

B.Tech. 3rd Semester (G-Scheme) Examination,**December-2024****ENGINEERING MECHANICS****Paper-ESC-ME-209-G****Time allowed : 3 hours] [Maximum marks : 75**

Note : Attempt any five questions in total, at least one question from each section. Question No. 1 is compulsory.

1. Explain following :

- (a) Dimensional homogeneity
 - (b) Concurrent force
 - (c) Fixed beam
 - (d) Polar moment of inertia
 - (e) Centre of mass
 - (f) Method of joint
- $6 \times 2.5 = 15$**

Section-A

2. (a) The following forces act at a point :

- (i) 20 N inclined at 30° towards North of East,
- (ii) 25 N towards North,
- (iii) 30 N towards North-West, and
- (iv) 35 N inclined at 40° towards South of West.

Find the magnitude and direction of the resultant force. 8

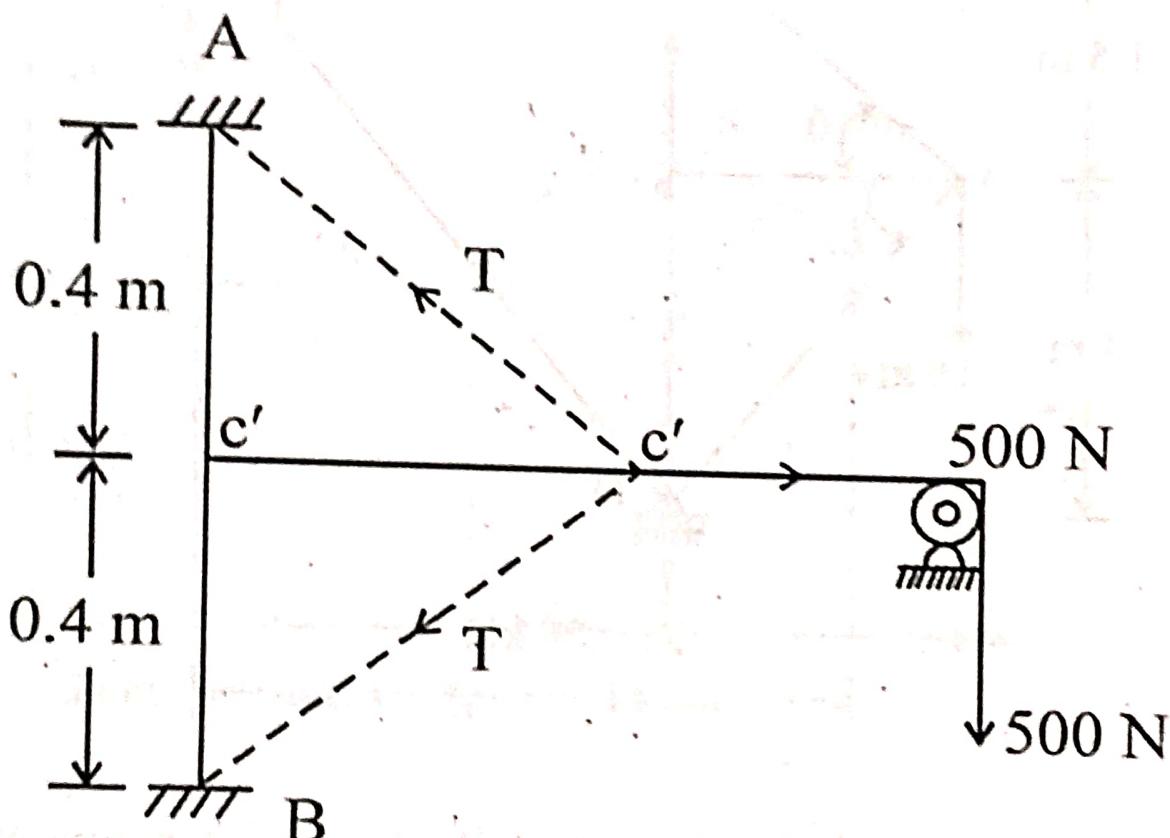
(b) ABCD is a rectangle, such that $AB = CD = a$ and $BC = DA = b$. Forces equal to P act along AD and CB and forces equal to Q act along AB and CD respectively. Prove that the perpendicular distance between the resultants of P and Q at A and that of P and Q at C

