B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2025
Second Semester
Mechanical Engineering
(Common to Mechanical and Automation Engineering)
24ESCE201 - ENGINEERING MECHANICS
Regulations - 2024

Duration: 3 Hours   Max. Marks: 100

PART - A (MCQ) (10 × 1 = 10 Marks)
Answer ALL Questions

		Marks	K–Level	CO

1. The principle of transmissibility of forces states that? — *1 K1 CO1*
   (a) The point of application of a force cannot be changed.
   (b) The line of action of a force can be shifted along its direction without changing the effect on the body.
   (c) The magnitude and direction of a force can be changed without affecting equilibrium.
   (d) The resultant of two forces is always perpendicular to the smaller force.

2. Lami's theorem is applicable only when — *1 K1 CO1*
   (a) Three forces act on a body and are concurrent and coplanar.
   (b) Four forces act on a body and are parallel.
   (c) Three forces act on a rigid body and are non-concurrent.
   (d) Forces act on a body at right angles.

3. According to Varignon's theorem, the moment of a resultant force about a point is equal to — *1 K1 CO2*
   (a) The algebraic sum of moments of the component forces about the same point.
   (b) The sum of the forces acting on the body.
   (c) The product of the resultant and perpendicular distance from the point.
   (d) The vector difference of the component forces.

4. The reaction at a simple roller support is always — *1 K1 CO2*
   (a) Vertical to the surface on which it rests   (b) Horizontal to the surface on which it rests
   (c) Inclined at 45° to the surface   (d) Perpendicular to the direction of the load

5. The limiting friction is — *1 K1 CO3*
   (a) Equal to static friction.
   (b) Greater than kinetic friction.
   (c) The maximum value of static friction just before motion begins.
   (d) Always less than rolling resistance.

6. A ladder resting against a smooth vertical wall and rough ground will slip when — *1 K1 CO3*
   (a) The angle between the ladder and ground is small.
   (b) The reaction at the wall exceeds the reaction at the ground.
   (c) The frictional force at the ground is less than the component of the weight parallel to the ground.
   (d) The coefficient of friction becomes infinite.

7. The centroid of a semicircular area lies at a distance of _____ from its base along the central axis. — *1 K1 CO4*
   (a) $4r / 3\pi$ (b) $r/2$ (c) $3r/8$ (d) r/π

8. The polar moment of inertia is used to measure. — *1 K1 CO4*
   (a) Bending resistance of a section.   (b) Shear resistance of a section.
   (c) Torsional resistance of a section.   (d) Axial stiffness of a section.

9. The acceleration of a particle in curvilinear motion is — *1 K1 CO5*
   (a) Always directed along the tangent.   (b) Always directed normal to the path.
   (c) Has both tangential and normal components.   (d) Always zero.

10. The work-energy principle states that the work done by all forces on a particle is equal to — *1 K1 CO6*
    (a) Its potential energy.   (b) The change in its kinetic energy.
   (c) The product of mass and acceleration.   (d) The change in its momentum.

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create   **14103**

PART - B (12 × 2 = 24 Marks)
Answer ALL Questions

11. Define Lame's Theorem.   *2 K1 CO1*

12. A force of 100 N is acting at a point, making an angle of 30° with the horizontal. Determine the components of this force along the x and y directions.   *2 K2 CO1*
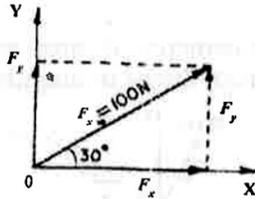
13. State Varignon's theorem.   *2 K1 CO2*

14. A horizontal beam is supported at both ends. A force of 100 N acts vertically downwards at a distance of 2 meters from the left support. Calculate the moment of this force about the left support.   *2 K2 CO2*

