

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

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Date: 02.06.2023

Max Marks: 70

Duration: 03 Hrs

Pass Marks: 35

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General Instructions

- (i) All Sections (A, B & C) are to be attempted.  
(ii) Options, if any, are specified in respective section.

1. 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

2. 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 teeth on the pinion  
(D) All of the above

3. In determining stresses in frames by methods of sections, the frame is divided into two parts by an imaginary section drawn in such a way as not to cut more than

- (A) Three members with unknown forces of the frame      (B) Two members with unknown forces of the frame  
(C) Four members with unknown forces of the frame      (D) Three members with known forces of the frame

4. Theorem of perpendicular axis is used in obtaining the moment of inertia of a

- (a) triangular lamina      (b) square lamina  
(c) circular lamina      (d) semi circular lamina

5. A weight of 900 N can be lifted by an effort of 70 N if the velocity ratio of the machine is 15. Then the machine is called

- a) Reversible                      b) non reversible                      c) ideal                      d) none

6. The area moment of inertia of an Isosceles triangle about centroidal y-axis is given by

- a)  $b \frac{h^3}{36}$                       b)  $h \frac{b^3}{36}$                       c)  $2[h \frac{b^3}{12}]$                       d) None

7. 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

8. Distance travelled in the  $n^{\text{th}}$  second by a particle travelling with uniform acceleration is given by

- (A)  $S = u + \frac{a}{2}(n - 1)$                       (B)  $S = 2u + \frac{a}{2}(n - 1)$   
(C)  $S = nu + \frac{a}{2}(2n - 1)$                       (D)  $S = u + \frac{a}{2}(2n - 1)$

9. An automobile having a mass 1500 kg deflects its spring by 5 cms under its dead weight. The natural frequency of the car in vertical direction in Hz will be,

- a) 2.229                      b) 4.29                      c) 3.784                      d) 5.626

10. 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)  $D/d$

### **Section B**

Five Questions of 02 Marks each

11. Differentiate between a truss and a frame

12. Obtain a relation between the linear acceleration ' $a$ ' and angular acceleration ' $\alpha$ ' of a body

13. Write the statements of the Pappu's Guldinus Theorems

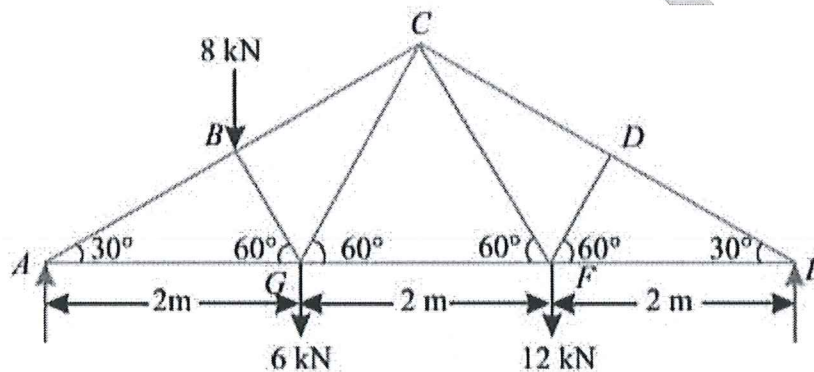
14. What is self-locking condition in simple machines?

15. State the mathematical expression for equivalent stiffness of helical springs connected in (a) series and (b) parallel using diagrams as required

### Section C

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

16. An inclined truss shown in Figure is loaded as shown:



Determine the nature and magnitude of the forces in the members BC, GC and GF of the truss by using Method of Sections.

17. A screw jack has square threaded screw of 5 cm diameter and 1 cm pitch. The coefficient of friction at the screw thread is 0.15. Find the force required at the end of a 70 cm long handle to raise a load of 2000 N. What is the force required if the Screw Jack is considered to be an Ideal Machine.

18. Determine the polar moment of inertia and radius of gyration of the Composite section as shown in Figure about centroidal z-axis

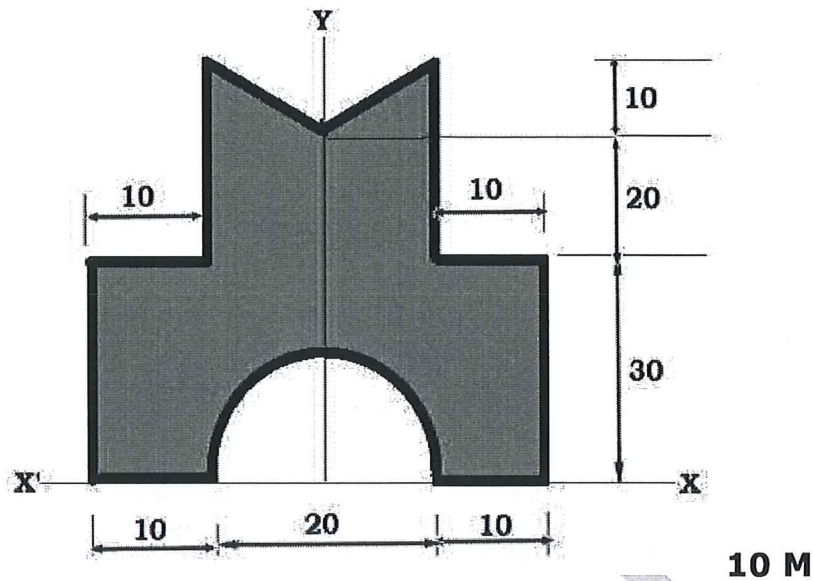


Fig.

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. A train moves along a straight line and its acceleration 'a' which varies with time 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 train was at 85 meters from the origin. Determine

- Its acceleration and velocity at the time of start (4)
- Distance from the origin at the start of observations (4)
- The time after start of observation in which the velocity becomes zero (2)

21. (a) Derive the expression for Moment of Inertia of a hollow circular section about its diameter when the center of the main circular section as well as that of the cut out circular section coincides with each other. (7)

(b) A hollow circular section has an external diameter of 80 mm and internal diameter of 60 mm. Find its Moment of Inertia about the horizontal axis passing through its center. (3)

22. Determine natural frequency and time period of a torsional pendulum which is a shaft-rotor system with the following dimensions:

Length of the shaft = 1m; Diameter of the shaft = 5 mm;

Diameter of the rotor = 2m; Mass of the rotor = 2 kg;

Modulus rigidity of the shaft material may be assumed to be 83 GPa.

(10)

Tolani

