Indian Maritime University

(A Central University, Govt of India)

End Semester Examinations– June 2024

Programme Name: B.Tech (NAOE/NASB)

Semester: II

Subject Code: UG12T2202 / UG13T1202

Subject Name: Applied Mechanics

Date: 30.05.2024	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. 'P' and 'Q' are two like parallel forces. If 'P' is moved parallel to itself through a distance of 4cm, then the resultant of 'P' and 'Q' moves through a distance of
   (a) 2cm
   (b) 4cm
   (c) $\frac{4Q}{P+Q}$ cm
   (d) $\frac{4P}{P+Q}$ cm

2. A body of weight 'W' on an inclined plane of angle 'α' being pulled up by a horizontal force 'P' will be on the point of motion up the plane, with Φ as friction angle, when 'P' is equal to
   (a) W
   (b) W sin(α+Φ)
   (c) W tan(α+Φ)
   (d) W tan α

3. The centroidal distance of semicircular arc from its base is
   (a) r/Π
   (b) 2r/Π
   (c) 3r/Π
   (d) 4r/Π

4. The moment of inertia of the quarter circular area (in 1st quadrant) about y-axis is

(a) $\Pi r^4/2$
(b) $\Pi r^4/4$
(c) $\Pi r^4/16$
(d) $\Pi r^4/32$

5. To solve a truss by the method of sections, the number of unknowns at a section should not be
(a) less than 2
(b) more than 2
(c) less than 3
(d) more than 3

6. According to principle of virtual work, "if a rigid body is in equilibrium the total virtual _____ of the external forces acting on the rigid body is zero for any virtual _____ of the body".

(a) work, displacement
(b) work, force
(c) displacement, force
(d) force, work

7. A particle is at rest at the origin. It moves along the x-axis with an acceleration $(x - x^2)$, where 'x' is the distance of the particle at time 't'. The particle next comes to rest after it has covered a distance of
(a) 1
(b) 1/2
(c) 3/2
(d) 2

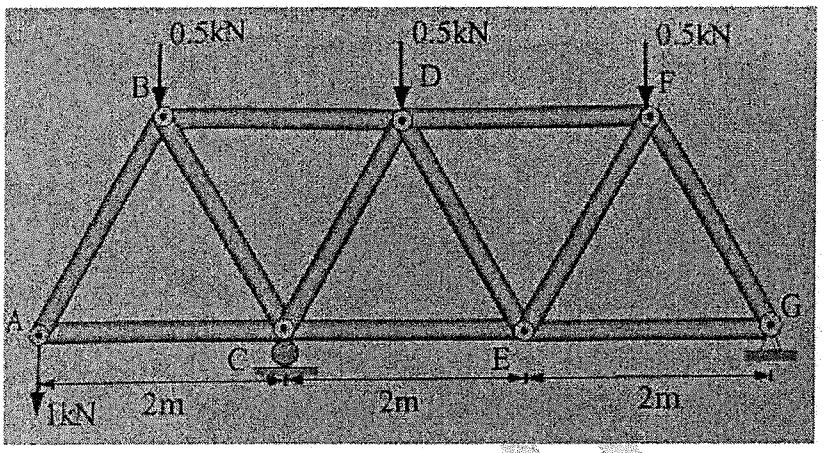
8. When any two elastic bodies collide and move in the same direction, the velocity of separation is
(a) independent of their initial velocities
(b) difference of their initial velocities
(c) sum of their initial velocities
(d) average of their initial velocities

9. The motion of a particle is given by the equation $S = 2t^3+3t$ (S in metres, t in seconds). Starting from t=0, to attain a velocity of 9m/s the particle will have to travel a distance of
(a) 5 m
(b) 10 m
(c) 15 m
(d) 20 m

10. Range of a projectile motion of a particle with velocity 'u' and an angle 'α' with horizontal surface is
(a) $\frac{u^2}{g}$

18. (a) Determine the forces in members BD and CD of the truss, as shown in figure 3., using method of sections. All triangles are equilateral.

(7 marks)



(Figure 3)

(b) Explain about "work of force".

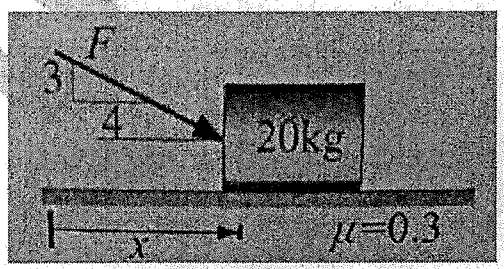
(3 marks)

19. (a) State and explain D' Alembert's principle.

(5 marks)

(b) A 20kg block is subjected to a force having a constant direction and a magnitude $F = 50x^2$, where x is in metres (Figure 4). Determine the speed of the block after it slides 3m. When x=0, the block is moving to the right at 2m/s. The coefficient of kinetic friction between the block and the surface is $\mu = 0.3$.

