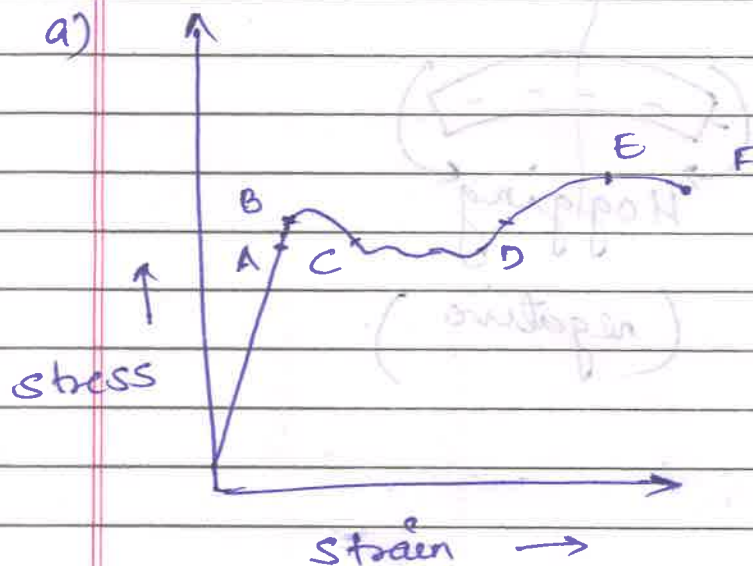


Q.1



b) Assumpⁿ in simple bending:

1. plane sections of beam, originally plane, remain plane.

2. The material of beam is homogeneous & obeys Hooke's law.

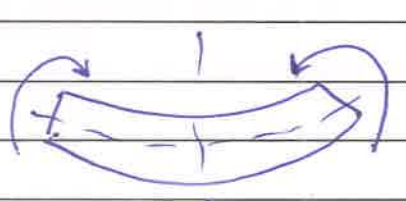
3. The modulus of elasticity for tension & compⁿ are equal.

4. The beam is initially st. & of const. c/s.

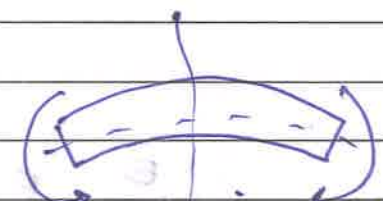
5. ---

Bending eqⁿ :
$$\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$$

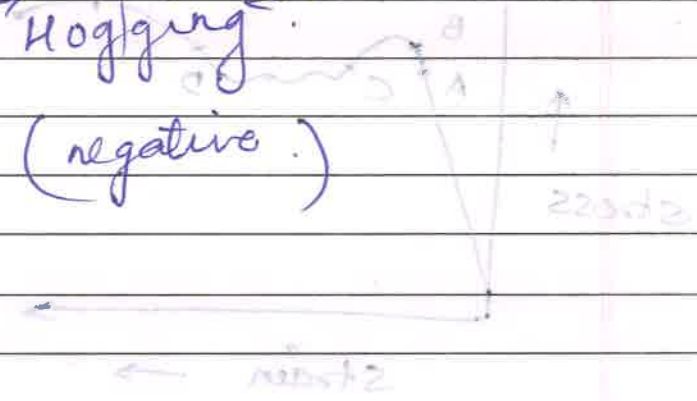
Q.1
c)



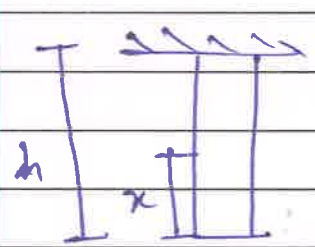
Sagging
(+ positive)



Hogging
(negative)



Q.1
d)



Q.1
e)

$$\frac{\tau}{J \cdot l} = \frac{C \theta}{L} = \frac{z}{r} \cdot \frac{M}{I}$$

The modulus of elasticity for tension & compression are equal. The beam is initially straight.

$$E = \frac{\sigma}{\epsilon} = \frac{M}{I} \cdot \frac{I}{r}$$

Q. 2

a)

$$P = \frac{2TNT}{60 \times 10^3}$$

$$T = 35810 \text{ Nm}$$

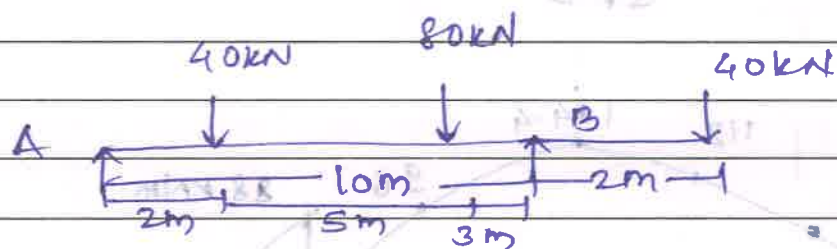
$$T_{\max} = 1.2 \times 35810 \\ = 42972 \text{ Nm}$$

$$Z_p = \frac{T_{\max}}{\tau}$$

$$d = 58.11 \text{ mm}$$

$$D = 137 \text{ mm}$$

b)



