Indian Maritime University

(A Central University, Govt of India)

Supplementary Examinations – September/October 2024

Programme Name: B Tech (Marine Engineering)

Semester: II

Subject Code: UG11T4204

Subject Name: ENGINEERING MECHANICS

Date: 18.09.2024	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 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

2. The periodic time of one oscillation for a simple pendulum is (where l = Length of the pendulum.)

   (a) $\frac{1}{2\pi}\sqrt{\frac{l}{g}}$

   (b) $\frac{1}{2\pi}\sqrt{\frac{g}{l}}$

   (c) $2\pi\sqrt{\frac{l}{g}}$

   (d) $2\pi\sqrt{\frac{g}{l}}$

3. The torque acting on a body of moment of inertia (I) and angular acceleration (α) is

(a) $I\alpha$

(b) $I\alpha^2$

(c) $0.5\ I\alpha$

(d) $0.5\ I\alpha^2$

4. The point, through which the whole weight of the body acts, irrespective of its position, is known as

(a) moment of inertia

(b) centre of gravity

(c) centre of percussion

(d) centre of mass

5. Which axial force is determined while analyzing a truss?

(a) compressive force

(b) tensile force

(c) both (a) and (b)

(d) none of the above

6. Which of the following statement is **wrong**?

(a) If two springs of stiffness s_1 and s_2 are arranged in series, then stiffness of the equivalent spring is $s_1 + s_2$

(b) The motion of a body from one extremity to another is known as beat

(c) A pendulum, which executes one beat per second is known as second's pendulum

(d) none of them

7. The velocity ratio of a simple wheel and axle with D and d as the diameters of effort wheel and load axle is

(a) D + d

(b) D – d

(c) D × d

(d) D/d

8. If a body is in equilibrium. We may conclude that

(a) No force is acting on the body

(b) The resultant of all the forces acting on it is zero

(c) The moments of the forces about any point is zero

(c) Both (b) and (c)

9. The maximum acceleration of a particle moving with simple harmonic motion is

(A) ω

(B) ωr

(C) $\omega^2 r$

(D) ω/r

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. Differentiate between constant acceleration and variable acceleration using suitable diagrams
12. State the theorem of perpendicular axis applied to moment of inertia
13. Define mechanical advantage and velocity ratio of a simple lifting machine
14. State the mathematical expression for equivalent stiffness of helical springs connected in (a) series and (b) parallel using diagrams as required
15. State triangle law of forces and Lami's theorem

Section C

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

16. State and derive the theorem of Parallel Axis for Moment of Inertia for a plane figure.

17. A stone is dropped from the top of a tower 50 m high. At the same time, another stone is thrown upwards from the foot of the tower with a velocity of 25 m/s. When and where the two stones cross each other?

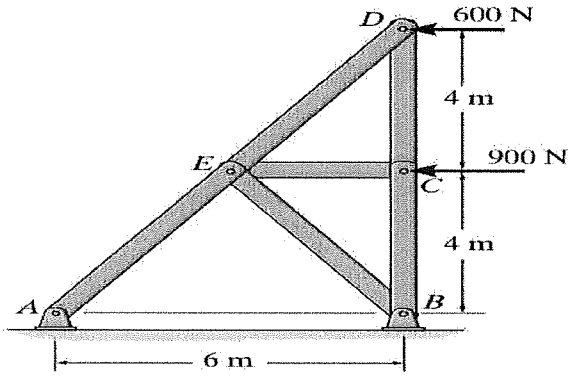
18. A body performing simple harmonic motion has a velocity of 12 m/s when the displacement is 50 mm, and 3 m/s when the displacement is 100 mm, the displacement being measured from the mid-point. Calculate the frequency and amplitude of the motion. What is the acceleration when the displacement is 75 mm?

19. The law of a certain lifting machine is :

$$P = \frac{W}{50} + 8$$

The velocity ratio of the machine is 100. Find the maximum possible mechanical advantage and the maximum possible efficiency of the machine. Determine the effort required to overcome the machine friction, while lifting a load of 600 N. Also calculate the efficiency of the machine at this load.

20. Determine the force in each member of the truss, and state if the members are in tension or compression.



21. Derive an expression for the frequency of motion for a Compound Pendulum in terms of radius of gyration 'k'

22. A flywheel rotates with a constant retardation due to braking. From t = 0 to t = 10 seconds, it made 300 revolutions. At time t = 7.5 sec, its angular velocity was 40 π rad/sec.

Determine (i) value of constant retardation ; (ii) total time taken to come to rest and (iii) total revolutions made till it comes to rest.