

**Indian Maritime University**  
**(A Central University, Govt of India)**  
**End Semester Examinations – December 2023**  
**Programme Name: B. Tech (Marine Engineering)**  
**Semester: II**  
**Subject Code: UG11T4204**  
**Subject Name: ENGINEERING MECHANICS**

Date: 16.11.2023

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.

**Section A**

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

1. In ideal machines, mechanical advantage is \_\_\_\_\_ velocity ratio
  - (a) equal to
  - (b) less than
  - (c) greater than
  - (d) No Relation
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 ( $\alpha$ ) 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)  $D \times d$
  - (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)  $\omega$   
(B)  $\omega r$   
(C)  $\omega^2 r$   
(D)  $\omega/r$
10. When the two ships are moving along inclined directions, then the time when the two ships will be closest together depends upon
- (a) velocity of one of the ships  
(b) velocity of both the ships  
(c) angle between the two directions  
(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. Write the conditions for perfect and imperfect frame
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. Define Routh's Rule of finding Moment of Inertia of an object

### **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?

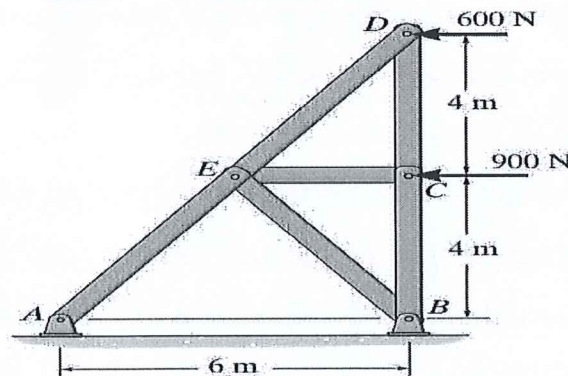
18. A body performing simple harmonic motion has a velocity of 12 m/s when the displacement is 50 mm, and 3 m/s when the displacement is 100 mm, the displacement being measured from the mid-point. Calculate the frequency and amplitude of the motion. What is the acceleration when the displacement is 75 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  $40\pi$  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.