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B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 20

Annual Pattern — First Year

Civil Engineering

GE 1 X 04 — ENGINEERING MECHANICS

(Common to B.E./B.Tech. Chemical Engineering, Textile Technology, Textile Tech. (Textile Chemistry), Polymer Technology, Petroleum Engineering, Food Technology)

Time : Three hours　　　　　　　　　　　　　　Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. The point of application of a force $F = 5i + 10j - 5k$ is displaced from the point $i + 3k$ to the point $3i - j - 6k$. Find the work done.

2. Define the law of transmissibility of force.

3. Differentiate space diagram from free body diagram.

4. Two unlike parallel forces of magnitude 400N and 100N are acting in such a way that their lines of action are 150mm apart. Determine the magnitude of the resultant force and the point at which it acts?

5. Define coefficient of friction and limiting friction.

6. A belt is running over a pulley of dia 120cm at 200 rpm. The angle of contact is 165° and μ is 0.3. If maximum tension is 300 N find power transmitted by belt.

7. Define parallel axis theorem.

8. Differentiate centre of gravity from centroid.

9. What is momentum? Define the law of conservation of momentum.

10. Define coefficient of restitution.

11. (a) A bar AB is acted upon by six forces as shown in figure Q. 11 (a). The forces are $F_1 = 80i$, $F_2 = 130k$, $F_3 = -50j$, $F_4 = -210k$, $F_5 = -100i + 190j - 50k$, $F_6 = 315j$. All forces are in Newtons. Determine the Equivalent force and moment acting at A.
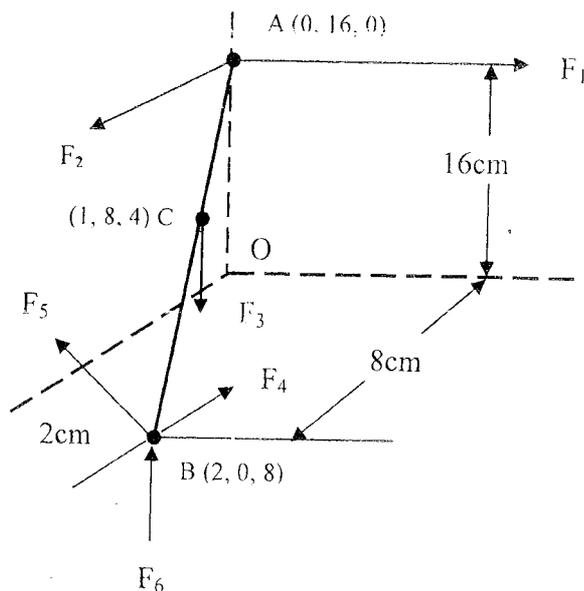

Figure Q. 11 (a)

Or

(b) A car is pulled by means of 2 cars as shown in figure Q. 11 (b). If the resultant of the two forces acting on the car A is 40KN being directed along the positive direction of X axis, determine the angle θ of the cable attached to the car at B such that the force on the cable AB is minimum. What is the magnitude of force in each cable?
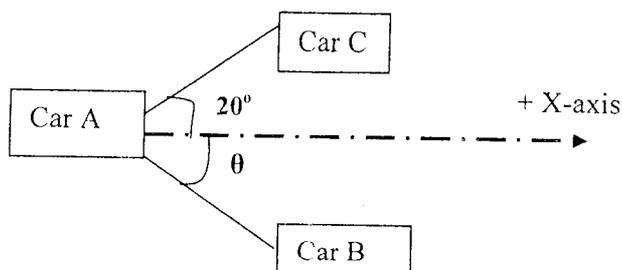

Figure Q. 11 (b)

