Code No: 182AA **R22**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech I Year II Semester Examinations, January/February – 2024
APPLIED MECHANICS
(Civil Engineering)

Time: 3 Hours **Max. Marks: 60**

Note: This question paper contains two parts A and B.
i) **Part- A** for 10 marks, ii) **Part - B** for 50 marks.
- Part-A is a compulsory question which consists of ten sub-questions from all units carrying equal marks.
- Part-B consists of **ten questions** (numbered from 2 to 11) **carrying 10 marks each**. From each unit, there are two questions and the student should answer one of them. Hence, the student should answer five questions from Part-B.

PART- A

(10 Marks)

1.a) What is the concept of a free body diagram? [1]
b) What are the key differences between statically determinate and indeterminate structures? [1]
c) Why is the centroid of a body important in the context of equilibrium? [1]
d) What is angle of friction? [1]
e) What is the significance of the perpendicular-axis theorem in the calculation of area moment of inertia? [1]
f) What is the difference between the first moment of area and the second moment of area? [1]
g) What is the fundamental concept of Newton's second law of motion? [1]
h) Define instantaneous velocity and instantaneous acceleration. [1]
i) How is the principle of Virtual Work used to analyze the equilibrium of structures? [1]
j) Define impulse in the context of the impulse-momentum principle. [1]

PART - B

(50 Marks)

2.a) A bracket is constructed by attaching member ABC to wall CD with a frictionless hinge at C and a horizontal cable at A, as shown in Figure 1. A smooth cylinder of weight 1.2 kN is placed in the bracket as shown. Determine the force acting on the cylinder at contact points B and D and the tension in the cable and reactions at support C.

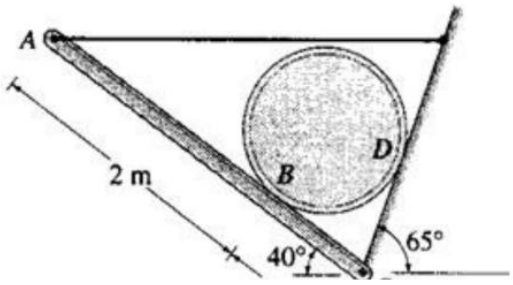

Figure 1

b) Determine tension in cable and horizontal and vertical component of reactions at pin A. The pulley P is frictionless as shown in figure 2. [5+5]

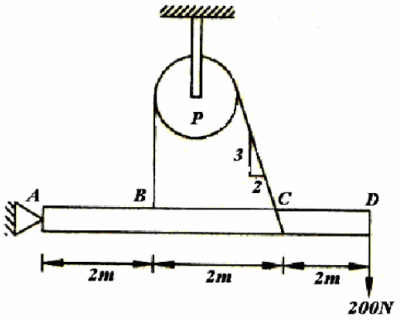

Figure 2

OR

3.a) Two identical iron spheres each of radius 5cm and weight 150 N is connected with a string of length 16cm, and rest on a horizontal smooth floor. Another sphere of radius 6cm and weight 200N rest over them. Determine the tension in the string and reaction at all contact surfaces as shown in figure 3.

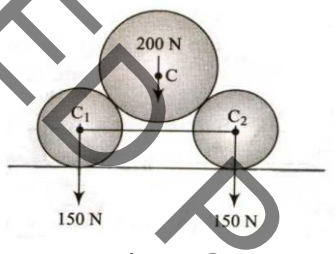

Figure 3

b) In the four bar mechanism ABCD, as shown in figure 4 below, determine the force P for equilibrium. [5+5]

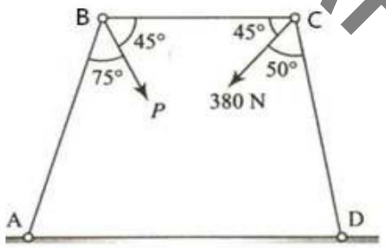

Figure 4

4. Determine the force P required to start the movement of the wedge as shown in Figure 5. The angle of friction for all surfaces of contact is 15°. [10]

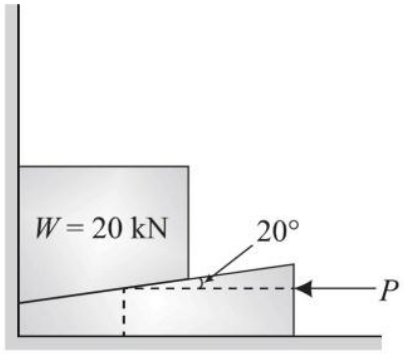

Figure 5

OR

5.a) Two blocks, connected by a horizontal link AB are supported on two rough planes as shown in Figure 6. The coefficient for friction of block A on the horizontal plane is $\mu = 0.4$. The angle of friction for block B on the inclined plane is $\theta = 15^0$. What is the smallest weight W of block A for which equilibrium of the system?

