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Total Pages : 5

**002301**

**December 2023**

**B.Tech. (CIVIL/ENV) Illrd SEMESTER  
Engineering Mechanics (ESC-203R)**

Time : 3 Hours]

[Max. Marks : 75

*Instructions :*

1. *It is compulsory to answer all the questions (1.5 marks each) of Part-A in short.*
2. *Answer any four questions from Part-B in detail.*
3. *Different sub-parts of a question are to be attempted adjacent to each other.*
4. *Use of non-programmable scientific calculator is allowed.*

**PART-A**

1. (a) Explain superposition law and law of transmissibility. (1.5)
- (b) Define equilibrium of a body and give conditions of equilibrium when subjected to forces. (1.5)
- (c) Define Truss and free body diagram. (1.5)
- (d) Differentiate centroid and center of gravity. (1.5)
- (e) State Transfer theorems. (1.5)
- (f) Define motion. Write different types of motion. (1.5)

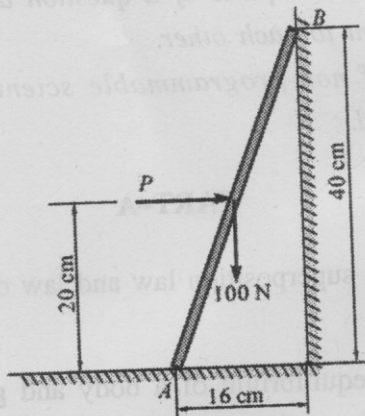
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- (g) Write Impulse-Momentum equation. (1.5)
- (h) Differentiate between centroid and centre of gravity. (1.5)
- (i) Discuss the significance of Moment of Inertia. (1.5)
- (j) State the D'Alembert's principle. (1.5)

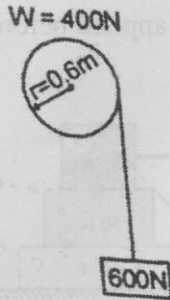
### PART-B

2. (a) A 100 N uniform rod AB is held in the position as shown in the figure. If the coefficient of friction is 0.15 at A and B. Calculate range of values of P for which equilibrium is maintained. (10)



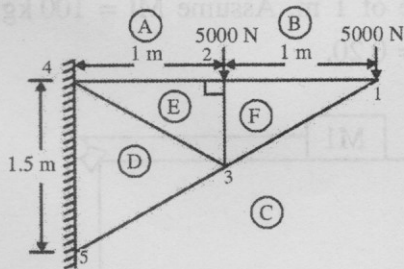
- (b) Derive the centroid of the trapezium having parallel side 'a' and b' and perpendicular distance between parallel sides 'h'. (5)
3. (a) A pulley of weight 400 N has a radius of 0.6 m. A block of 600 N is suspended by a tight rope wound round the pulley, the other end being attached to the

pulley as shown in figure. Determine the resulting acceleration of the weight and the tension in the rope. (5)



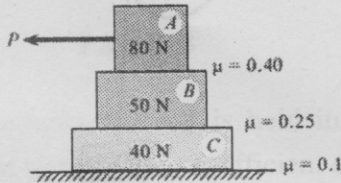
(b) Determine the mass moment of inertia of a solid sphere of radius  $R$  about its diametral axis. (10)

4. Find the forces in members B, E and F of cantilever truss loaded as shown in figure below : (15)

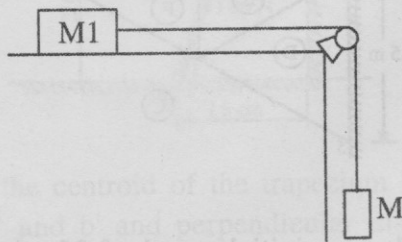


5. (a) A car has an initial speed of  $25 \text{ m/s}$  and a constant deceleration of  $3 \text{ m/s}^2$ . Determine the velocity of the car when  $t = 4 \text{ s}$ . What is the displacement of the car during the  $4 \text{ s}$  time interval? How much time is needed to stop the car? (5)

- (b) Three blocks are placed on the surface one above the other as shown in the figure. The static coefficient of friction between the blocks and block C and surface is also shown in figure. Determine the maximum value of  $P$  that can be applied before any slipping takes place. (10)



6. (a) Two blocks of masses  $M_1$  and  $M_2$  are connected by a string as shown in below. Assuming the coefficient of friction between block  $M_1$  and the horizontal surface to be  $\mu$  if the system is released from rest, find the velocity of the block A having mass  $M_1$  after it has moved a distance of 1 m. Assume  $M_1 = 100$  kg,  $M_2 = 150$  kg and  $\mu = 0.20$ . (10)



- (b) Write the principle of Virtual work. Also, derive Work-energy equation. (5)

7. Determine the moment of inertia of the quarter circular spandrel shown in figure about axes AA and about BB. (15)

