

December 2023

B.Tech. (RAI) IIIrd SEMESTER

Engineering Mechanics (ESC-303-RAI-21)

Time : 3 Hours]

[Max. Marks : 75

*Instructions :*

1. It is compulsory to answer all the questions (1.5 marks each) of Part-A in short.
2. Answer any four questions from Part-B in detail.
3. Different sub-parts of a question are to be attempted adjacent to each other.
4. Any missing data can be assumed after proper justification.

**PART-A**

1. (a) Two forces P and Q act on a bolt A are shown as in fig 1. Determine their resultant (1.5)

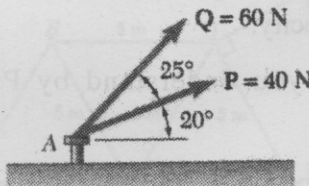


Fig. 1

- (b) What is Polygon Law of Forces to find out resultant? (1.5)

- (c) Write two differences between Vector and Tensor. (1.5)
- (d) A plane lamina of 220 mm radius is shown in figure 2. Find its centroids. (1.5)

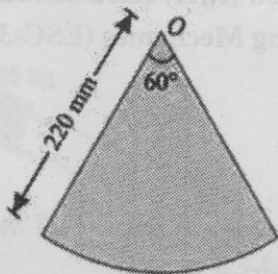


Fig. 2

- (e) What is Lami's Theorem? (1.5)
- (f) What do you understand by perfect frame? (1.5)
- (g) What do understand by Conservation of Angular Momentum? (1.5)
- (h) Write the law of the work and energy conservation. (1.5)
- (i) A body is rotating with 120 rpm at 5 m radius. Find its linear velocity. (1.5)
- (j) What do you understand by Principle of Linear Impulse? (1.5)

### PART-B

2. (a) A machine component of length 2.5 metres and height 1 metre is carried upstairs by two men, who hold it by the front and back edges of its lower face. If the machine

component is inclined at  $30^\circ$  to the horizontal and weighs 100 N, find how much of the weight each man supports? (5)

- (b) The body is constructed of uniform slender rod which has mass per  $f$  unit length. Determine the magnitudes of the force and moment reactions at the built-in support O.

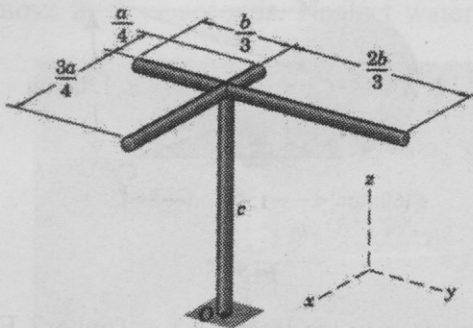


Fig. 3

3. (a) Compute the force in each member of the loaded cantilever truss by the method of joints of fig. 4 (10)

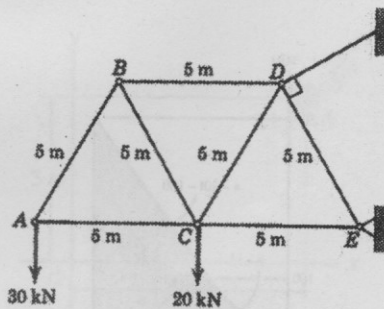


Fig. 4

(b) Determine the distance from the base of a triangle of altitude  $h$  to the centroid of its area. (5)

4. (a) A solid consists of a right circular cylinder and a hemisphere with a cone cut out from the cylinder as shown in Fig. 5. Find the centre of gravity of the body. (10)

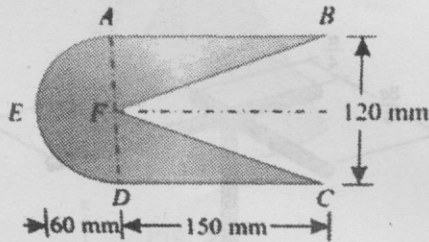


Fig. 5

(b) What do you understand by Tensor? Explain Eigen value and principal axes. (5)

5. (a) A bicycle moves along a straight road such that its position is described by the graph shown in Fig. 6. Construct the  $v-t$  and  $a-t$  graphs for  $0 < t < 30$  s. (10)

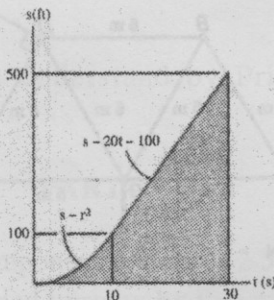


Fig. 6

(b) What do you understand by Curvilinear motion? Write equations for position, velocity and acceleration in this motion. (5)

6. (a) The 80-kg man can throw the 20-kg box horizontally at 4 m/s when standing on the ground. If instead he firmly stands in the 120-kg boat and throws the box, as shown in the fig. 7. Determine how far the boat will move in three seconds. Neglect water resistance.

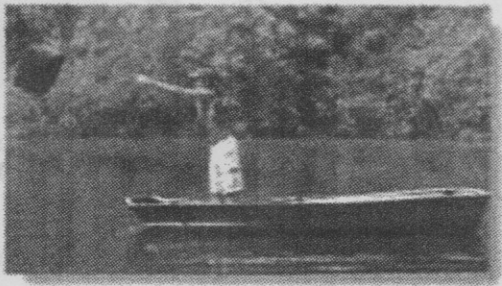


Fig. 7

(b) The 2-kg particle A has the velocity shown in fig. 8. Determine its angular momentum  $H_o$  about point O. (5)

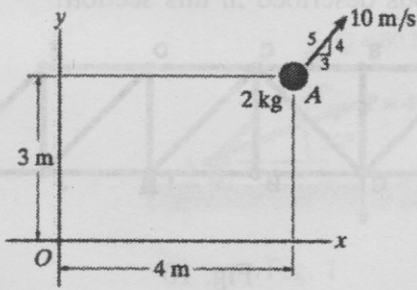


Fig. 8

7. (a) Two bodies A and B are connected by a light inextensible cord as shown in fig. 9. If both the bodies are released simultaneously, what distance do they move in 3 seconds? Neglect friction between the two bodies and the inclined surfaces. (10)

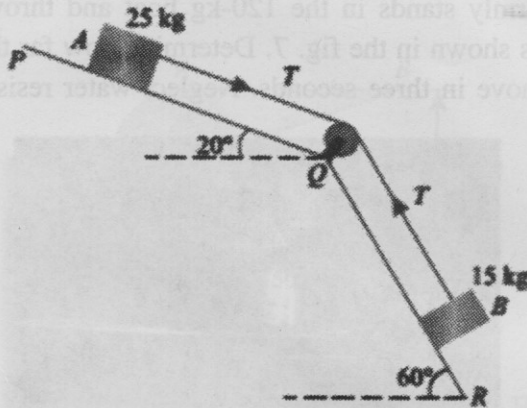


Fig. 9

- (b) In the truss shown in fig. 10, how many zero force members can be immediately identified using the methods described in this section? (5)

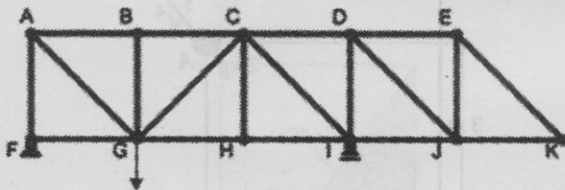


Fig. 10