Indian Maritime University

(A Central University, Govt of India)

End Semester Examinations – June 2023

Programme Name: B Tech (NAOE)

Semester: II

Subject Code: UG12T2202

Subject Name: Applied Mechanics

Date: 29.05.2023	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.
(iii) Log tables can be used

Section A

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

1.The reaction support of the beam at B in Fig.1 is

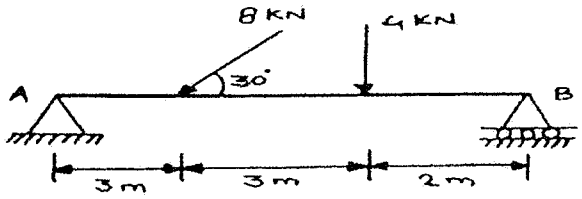

Fig.1

(a) 5KN
(b) 4.5KN
(c) 3.5KN
(d) 10KN

2. During inelastic collision of two particles, which one is conserved?
(a) Total linear momentum only
(b) Total kinetic energy
(c) Both linear momentum and kinetic energy
(d) Neither linear momentum nor kinetic energy

3. The area moment of inertia of a hollow circular cross-section with outer diameter d_o and inner diameter d_i is

(a) $\frac{\pi}{32}(d_o{}^4 - d_i{}^4)$

(b) $\frac{\pi}{64}(d_o{}^4 - d_i{}^4)$

(c) $\frac{\pi}{16}(d_o{}^4 - d_i{}^4)$

(d) $\frac{\pi}{128}(d_o{}^4 - d_i{}^4)$

4. The centre of gravity of a semi-circular plate of 66 diameter from its base is

(a) 10cm

(b) 12cm

(c) 14cm

(d) 16cm

5. What is the relationship between each force, if three concurrent forces acting on a body according to Lami's theorem?

(a) Directly proportional to the sine of the angle between the other two forces

(b) Inversely proportional to the cosine of the angle between the other two forces

(c) Directly proportional to the cosine of the angle between the other two forces

(d) Inversely proportional to the sine of the angle between the other two forces

6. Which element of the truss section is made to apply the method of sections in the free body diagram?

(a) The whole structure

(b) Any section can be used

(c) Joints

(d) Truss

7. Two of the things of the composite materials are to be known so that their properties can be varied. Which of the following is one of them?

(a) Weight of the centre of gravity

(b) Weight of the centre of body

(c) Location of the centre of gravity

(d) Location of the centre of mass

8. Two rings of radii R and nR made from the same wire have the ratio of moments of inertia about an axis passing through their centre equal to 1:8. What is the value of n?

(a) 2

(b) $2\sqrt{2}$

(c) 4

(d) ½

9. Two bodies of mass and 4m have equal kinetic energy. What is the ratio of their momentum?
(a) 1:4
(b) 1:2
(c) 1:1
(d) 2:1

10. A block is kept on a horizontal friction less on a inclined surface with an angle of inclination 60^0. The inclined is given as acceleration a to keep the block stationary then a is equal to
(a) $\sqrt{3}g/2$
(b) $2g/\sqrt{3}$
(c) g
(d) $g/\sqrt{3}$

Section B

Five Questions of 02 Marks each

11. State Varignon's theorem.
12. State the parallel axis and perpendicular axis theorem
13. Define the principle of virtual work.
14. What do you understand by D'Alembert's principle?
15. Write the equation of motion of a freely falling body.

Section C

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

16. a) State and explain the parallelogram law of forces.

(5 marks)

b) Two identical rollers of weight 1000N are supported on a vertical plane as shown in Fig.2. Find the reaction at the supports A, B and C. Assume all surfaces to be smooth.

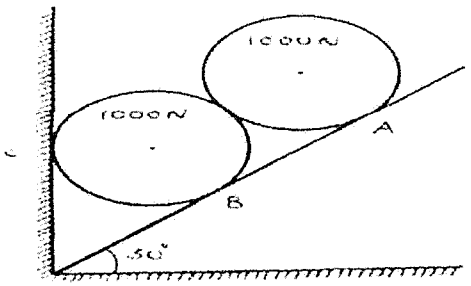

Fig.2 (5 marks)

17. (a) Define truss and what are the assumptions made in finding out the forces in the truss.