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12. (a) Three forces and a couple of magnitude 18 Nm are applied at an angle bracket shown in figure Q. 12 (a). Find the resultant of this system of forces and locate the points where the line of action of resultant intersects AB and BC.
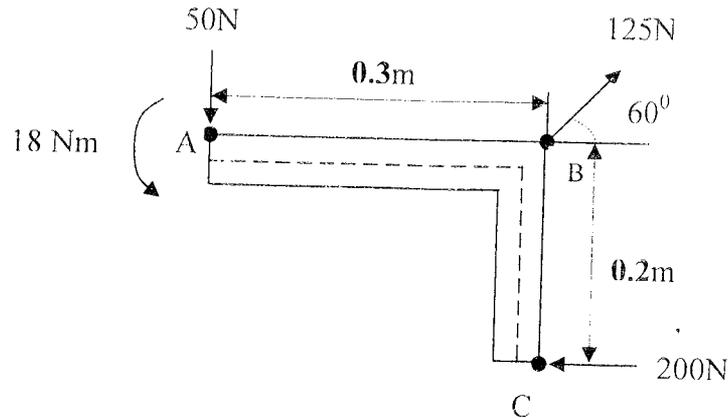

Figure Q. 12 (a)

Or

(b) Three smooth pipes each weighing 20 kN and of diameter 60cm are to be placed in a rectangular channel with horizontal base as shown in figure Q. 12 (b). Calculate the reactions at the points of contact between the pipes and between the channel and the pipes. Take width as 160 cm.
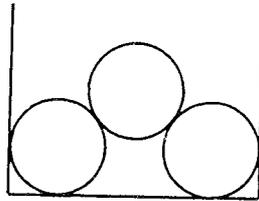

Figure Q. 12 (b)

13. (a) A cord connects two bodies of weights 400 N and 800 N. The two bodies are placed on an inclined plane and cord is parallel to inclined plane. The μ for 400 N is 0.15 and 800 N is 0.4. Determine the inclination of the plane to the horizontal and tension in the cord when the motion is about to take place down the inclined plane. The body weighing 400 N is below the body weighing 800 N.

Or

(b) The screw of a jack is square threaded with two threads in a centimeter. The outer diameter of the screw is 5cm. If the coefficient of friction is 0.1, calculate the force required to be applied at the end of the lever, which is 70 cm long to lift a load of 4kN and to lower it.

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14. (a) For the 'T' section shown in figure Q.14 (a) determine, Moment of Inertia about horizontal, vertical axis passing through centroid. [Units in mm].
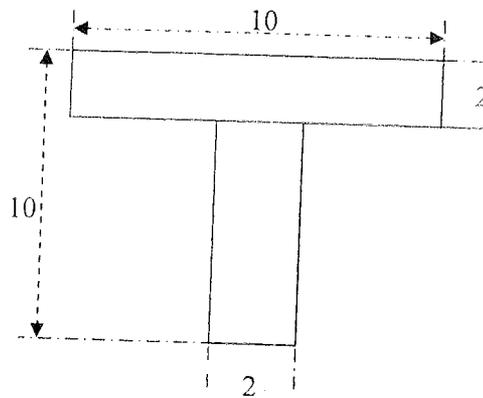

Figure Q. 14 (a)

Or

(b) Locate the centroid of the shaded area of the circular segment shown in figure Q. 14 (b). [Units in mm].
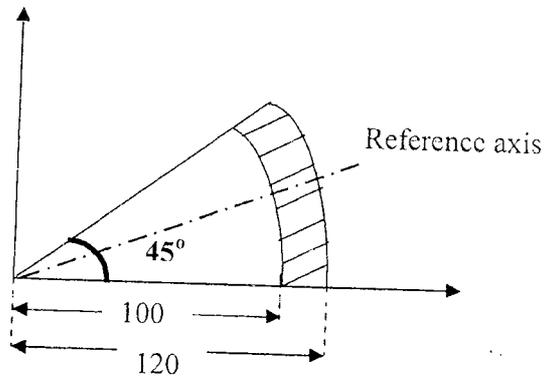

Figure Q.14 (b)

15. (a) A soldier fires a bullet at an angle of 30° upward from his position on hill to strike a target which is 61m lower than the position of the soldier. The initial velocity of bullet is 91.5 m/s. Calculate

    (i) Maximum height

    (ii) Actual velocity with which it will hit the target

    (iii) Total time required for flight.

Or

(b) A ball of mass 1kg, moving with a velocity of 6m/s, strikes on a ball of mass 2kg moving with a velocity of 2m/s. at the instant of impact, the velocities of 2 balls are parallel and inclined at 30° to the line joining their centres. If the coefficient of restitution is 0.5 find velocity and direction of balls after impact.

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