Indian Maritime University

(A Central University, Govt of India)

End Semester Examinations–June 2024

Programme Name: B Tech (ME)

Semester: II

Subject Code: UG11T4204

Subject Name: ENGINEERING MECHANICS

Date: 05.06.2024	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. The centre of gravity of hemisphere lies at a distance of _____ from its base measured along the vertical radius.
   (a) $\frac{3r}{8}$ (b) $\frac{3}{8r}$ (c) $\frac{8r}{3}$ (d) $\frac{8}{3r}$

2. The forces whose lines of action lie in the same plane and are meeting at one point, are known as
   (a) Coplanar concurrent force system
   (b) Coplanar non-current force system
   (c) Non-coplanar concurrent force system
   (d) Non-coplanar non-concurrent force system

3. Theorem of perpendicular axis is used in obtaining the moment of inertia of
   (a) Triangular lamina (b) Square lamina
   (c) Circular lamina (d) Semicircular lamina

4. The efficiency of a lifting machine is the ratio of
   (a) Its output to input
   (b) Work done by it to the work done on it
   (c) Its mechanical advantage to its velocity ratio
   (d) All of the above

5. A car which is moving along a straight road starts retarding after the brakes are applied. Then the direction of inertia force will be
(a) Forward (b) Backward (c) Both A & B (d) None

6. A differential pulley block has larger and smaller diameters of 100 mm and 80 mm respectively. Its velocity ratio is
(a) 5 (b) 10 (c) 20 (d) 40

7. If a body is projected vertically upwards, then at the highest point the final velocity is
(a) Maximum (b) Zero
(c) Equal to 'g' (d) None of the above

8. The periodic time of a body moving with simple harmonic motion.
(a) Depends upon its amplitude under all conditions
(b) Is independent of its amplitude
(c) Depends upon its amplitude under certain conditions
(d) Has no relation with its frequency

9. The moment of inertia of a triangular section of base (b) and height (h) about an axis through its *centre of gravity (c.g.)* and parallel to the base is given by the relation.
(a) $bh^3/12$ (b) $bh^3/24$
(c) $bh^3/36$ (d) $bh^3/48$

10. The velocity ratio of a single purchase crab winch can be increased by
(a) Increasing the length of the handle
(b) Increasing the radius of the load drum
(c) Increasing the number of the teeth on the pinion
(d) All of the above

Section B

Five Questions of 02 Marks each

11. State the assumptions made in finding out the axial force in a frame.

12. State the theorem of perpendicular axis applied to moment of inertia

13. A bullet is fired with a velocity of 100 m/s at an angle of 45^0 with the horizontal. How high the bullet will rise?

14. State triangle law of forces and Lami's theorem.

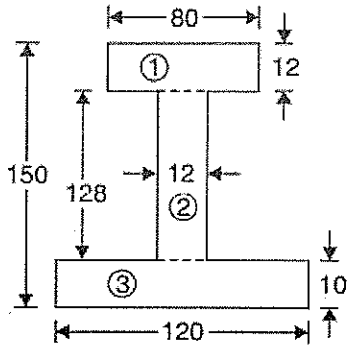
15. Define mechanical advantage and velocity ratio of a lifting machine

Section C

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

16. The law of a machine is given by the relation P = 0.04W+7.5 where (P) is the effort required to lift a load (W), both expressed in Newtons. What is the mechanical advantage and efficiency of the machine, when the load is 2 KN and velocity ratio is 40? What is the maximum efficiency of the machine? If (F) is the effort lost in friction, find the relation between F and W. Also find the value of F when W is 2KN. (10 marks)

17. Determine the polar moment of inertia of I-section shown in Figure. (All dimensions are in mm).



(10 marks)

18. (a) A bullet, moving at the rate of 250 m/s, is fired into a log of wood. The bullet penetrates to a depth of 40 cm. If the bullet moving with the same velocity is fired into a similar piece of wood 20 cm thick, with what velocity would it emerge. Take the resistance to be uniform in both the cases. (7 marks)

(b) A body is rotating with an angular velocity of 5 radians/s. After 4 seconds, the angular velocity of the body becomes 13 radians/s. Determine the angular acceleration of the body. (3 marks)

19. A body moves along a straight line and its acceleration (a) which varies with time (t) is given by a = 2 - 3t. After 5 seconds, from start of observations, its velocity is observed to be 20 m/s. After 10 seconds, from start of observation, the body was at 85 metres from the origin. Determine
(a) its acceleration and velocity at the time of start
(b) distance from the origin at the start of observations,
(c) the time after start of observation in which the velocity becomes zero.
(10 marks)

20. A plane has a rise of 5 in 12. A shot is projected with a velocity of 200 m/s at an elevation of 30^0. Find the range of the plane, if
(a) the shot is fired up the plane,
(b) the shot is fired down the plane.

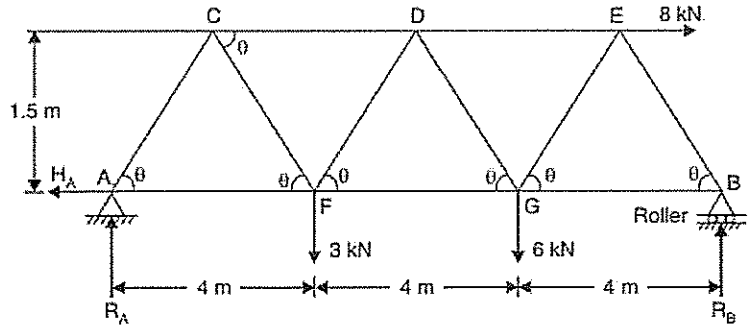
(5 + 5 marks)

21. (a) With a neat figure explain the following terms with respect to simple harmonic motion.
    i. Amplitude
    ii. Oscillation
    iii. Beat
    iv. Periodic time
    v. Frequency

    (b) Find amplitude and time period of a particle moving with simple harmonic motion, which has a velocity of 9 m/s and 4 m/s at the distance of 2 m and 3 m respectively from the center.

(6 + 4 marks)

22. Determine the forces acting on all the members of the truss shown in figure. The truss is subjected to both horizontal and vertical loads. Additionally, describe the nature of forces under each case.



(10 marks)