Indian Maritime University

(A Central University, Govt of India)

Sep/Oct'25 SE

Programme Name: B Tech (ME)

Semester: II

Subject Code: UG11T5204

Subject Name: Engineering Mechanics

Date: 11.09.2025	Max Marks: 70
Duration: 03 Hrs	Pass Marks: 35

General Instructions

(i) All Sections (A, B & C) are to be attempted.
(ii) Options, if any, are specified in respective section.

Section A

Ten MCQs/Fill in the Blanks of 01 Mark each – Choose the correct answer as applicable.

1. The forces which meet at one point, but their lines of action do not lie in a plane are called
   A. Coplanar non- concurrent forces
   B. Non- Coplanar concurrent forces
   C. Non- coplanar, non-concurrent forces
   D. Intersecting forces
2. The angle between two forces when the resultant is maximum and minimum respectively are
   A. 0° and 180° B. 180° and 0°
   C. 90° and 180° D. 90° and 0°
3. Varignon's theorem of moments states that if a number of coplanar forces acting on a particle are in equilibrium, then
   A. Their algebraic sum is zero
   B. Their lines of action are at equal distances
   C. The algebraic sum of their moments about any point in their plane is zero
   D. The algebraic sum of their moment about any point is equal to the moment of their resultant force about the same point.
4. Moment of inertia of a triangle about centroidal axis parallel to the base
   A. $\frac{bh^3}{36}$ B. $\frac{bh^3}{12}$ C. $\frac{bh^3}{3}$ D. $\frac{bh^3}{18}$
5. Centre of gravity of solid cone lies on the axis at the height of (from base)
   A. $\frac{H}{4}$ B. $\frac{H}{3}$ C. $\frac{2H}{3}$ D. $\frac{H}{2}$
6. Which of the following is a vector quantity?
   A. Speed B. Mass C. Force D. Energy
7. Which of the following is true for an object in equilibrium?
   A. The net force acting on the object is zero
   B. The object is always at rest
   C. The net moment is infinite
   D. The object is always moving at a constant speed
8. In projectile motion, the horizontal component of velocity:
   A. Increases with time B. Decreases with time
   C. Remains constant D. Becomes zero at the highest point
9. At the highest point of the projectile's trajectory, the velocity is:
   A. Zero B. Horizontal C. Vertical D. Maximum
10. Which of the following statements best describes D'Alembert's Principle?
    A. The sum of external forces equals the mass times acceleration.
    B. The sum of forces, including inertial forces, is zero in a dynamic system.
    C. The sum of internal forces equals the acceleration of the system.
    D. The system remains at rest under the action of the applied forces.

Section B

Five Questions of 02 Marks each

11. What is dry friction or Coulomb friction?
12. What is a centroid?
13. Define Vector and Scalar.

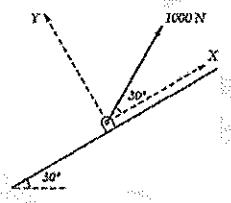
14. What is a rigid body? Define static equilibrium.
15. Define trajectory of a projectile motion.

Section C

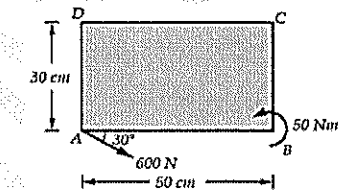
Seven Questions of 10 Marks each of which any 05 questions to be answered.

16. (i) Explain with a neat sketch, principle of transmissibility of a force. (4)
(ii) State triangle law for addition of vectors. (3)
(iii) State law of parallelogram of vectors. (3)

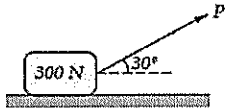
17. Replace the 1000 N force shown in Figure by two forces, a 500 N force acting in the negative Y direction and a force $\vec{F}$, which together are equivalent to the action of the 1000 N force. Find the magnitude of $\vec{F}$ and the angle α that it makes with the Y axis.



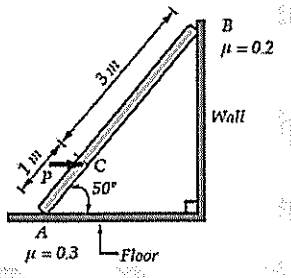
18. Replace the force and couple acting on the rectangular plate shown in Figure by two forces - a horizontal force at B and another force at D.



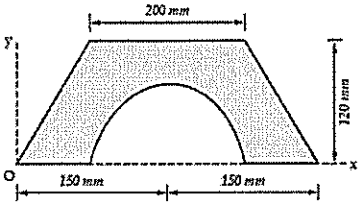
19. (i) A body of weight 300 N is kept on a rough horizontal plane and a force P is applied to just move the body horizontally as shown in Figure. Find the magnitude of force P required if coefficient of static friction is $\mu_s = 0.4$. (5)



(ii) A ladder AB weighing 196 N is resting against a rough wall and a rough floor, as shown in Figure. Calculate the minimum horizontal force 'P' required to be applied at C in order to push the ladder towards the wall. Assume coefficient of friction at A = 0.3 and that B = 0.2. (5)



20. A semi-circular area is cut from a trapezium as shown in Figure. Determine the centroid of the shaded portion with respect to the origin.



21. In a flood relief area, a helicopter going up with constant velocity drops a food packet, which takes 4 seconds to reach ground. No sooner than the first packet reaches the ground, second packet was released, which takes 5 seconds to reach ground. From what height the first packet was released? Also find the constant, upward velocity of helicopter.

22. (i) The velocity of a particle moving in x-y plane is given by $\vec{v} = 3\hat{i} - 2j$ m/sec at t= 2 s. Its average acceleration during the next 2 s is $\hat{i} + 2j\ m/\sec^2$. Determine

the velocity at t = 4s and the angle between the average acceleration vector and the velocity vector at t = 4s? (5)

(ii) A plane flying horizontally at 500 km/hr releases a bomb at an elevation of 1200 m from ground. Write vector equations for velocity and position of the bomb at any time 't' seconds after release. Hence find the time when the bomb will strike the ground. Use point of release as the origin. (5)