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Total Number of Pages : 04

B.Tech/  
Integrated Dual Degree (B.Tech and M.Tech)  
REM2B001

2<sup>nd</sup> Semester Regular/Back Examination: 2022-23

Engineering Mechanics

AERO, AE, AEIE, AUTO, BIOMED, BIOTECH, CHEM, CIVIL, CST, CSEAI, CSEDS, CSE,  
CSIT, CSEAIME, ELECTRICAL & C.E, EEE, ELECTRICAL, ECE, ETC, EIE, IT, MANUTECH,  
MECH, MME, METTA, MINERAL, MINING, PLASTIC, ELECTRONICS & C.E

Time : 3 Hour

Max Marks : 100

Q.Code : M310

Answer Question No.1 (Part-1) which is compulsory, any eight from Part-II and any two from Part-III.

The figures in the right hand margin indicate marks.

Part-I

Q1 Answer the following questions:

(2 x 10)

- State Lami's theorem.
- Find the resultant of two forces equal to 50 N and 30 N acting at an angle of  $60^\circ$ .
- State the Varignon's principle of moments.
- What is a couple? What is the arm of a couple and its moment ?
- What is a free-body diagram?
- Define coefficient of friction and limiting friction.
- State the perpendicular axis theorem.
- What do you understand by perfect truss, deficient truss and redundant truss structure?
- State D' Alembert's Principle.
- A body is moving with a velocity of 3 m/s. After five seconds the velocity of the body becomes 13 m/s. Find the acceleration of the body.

Part-II

Q2 Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)

(6 x 8)

- Define and explain the following terms:
  - Coplanar and non-coplanar forces
  - Collinear and concurrent forces
  - Parallel and non-parallel forces.
- A uniform plank ABC of weight 30 N and 2 m long is supported at one end A and at a point B 1.4 m from A as shown in Fig 1. Find the maximum weight W, that can be placed at C, so that the plank does not topple.

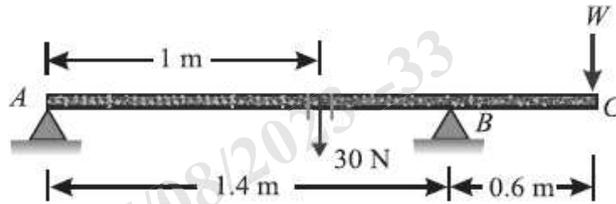


Fig. 1

- c) Two identical rollers P and Q, each of weight  $W$ , are supported by an inclined plane and a vertical wall as shown in Fig. 2. Assume all the surfaces to be smooth. Draw the free body diagrams of:
- roller Q,
  - roller P and
  - rollers P and Q taken together.

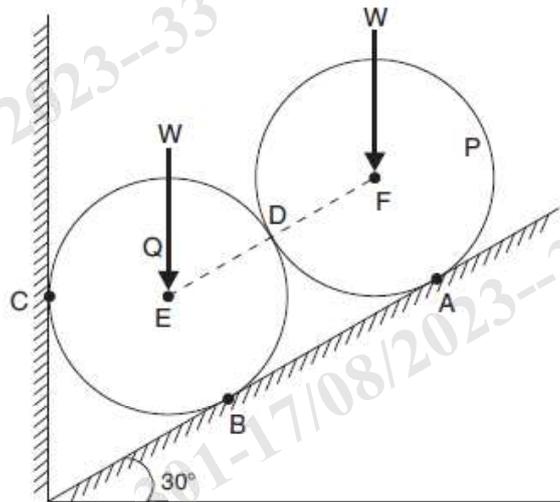


Fig. 2

- The force required to pull a body of weight 40 N on a rough horizontal plane is 15 N. Determine the co-efficient of friction if the force is applied at an angle of  $20^\circ$  with the horizontal.
- Consider the triangle ABC of base 'b' and height 'h'. Determine the distance of centroid from the base.
- Find the centroid of a 100 mm  $\times$  150 mm  $\times$  30 mm T-section as shown in Fig. 3.

