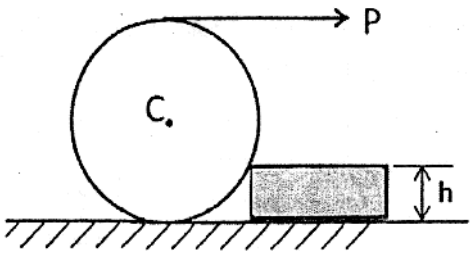

Fig. 12(b)

13. (a) (i) Derive, from first principles, the second moment of area of a circle about its diametral axis. (6)

(ii) For the section shown in figure. 13(a)(ii) below, locate the horizontal and vertical centroidal axes. (10)

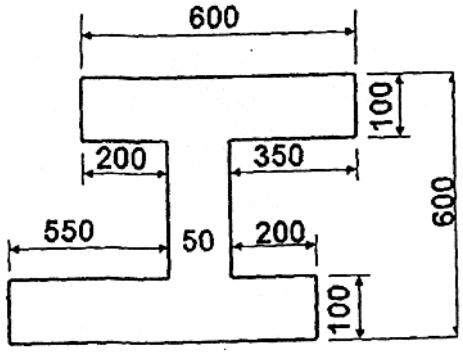

Fig. 13(a)(ii)

Or

(b) (i) Calculate the centroidal polar moment of inertia of a rectangular section with breadth of 100 mm and height of 200 mm. (4)

(ii) Find the moment of inertia of the shaded area shown in figure. 13(b)(ii) about the vertical and horizontal centroidal axes. The width of the hole is 200 mm. (12)

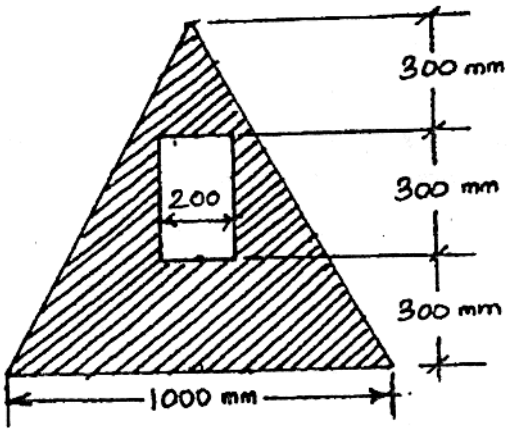

Fig. 13(b)(ii)

14. (a) A Bullet is fired making an angle 30° to the horizontal from a hill which strikes the target which is 80 m lower than the horizontal passing through the firing point. The initial bullet velocity is 100 m/s.

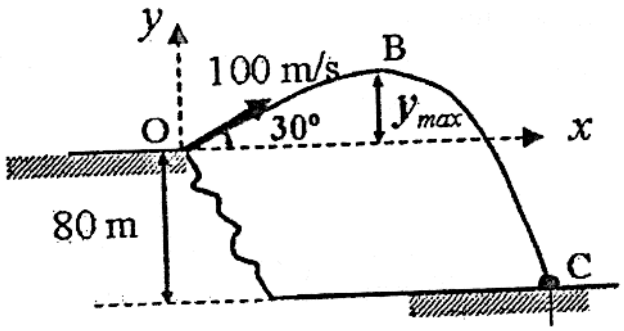

Fig. 14(a)

Find the following:

(i) The maximum height above horizontal to which the bullet will rise. (4)

(ii) The velocity of bullet when it strikes the target. (6)

(iii) The total time required for the bullet when it strikes the target. (6)

Or

(b) (i) Block *P* of weight 100 *N* and block *Q* of weight 50 *N* are connected by a rope that passes over a smooth pulley as shown in figure.14(b)(i) Find the acceleration of the blocks and the tension in the rope, when the system is released from rest. Neglect the mass of the pulley. (8)

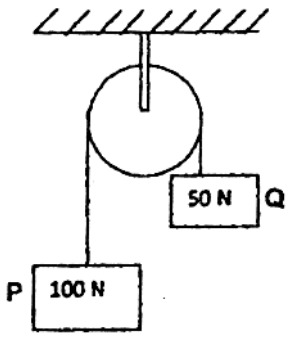

Fig. 14(b) (i)

(ii) A 2000 kg automobile is driven down a 5° inclined plane at a speed of 100 km/h when the brakes are applied causing a constant total breaking force (applied by the road on the tires) of 7 kN. Determine the distance traveled by the automobile as it comes to a stop. (8)

15. (a) Calculate the static coefficient of friction μ_S between the block shown in Fig. 15(a) having a mass of 75 kg and the surface. Also, find the magnitude and direction of the friction force if the force P applied is inclined at 45° to the horizontal and $\mu_S = 0.30$.

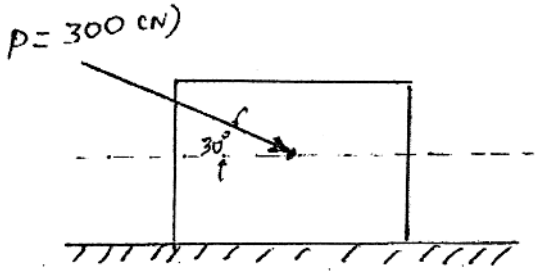

Fig. 15(a)

Or

(b) A body rotates according to the relation $\theta = at^4 + bt^2 + ct$ where *a, b* and *c* are constants. Determine the values of the constants *a, b* and *c* if the angular coordinate is 20 red, angular velocity is 20 rad/s and angular acceleration is 16 rad/s^2 at time $t = 2$ *s*.