$$= \frac{(P \times a) - (Q \times b)}{\sqrt{P^2 + Q^2}}$$

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3. An elastic string AB is just taut before a force of 500 N is applied at its centre. If the string takes 4 N/mm of elongation of the string, at what angle (α), equilibrium will be maintained after the application of 500 N force as shown in figure.

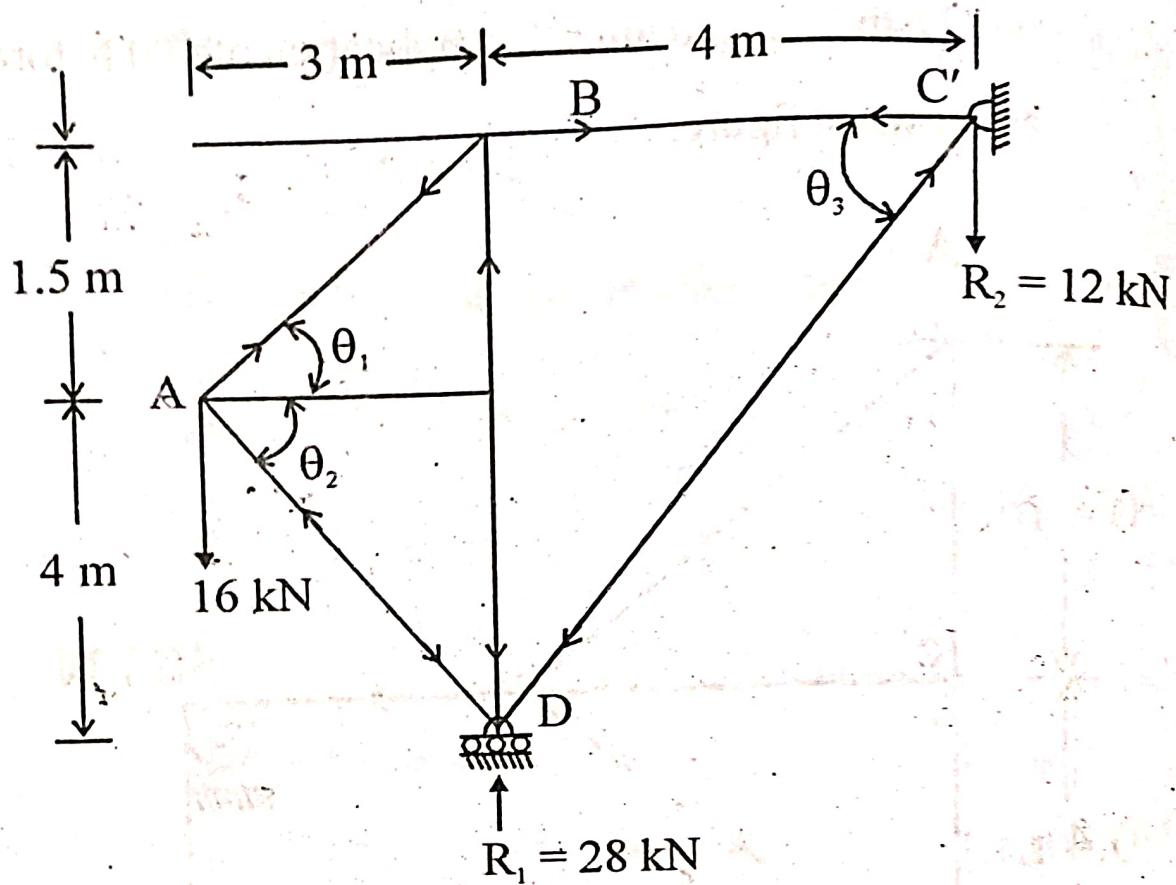
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**Section-B**

4. Figure shows a truss ABCD hinged at C and roller supported at D, carrying a vertical load of 16 kN

at A. Determine reaction forces in the members of the truss.