(5 marks)



(Figure 4)

20. For the slider-crank mechanism shown in Figure 5, determine the velocity of the slider and the angular velocity of the connecting rod.

(b) $\frac{u^2 \sin 2\alpha}{g}$

(c) $\frac{2u \sin \alpha}{g}$

(d) $2\frac{u^2}{g}$

Section B

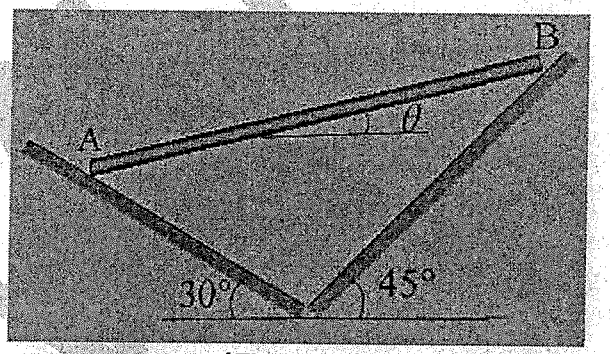
Five Questions of 02 Marks each

11. Define Lame's theorem. Write down its mathematical expression.
12. Define Pappus two theorems.
13. What is deficient truss and redundant truss?
14. Define Newton's first and second laws of motion.
15. Write down the equations of motion for rectilinear and curvilinear motion.

Section C

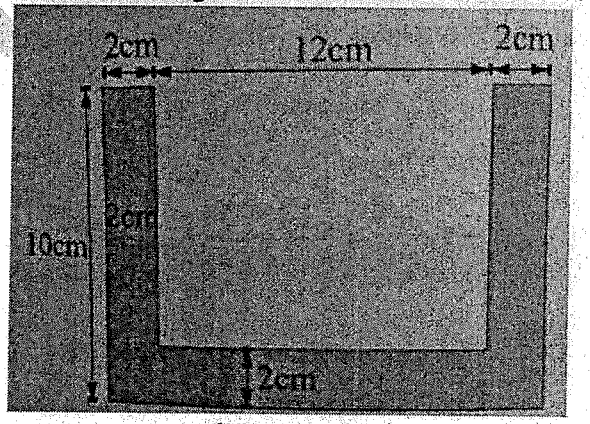
Seven Questions of 10 Marks each of which any 05 questions to be answered.

16. A uniform rod AB is resting on two inclined smooth planes as shown in Figure 1. Determine the angle θ for equilibrium.

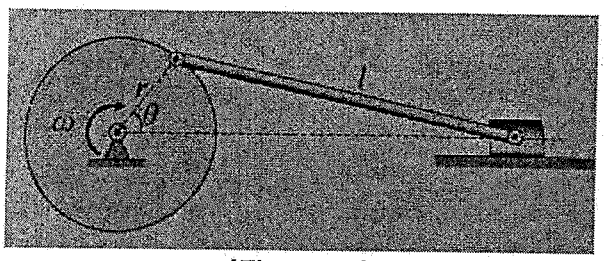


(Figure 1)

17. Find the moment of inertia of section, as shown in figure 2., about x-axis through the centroid of the section.



(Figure 2)



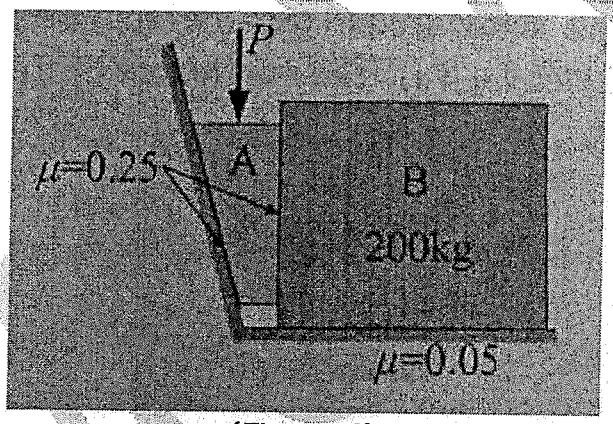
(Figure 5)

21. (a)Explain static friction and kinetic friction in brief.

(5 marks)

(b) The horizontal position of the 200kg rectangular block is adjusted by a 6^0 wedge under the action of a force P, as shown in Figure 6. If the coefficient of friction for both the pairs of wedge surface is 0.25 and if the coefficient of friction between the block and the horizontal surface is 0.5, determine the least force P required to move the block.

(5 marks)



(Figure 6)

22. (a) Derive for the centroid of right circular cone, whose apex is at the origin and its axis lying on x-axis.

(5 marks)

(b) State and explain perpendicular axis theorem.

(5 marks)