C

Reg. No. :

Question Paper Code: R2104

B.E./B.Tech. DEGREE EXAMINATION, DEC 2025

First Semester

Civil Engineering

R21UCE204 - ENGINEERING MECHANICS

(Regulations R2021)
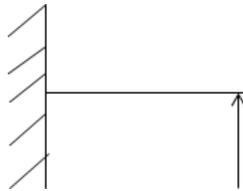
Duration: Three hours   Maximum: 100 Marks

Answer All Questions

PART A - (5x 1 = 5 Marks)

1. The _____ forces do not cause the rotation.   CO1-U

    (a) Non-concurrent   (b) Parallel   (c) Non-Parallel   (d) Concurrent

2. The diagram depicts _____ kind of beam.   CO1-U

    (a) Cantilever   (b) Continuous   (c) Over hanging   (d) Propped cantilever

3. What will be the moment of inertia of the given rectangle as shown in figure Q.3?   CO1-U

Fig.Q.3

    (a) 150.25mm^4 (b) 165.5 mm^4 (c) 104.17 mm^4 (d) 178.2 mm4

4. The co-efficient of friction depends upon   CO1-U

    (a) nature of surfaces   (b) area of contact   (c) shape of the surfaces   (d) all of the above.

5. The Newton's Second Law of Motion gives a relation between force, mass and _____   CO1-U

   (a) Velocity   (b) Time   (c) Acceleration   (d) Distance

PART – B (5 x 3= 15 Marks)

6. State the principle of resolution of forces.   CO1- U

7. Examine how the parallelogram and triangular laws of forces are used to   CO4-Ana
   determine the resultant in a system of concurrent forces.

8. State Perpendicular Axis Theorem.   CO1-U

9. Apply Coulomb's law of dry friction to find the limiting frictional force   CO5-App
   between two contact surfaces.

10. What is meant by curvilinear motion of translation.   CO1-U

PART – C (5 x 16= 80 Marks)

11. (a) Apply the principle of resolution to determine the magnitude and   CO2-App   (16)
        direction of the resultant force for the action of four forces 10 N,
        20N, 30N and 40N are acts on one of the vertices of a regular
        pentagon towards the other four vertices taken in order.

                                     Or

    (b) Apply the principle of resolution to determine the unknown force   CO2-App   (16)
        and its inclination with reference to X axis for the action of three
        coplanar forces acts in a particle as shown in figure 11.a. One of the
        force is unknown and its magnitude is shown by P. The resultant
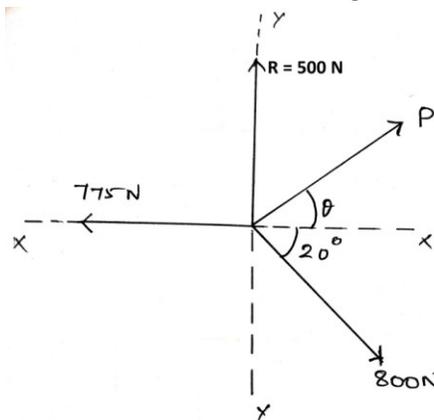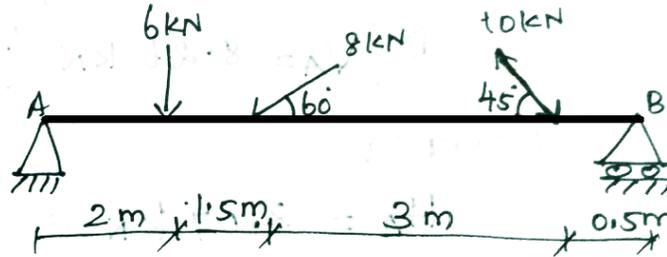   having a magnitude of 500 N and it is acting along Y axis (Positive).


Fig.Q.11.b

2

R2104

12. (a) Analyse the equilibrium of the simply supported beam carrying the given system of loads as shown in the figure 12.a. Break down the force system into components and evaluate the reactions at supports A and B using static equilibrium principles.   CO4-Ana (16)


Fig.Q.12.a

Or

(b) Consider a simply supported beam AB of span 11 m with an overhang, carrying multiple loads as illustrated in 12.b. By resolving all forces and moments, analyse the equilibrium of the beam and compute the reactions developed at supports A and B.   CO4- Ana (16)
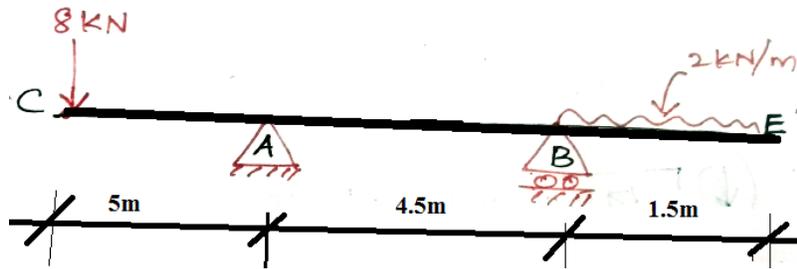