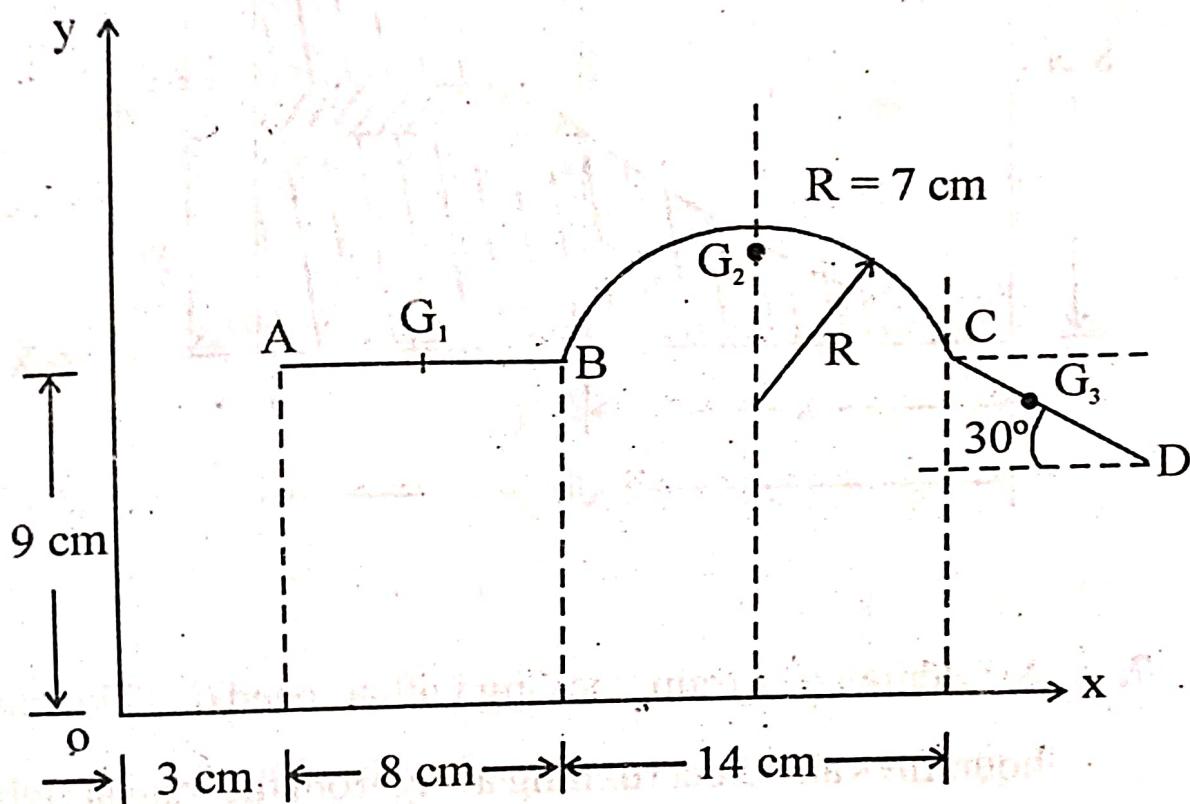
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5. Figure shows a composite line with segments AB = 8 cm (parallel to ox), BC = a semi circle of radius 7 cm and CD = 8 cm, a straight line segment inclined at

angle 30° to axis ox. Determine the position of the centroid of the composite line. Co-ordinates of point A are (3, 9).