15. Define coefficient of friction.   *2 K1 CO3*

16. What is the force F required to just initiate the block shown in figure to slide if the coefficient of friction between the surfaces in contact is 0.4?   *2 K2 CO3*
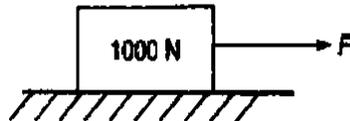

17. Define Centroid.   *2 K1 CO4*

18. What is Principal moment of inertia?   *2 K1 CO4*

19. A car is moving with a velocity of 20m/s. The car is brought to rest by applying brakes in 6 seconds. Find i) Retardation ii) Distance travelled by the car after applying the brakes.   *2 K2 CO5*

20. List the types of rectilinear motion with the uniform acceleration.   *2 K1 CO5*

21. What is work energy principle?   *2 K1 CO6*

22. Define D'Alembert's principle.   *2 K1 CO6*

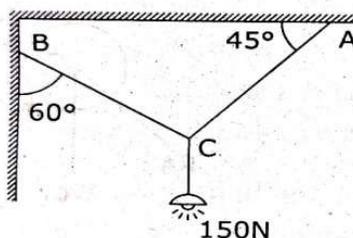## PART - C (6 × 11 = 66 Marks)
Answer ALL Questions

23.   a)   The four coplanar forces are acting at a point as shown in figure. Determine the resultant in magnitude and direction.   *11 K3 CO1*
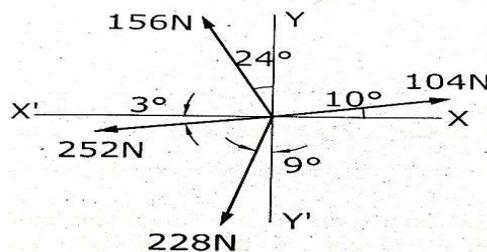

OR

   b)   An electric light fixture weighing 150 newton hangs from a point C, by two strings AC and BC as shown in figure. Determine the forces in the strings AC and BC.   *11 K3 CO1*
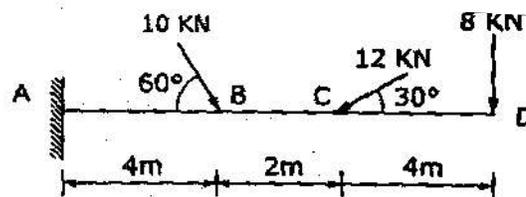
24.   a) ABCD is a weightless rod under the action of four forces P, Q, S and T as shown in   *11 K3 CO2*
figure. If P = 10 N, Q = 4 N, S = 8 N, T = 12 N. Calculate the resultant and mark
the same in direction with respect to the end A of the rod.
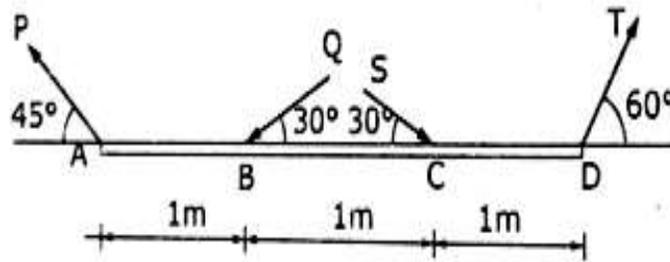
OR

 b) Determine the support reactions of a beam shown in figure.   *11 K3 CO2*

25.   a) A uniform ladder of weight 1000 N and of length 4m rests on a horizontal ground   *11 K2 CO3*
and leans against a smooth vertical wall. The ladder makes an angle of 600 with
horizontal. When a man of weight 750 N stands on the ladder at a distance 3 m
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.
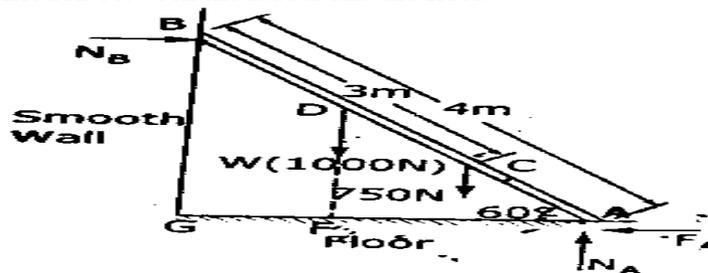
OR