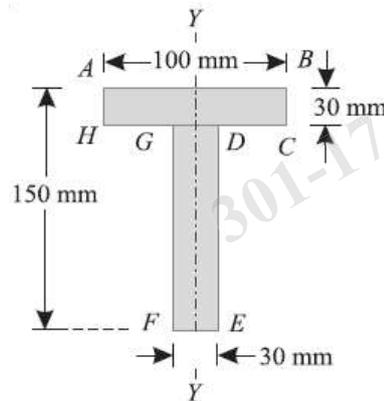


Fig. 3

- g) Find the moment of inertia of a rectangular section 60 mm wide and 40 mm deep about its centre of gravity.
- h) State and prove the theorem of parallel axis.
- i) State the principle of virtual work. Explain the application of the principle of virtual work in case of lifting machines.
- j) The equation of motion of a particle moving in a straight line is given by  

$$s = 18t + 3t^2 - 2t^3$$
 where  $s$  is the total distance covered from the starting point in metres at the end of  $t$  seconds. Find:  
 (i) the time, when the particle reaches its maximum velocity  
 (ii) the maximum velocity of the particle.
- k) A particle is thrown with a velocity of 5 m/s at an elevation of  $60^\circ$  to the horizontal. Find the velocity of another particle thrown at an elevation of  $45^\circ$  which will have (a) equal horizontal range, and (b) equal maximum height.
- l) A body of mass 50 kg, moving with a velocity of 6 m/s, collides directly with a stationary body of mass 30 kg. If the two bodies become coupled so that they move on together after the impact, what is their common velocity.

### Part-III

#### Only Long Answer Type Questions (Answer Any Two out of Four)

Q3

Two smooth spheres of weight ' $W$ ' and radius ' $r$ ' each are in equilibrium in a horizontal channel of 'A' and 'B' vertical sides as shown in Fig. 4. Find the force exerted by each sphere on the other. Calculate these values, if  $r = 250$  mm,  $b = 900$  mm and  $W = 100$  N.

(16)

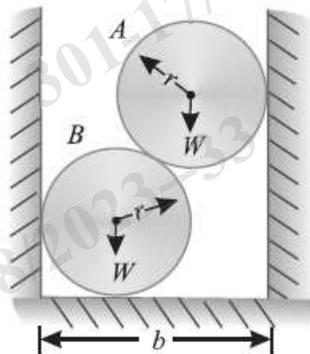


Fig. 4

Q4

Find the reactions and forces in the members of the truss as shown in Fig. 5.

(16)

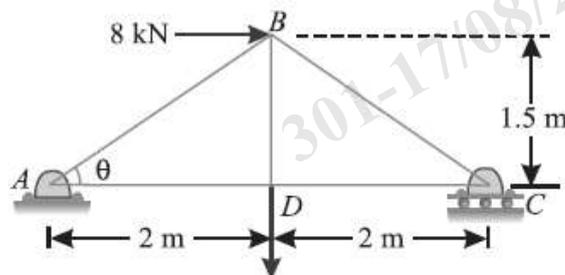


Fig. 5

- Q5** Two smooth inclined planes whose inclinations with the horizontal are  $30^\circ$  and  $20^\circ$  are placed back to back. Two bodies of mass 10 kg and 6 kg are placed on them and are connected by a light inextensible string passing over a smooth pulley as shown in Fig 6. Find the tension in the string. Take  $g = 9.8 \text{ m/s}^2$ . **(16)**

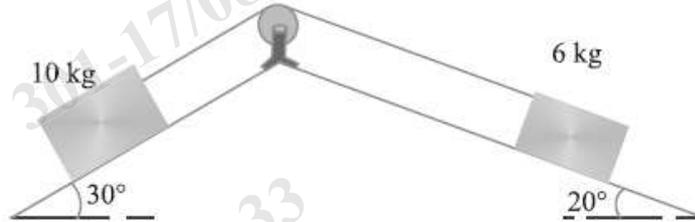


Fig. 6

- Q6** A body weighing 196.2 N slides up a  $30^\circ$  inclined plane under the action of an applied force 300 N acting parallel to the inclined plane. The co-efficient of friction,  $\mu$  is equal to 0.2. The body moves from rest. **(16)**
- Determine:
- (i) acceleration of the body,
  - (ii) work done on the body in four seconds,
  - (iii) momentum of the body after four seconds,
  - (iv) impulse applied in four seconds.