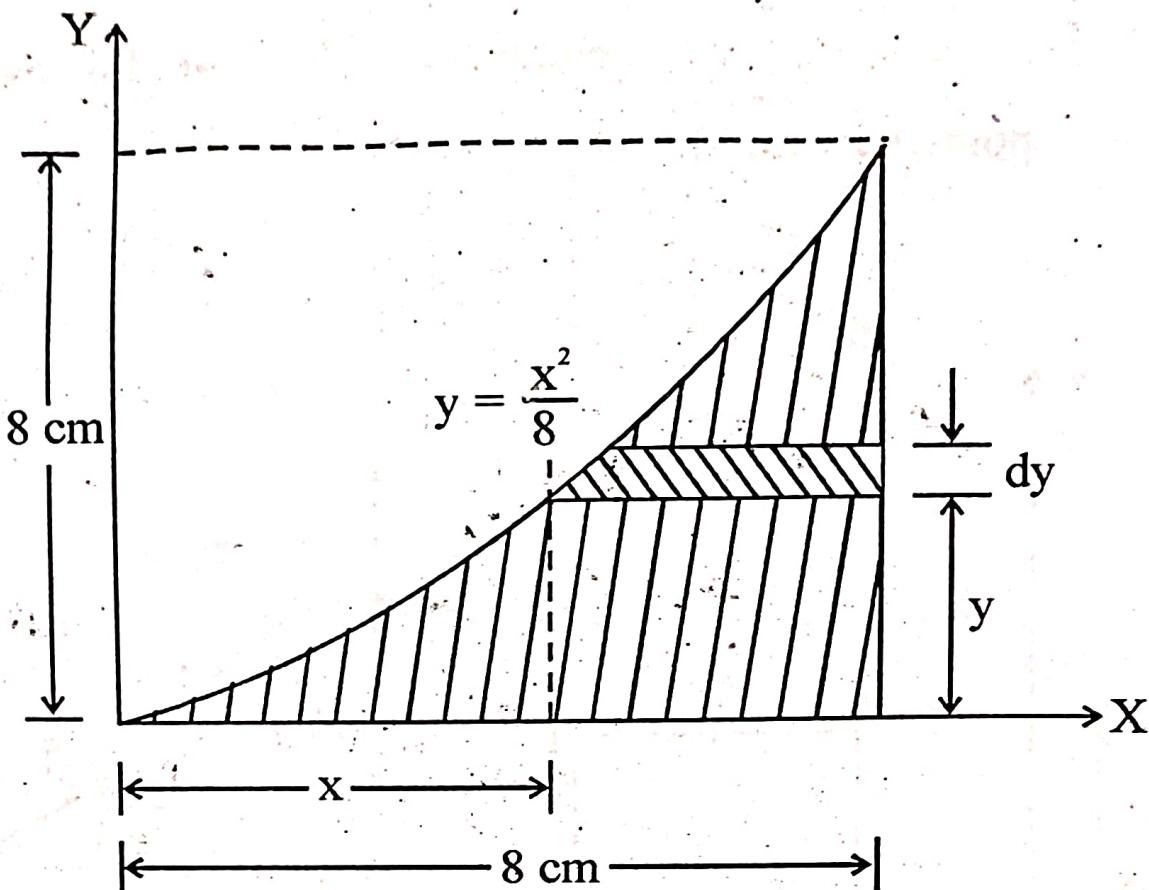
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**Section-C**

6. A parabolic curve is shown in figure. For the shaded area, determine I_{xx} and I_{yy} .

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[P.T.O.]



7. A rifleman on a train, moving with a speed of 52 km per hour, fires an object running away from the train at right angle with a speed of 39 km per hour. The line connecting the man and the object makes an angle of 30° to the train at the instant of shooting. At what angle to the train should he aim in order to hit the object, if the muzzle velocity is 200 m/s ?

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Section-D

8. A particle is thrown with a velocity of 5 m/s at an elevation of 60° to the horizontal. Find the velocity of another particle thrown at an elevation of 45° which will have (a) equal horizontal range, (b) equal maximum height, and (c) equal time of flight. 15
9. A beam ABC, 5 m long, free at end A and fixed at end C carries a uniformly distributed load of 15 kN/m run from the point B (1 m from end A) up to point C. Draw the shear force and bending moment diagram for the cantilever. 15