

B.Tech I Year (R13) Supplementary Examinations December 2019

**ENGINEERING MECHANICS**

(Common to CE &amp; ME)

Time: 3 hours

Max. Marks: 70

**PART – A**

(Compulsory Question)

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- 1 Answer the following: (10 X 02 = 20 Marks)
- Give the principle of transmissibility of forces.
  - State the Varignon's principle of moments.
  - What do you understand by the term friction? Explain clearly why it comes into play.
  - A load of 2.5 kN is to be raised by a screw jack with mean diameter of 75 mm and pitch of 12 mm. Find the efficiency of the screw jack, if the coefficient of friction between the screw and nut is 0.075.
  - What do you understand by axes of reference?
  - Find the moment of inertia of a hollow rectangular section about its centre of gravity if the external dimensions are breadth 60 mm, depth 80 mm and internal dimensions are breadth 30 mm and depth 40 mm respectively.
  - A body is moving with a velocity of 2 m/s, after 4 seconds the velocity of the body becomes 5 m/s. Find the acceleration of the body.
  - A body is rotating with an angular velocity of 5 radians/s. After 4 seconds, the angular velocity of the body becomes 13 radians/s. Determine the angular acceleration of the body.
  - What are the assumptions made, while finding out the forces in various members of a framed structure?
  - Find the natural frequency of torsional vibrations.

**PART – B**

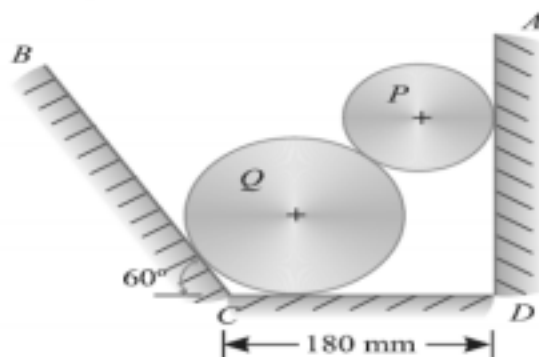
(Answer all five units, 5 X 10 = 50 Marks)

**UNIT – I**

- 2 (a) Distinguish clearly between resolution of forces and composition of forces.
- (b) A horizontal line PQRS is 12 m long, where PQ = QR = RS = 4 m. Forces of 1000 N, 1500 N, 1000 N and 500 N act at P, Q, R and S respectively with downward direction. The lines of action of these forces make angles of 90°, 60°, 45° and 30° respectively with PS. Find the magnitude, direction and position of resultant force.

OR

- 3 Two cylinders P and Q rest in a channel as shown in figure below. The cylinder P has diameter of 100 mm and weighs 200 N, whereas the cylinder Q has diameter of 180 mm and weighs 500 N. If the bottom width of the box is 180 mm, with one side vertical and the other inclined at 60°. Determine the pressures at all four points of contact.



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**UNIT – II**

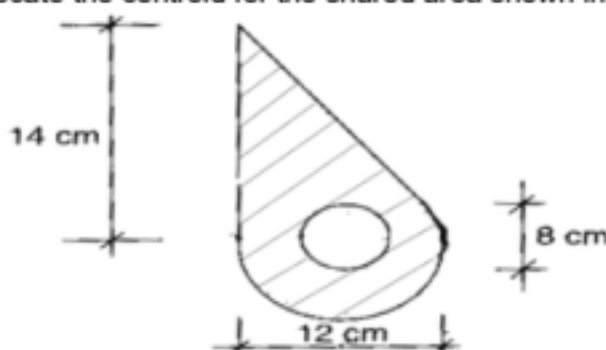
- 4 (a) Define coefficient of friction and limiting friction.  
 (b) A body resting on a rough horizontal plane required a pull of 180 N inclined at  $30^\circ$  to the plane to move it. It was found that a push of 220 N inclined at  $30^\circ$  to the plane moved the body. Determine the weight of the body and the coefficient of friction.

OR

- 5 A uniform ladder of length 3.25 m and weighing 250 N is placed against a smooth vertical wall with its lower end 1.25 m from the wall. The coefficient of friction between the ladder and floor is 0.3. What is the frictional force acting on the ladder at the point of contact between the ladder and the floor? Show that the ladder will remain in equilibrium in this position.

**UNIT – III**

- 6 Locate the centroid for the shaded area shown in figure below.



OR

- 7 Determine the mass moment of inertia of a right circular cone of height 'h' and base radius 'R' about an axis through vertex normal to the axis of rotation.

**UNIT – IV**

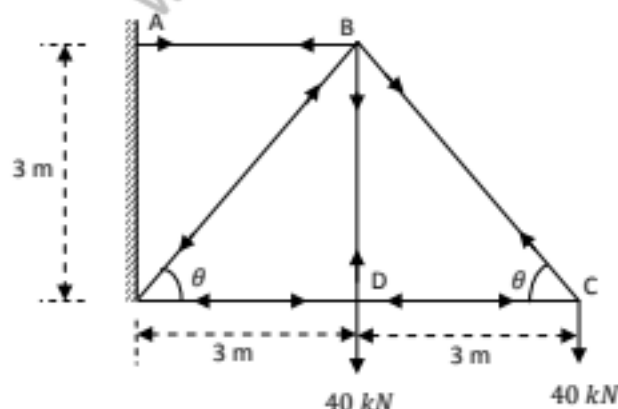
- 8 Two trains A and B leave the same station in parallel lines. Train A starts with a uniform acceleration of  $0.15 \text{ m/sec}^2$  and attains a speed of 27 kmph when the steam is reduced to keep speed constant. Train B leaves 40 seconds later with uniform acceleration of  $0.3 \text{ m/sec}^2$  to attain a maximum speed of 54 kmph. When and where will B overtake A?

OR

- 9 Derive work energy equation for:  
 (a) Translation.  
 (b) Fixed axis rotation.  
 (c) Plane motion.

**UNIT – V**

- 10 Find the forces in all the members of the truss shown in the figure below. Tabulate the results.



OR

- 11 A vertical shaft 100 mm in diameter and 1 meter in length has its upper end fixed to the ceiling. At the other end it carries a disc of weight 5000 N having a radius of gyration 450 mm. The modulus of rigidity of material of the shaft is  $0.8 \times 10^5 \text{ N/mm}^2$ . Determine the frequency of torsional vibrations.