  b) Block 2 rests on block 1 and is attached by a horizontal rope AB to the wall as   *11 K2 CO3*
shown in figure. What force P is necessary to cause motion of block 1 to impend?
The co-efficient of friction between the blocks is 1/4 and between the floor and
block 1 is 1/3. Mass of blocks 1 and 2 are 14 kg and 9 kg respectively.
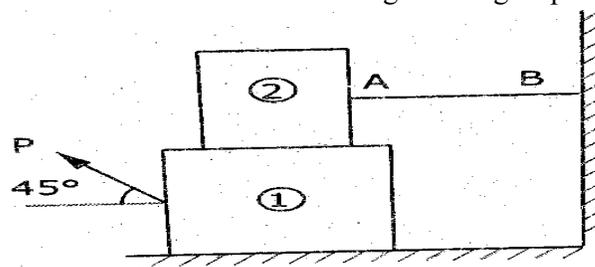
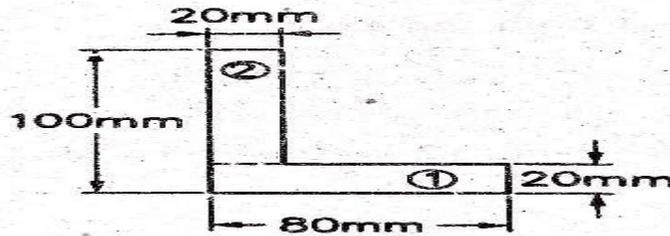26. a) Locate the centroid of the sectioned area shown in figure. *11 K3 CO4*
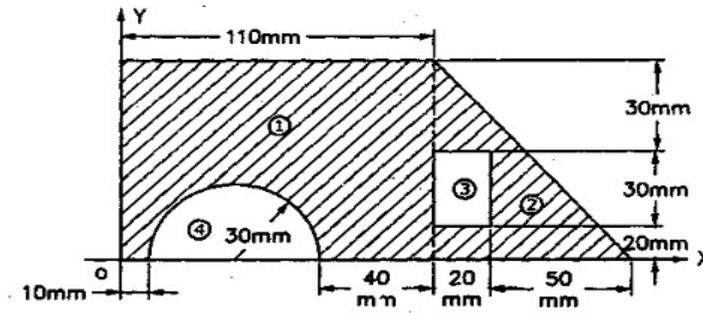
OR

b) Locate the principal axes and determine the principal moments of inertia of an angle of section, shown in the figure. *11 K3 CO4*

27. a) The position of a particle is given by the relation $S = 1.5t^3 - 9t^2 - 22.5t + 60$, where S is expressed in meters and t in seconds. Determine (i) the time at which the velocity will be zero (ii) the position and distance travelled by the particle at that time (iii) the acceleration of the particle at that time and (iv) the distance travelled by the particle from $t = 5s$ to $t = 7s$. *11 K3 CO5*

OR

b) A motor cyclist wants to jump over a ditch which is 5m wide and the other bars of which is lower by 2.5m from the bank, he intends to start the jump. Calculate the minimum velocity so that he can accomplish this task? With what velocity he will reach the other bank? *11 K3 CO5*

28. a) A Bullet of mass 30 gm is fired horizontally into a body of mass 10 kg, which is suspended by a string of 0.8m long. Due to this impact, the body swings through an angle of 30°. Find the velocity of the Bullet. *11 K3 CO6*

OR

b) A spring is used to stop a 70 kg package which is moving down a 30° incline. The spring constant is 220 N/m. The package is released from rest when it is 2m from the spring. The package strikes the spring which is compressed to 200 mm, before the package is brought to rest. Determine the coefficient of kinetic friction between the package and the plane. *11 K3 CO6*