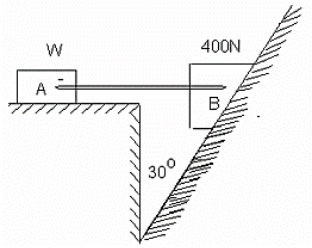

Figure 6

b) Determine the force 'P' required to start the wedge shown in figure 7. The angle of friction for all surface contact is 15^0. [5+5]

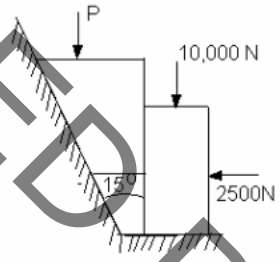

Figure 7

6.a) Explain the transfer formula for product of inertia.

b) Find the moment of inertia for the shaded area parallel to x – axis. As shown in the Figure 8. [5+5]

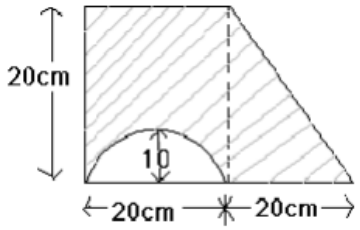

Figure 8

OR

7.a) Derive the expression for the moment of inertia of a homogeneous sphere of radius 'r' and mass density 'w' with reference to its diameter.

b) Explain the terms:
i) Moment of inertia
ii) Polar moment of inertia
iii) Product of inertia. [5+5]

8.a) Explain the terms displacement, velocity and acceleration connected to rectilinear translation.

b) A particle falling under gravity travels 25m in a particular second. Find the distance travelled by it in next three seconds. [5+5]

OR

9.a) Two balls of the masses 10 kg and 20 kg are moving along a straight line towards each other at velocities of 4m/s and 1m/s respectively. If e=0.6, determine the velocities of the balls just after collision.

b) A particle moves in x-y plane and its position is given by $r = (3t)i + (4t-3t^2)j$, where r is the position vector of particle in meters at time t sec. Find the radius of curvature of the path and normal and tangential components of acceleration when it crosses X-axes again.[5+5]

10.a) A beam of span 5 meters is carrying a point load of 2kN at a distance of 2 meters from A. Determine the beam reactions, by using the principle of the virtual work(Figure 9).

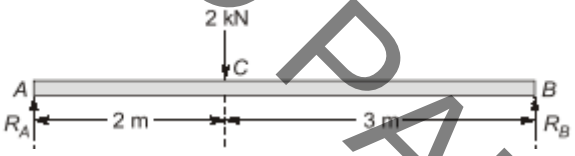

Figure 9

b) Determine force in member CD by using the method of virtual work(Figure 10). [5+5]

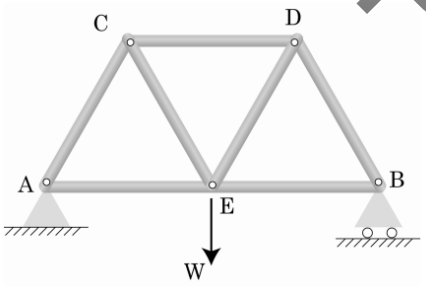

Figure 10

OR

11.a) Find reaction at E by using method of virtual work(Figure 11)

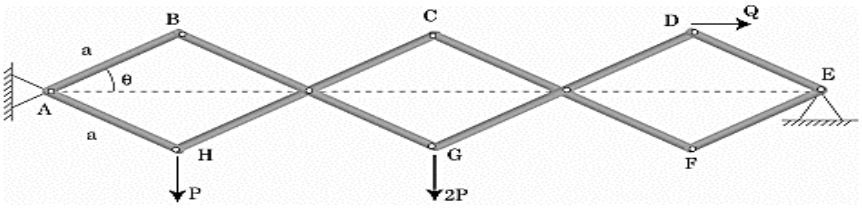

Figure 11

b) Explain the principle of Virtual Work and its application in structural analysis. [5+5]

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