Code No: 182AK **R22**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech I Year II Semester Examinations, January/February - 2024
ENGINEERING MECHANICS
(Common to ME, AE, MIE)

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) State Avignon's theorem. [1]
b) Distinguish types of friction. [1]
c) What is product of inertia illustrate with an example? [1]
d) State the principle of impulse-momentum. [1]
e) Write work energy equation for rotating bodies. [1]
f) What is coplanar system of forces? [1]
g) State and explain pappus theorem II. [1]
h) What is perpendicular axis theorem? [1]
i) State the D'Alemberts principle. [1]
j) A constant force of 30 N magnitude acts horizontally on a body of 10 kg mass moving at 5m/s. Determine its displacement and velocity after 3 seconds. [1]

PART - B

(50 Marks)

2.a) State and prove Lami's theorem.
b) Coplanar system of force is acting on a flat plate as shown in Figure 1. Determine i) the resultant and ii) x and y intercepts of the resultant. [4+6]

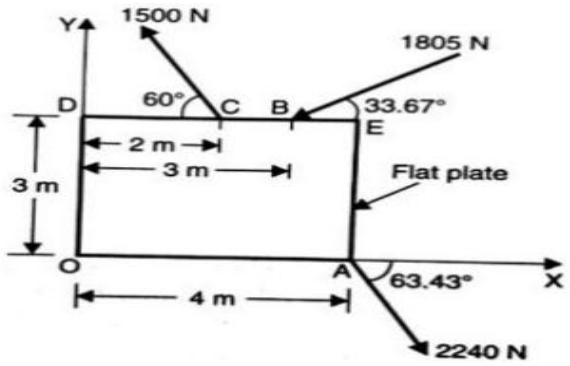

Figure.1

OR

3.a) Determine and locate the resultant R of the two forces and one couple acting on the I-beam as shown in figure.2

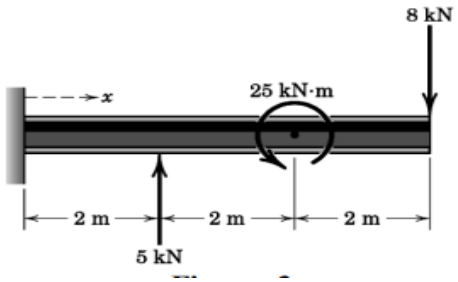

Figure.2

b) Three bars pinned together at B and C and supported by hinges at A and D as shown in figure 3 form a four-link mechanism. Determine the value of P which is required to hold the system in equilibrium. [5+5]

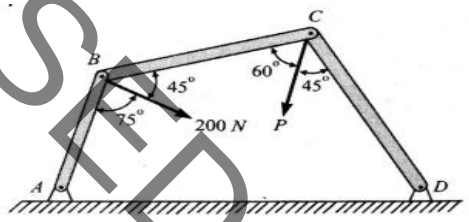

Figure.3

4.a) What is a screw jack? Explain the principle of operation of a screw jack with a neat sketch.

b) Two block of weight $W_1 = 50$ N and $W_2 = 50$ N are resting on a rough inclined plane as shown in the figure 4. If $\mu = 0.3$ for W_1 and plane and $\mu = 0.2$ for W_2 and plane, find the inclination of the plane for which slipping will impend. [4+6]

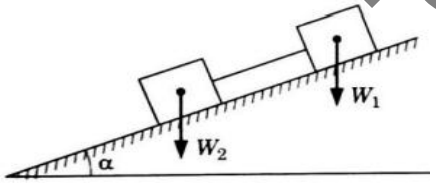

Figure.4

OR

5.a) A pulley is driven by a flat belt running at 200 m/minute speed. Find the power transmitted by the belt, if the maximum tension in the belt is 1000 N. Assume the coefficient of friction between the belt and pulley surface as 0.3, and the angle of lap is 160 degrees.

b) Show that for an ideal screw-jack, the efficiency is independent of the weight lifted. [5+5]

6.a) Locate the centroid of a section as shown in Figure 5.

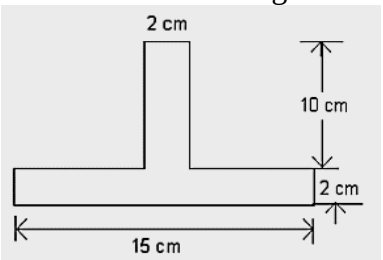

Figure.5

b) State and prove parallel axis theorem. [5+5]

OR

7. Find the MI about the centroidal axis and about the xy axis for figure.6 shown. All dimensions are in mm. [10]

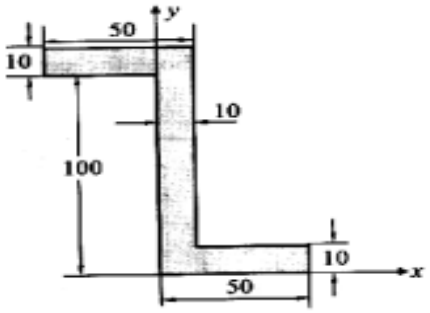

Figure.6

8.a) A locomotive of weight W = 534 kN goes around a curve of radius r = 300 m at a uniform speed of 72 kmph. Determine the total lateral thrust on the rails.

b) Write the governing equations for angular velocity and angular rotation of a rigid body rotating about a fixed axis under the action of a constant moment. [5+5]

OR

9. Determine the polar mass moment of inertia of a circular ring of mean radius R and mass M. [10]

10.a) A body weighing 20 N is projected up a 200 inclined plane with a velocity of 12 m/s, coefficient of friction is 0.15. Find the maximum distance the body will move up the inclined plane.

b) Two blocks of weights A and B are connected by a flexible but inextensible cord and supported as shown in figure 7. If the coefficient of friction between the block P and the horizontal surface is m and all other friction is negligible, find (i) the acceleration of the system and (ii) the tensile force S in the cord. The following numerical data are given: A = 54 N ; B = 25 N; $\mu = 1/3$. [5+5]

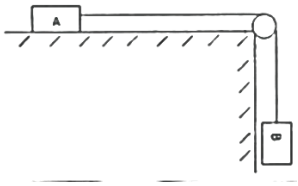

Figure.7

OR

11. Determine the constant force P that will give the system of bodies shown in Figure 8. A velocity of 3m/sec after moving 4.5m from rest. Coefficient of friction between the blocks and the plane is 0.3. Pulleys are smooth. [10]

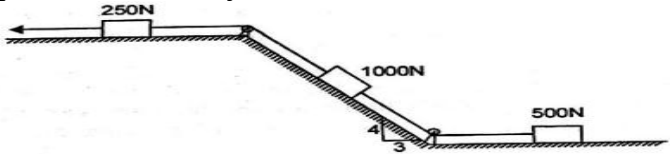

Figure.8

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