(3 marks)

(b) Find the forces in the members DF,BC,CE in Fig.3 by using section method

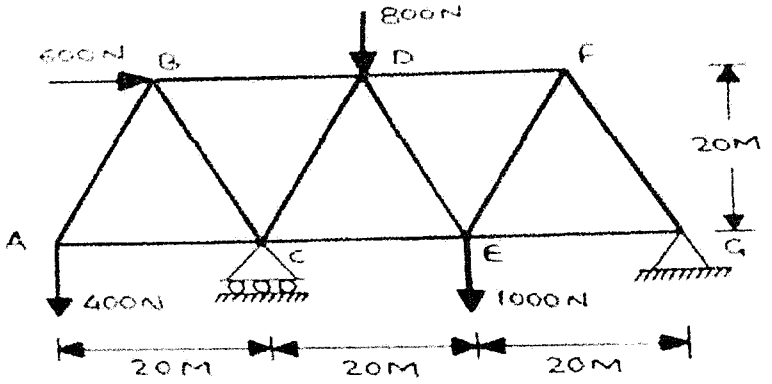

Fig.3

(7 marks)

18. (a) State the laws of the friction.

(3 marks)

(b) A uniform ladder 24m long weights 40kg.It is placed against a vertical wall at an angle of 60° with the ground. How Far along the ladder can a 160 kg man climb before the ladder is on the verge of slipping .The angle of friction at all the contact surfaces is 15 degree.

(7 marks)

19. Determine the moment of inertia about its centroid along x and y axis for the section shown in

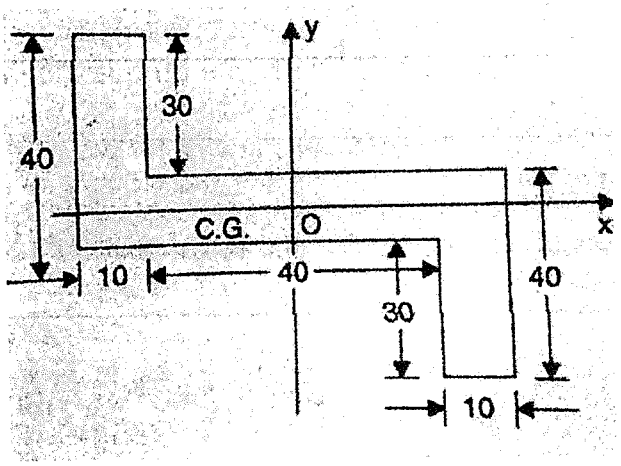

Fig.4

20. (a) A ball of mass 20 kg moving with a velocity of 5m/s. strikes directly another ball of mass 10 kg in the opposite direction with a velocity of 10m/s.if the coefficient of the restitution is equal to 5/6., then determine the velocity of each ball after impact.

(5 marks)

(b) A particle is projected from a point on a inclined plane with a velocity of 40m/s. The angle of projection and the angle are 50^0 and 20^0 to the horizontal respectively. If the motion of the particle is up the plane, Determine time of flight, range, angle of projection, maximum range up the plane.

(5 marks)

21. (a) Two blocks of the weights 20N and 10 N are connected to two ends of a light inextensible string passing over a smooth pulley the weight A is placed on a rough horizontal surface while the weight B is hanging vertically in air the coefficient of friction between the block A and the horizontal plane is 0.25. If the system is released from the rest and block B falls through a vertical distance of 2m. What is the velocity attained by the block B. Neglect the friction in the pulley and the extension of the string.

(5 marks)

(b) A simply supported beam of AB of span 10m carries a two point loads of 15KN and 20KN at 4m and 6m from the end A respectively. Determine the beam reactions by the principle of virtual work.

(5 marks)

22. (a) Locate the centroid for the geometry given in Fig.5.

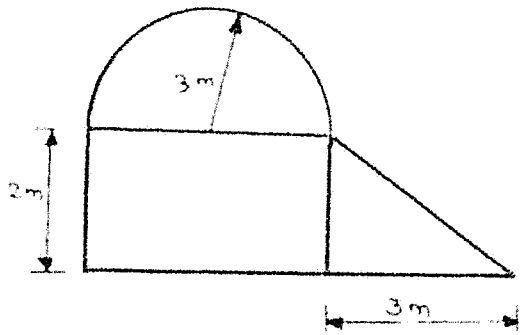

Fig.5

(4 marks)

b) Find the forces in all the members shown in Fig.6 using method of joints.

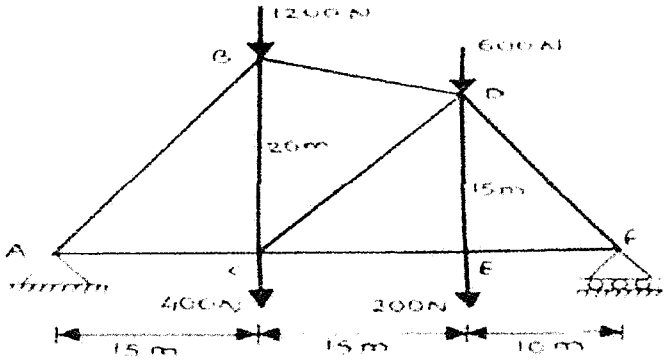

Fig.6

(6 marks)