Fig.Q.12.b

13. (a) A channel section is shown in the figure.13.a. Apply laws of mechanics to: CO3- App (16)
(a) decompose the section into simple rectangles,
(b) compute the centroid, and
(c) determine the centroidal moments of inertia about the x–x and y–y axes. Include all intermediate tables and formulae used.

3

R2104
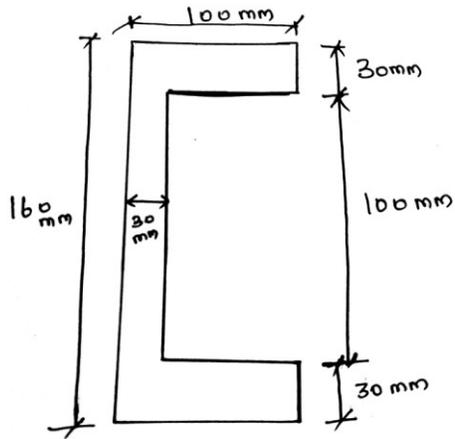
Fig.Q.13.a

Or

(b) Apply the composite-area method to determine the second moment CO3- App (16)
of area (moment of inertia) of the shaded section shown in the figure
13.b about the x-axis. Decompose the shaded region into simple
shapes, compute each sub-area's centroidal moment of inertia about
its own x-axis, use the parallel-axis theorem as required, account for
removed material (if any), and sum the contributions to obtain the
total I_{xx}.
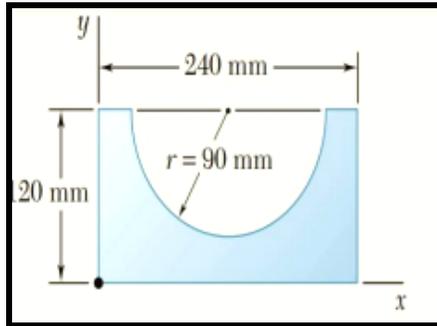
Fig.Q.13.b

14. (a) A block of weight $W_1 = 1290$ N rests on a horizontal surface and CO5-App (16)
supports another block of weight $W_2 = 1290$ N on the top of it as
shown in figure 14.a. Block of weight W_2 is attached to a vertical
wall by an inclined string AB. Calculate the force 'P' applied to the
lower block that will be necessary to cause the slipping to impend
using concepts of frictional force.

R2104
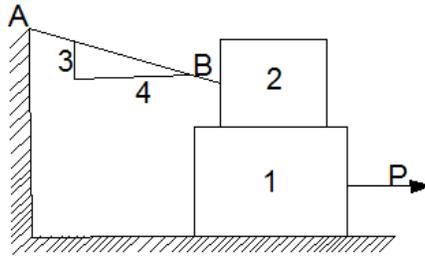
Fig.Q.14.a

Or

(b) A uniform ladder of weight 900N and of length 5m rests on a horizontal ground and leans against a smooth vertical wall. The ladder makes an angle of 550 with horizontal. When a man of weight 600N stands on the ladder at a distance 3m from the top of the ladder, the ladder is at the point of sliding. Determine the co-efficient of friction between the ladder and the floor using sliding friction and ladder friction concept.   CO5-App (16)

15. (a) Analyse the motion of two bodies A and B of masses M_A = 80 kg and M_B = 20 kg, connected by a light inextensible thread and moving on a rough horizontal plane. A horizontal force P = 400 N is applied to the 80 body (see figure .15.a). The coefficient of friction between each body and the plane is µ=0.3. Using D'Alembert's principle (i.e., replace ma by an inertial force -ma and apply static equilibrium to each body), determine: CO6-Ana (16)

    i. The common acceleration a of the two bodies, and

   ii. The tension T in the connecting thread.

Fig.Q.15.a

Or

(b) A van accelerates uniformly from rest to 60 km/h in 3 minutes. Analyse the motion and compute   CO6-Ana (16)

(a) acceleration in m/s²,

(b) distance travelled during this period in metres, and

(c) the time required to reach 44 km/hr from rest.

R2104

7