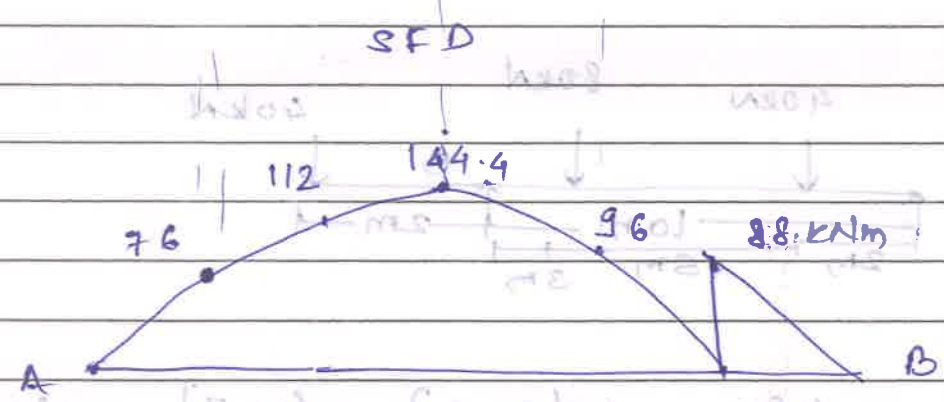
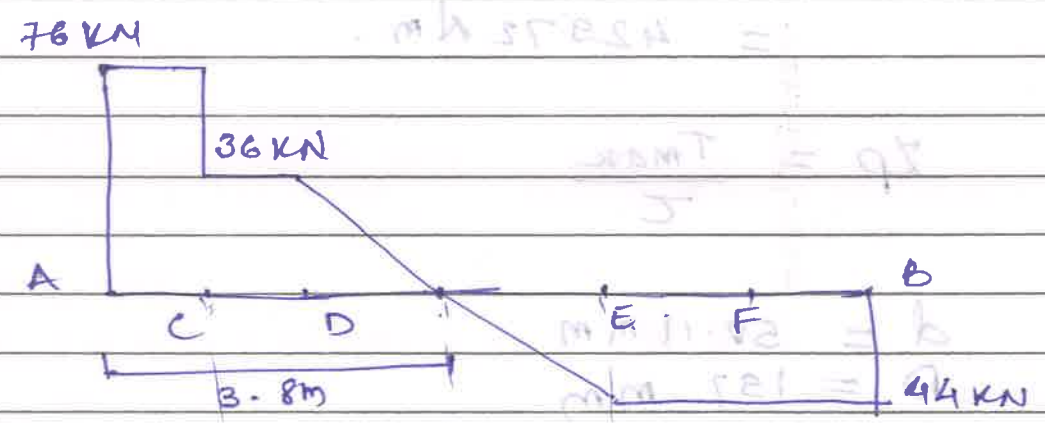
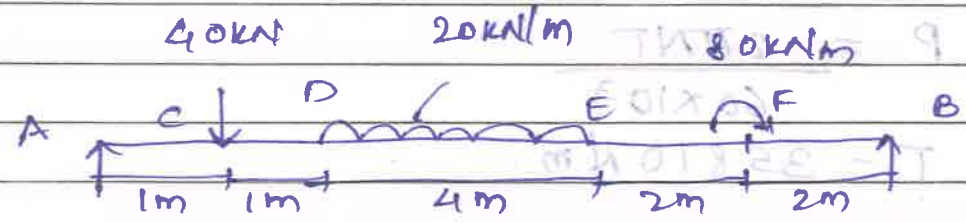
$$M_x = 48x - 40(x-2) - 80(x-7) + 112(x-10)$$

$$y_c = \frac{781.34}{EI}$$

$$y_D = \frac{1048.23}{EI}$$

$$y_E = -\frac{568}{EI}$$

Q.3
a)



BMD

$$R_A(x) - (40-x) + (20-x)(x-2) - (80-x)(x-6) = 0$$

$$R_A \cdot x - 40x + 40 + 20x^2 - 40x - 40 + 80x - 480 + 480 - 80x + 480 - 480 = 0$$

$$20x^2 - 40x + 40 - 40x + 480 - 480 = 0$$

$$20x^2 - 80x + 40 = 0$$

$$x^2 - 4x + 2 = 0$$

$$x = \frac{4 \pm \sqrt{16 - 8}}{2} = \frac{4 \pm \sqrt{8}}{2} = 2 \pm \sqrt{2}$$

$$x = 2 + 1.414 = 3.414 \text{ m}$$

Q.3

b)

$d = 152.8 \text{ mm}$ — solid shaft.

$D = 164.4 \text{ mm}$ or

$\theta = \frac{T}{GJ}$
 180×10^3

$\theta = \frac{T}{GJ}$

$D = 158.8 \text{ mm}$

$d = 148 \text{ mm}$ $D = 164.4 \text{ mm}$
--

Q.4

a)

increase in vol^m = 325 mm^3

$\sigma = 0.8 \times 10^5 \text{ N/mm}^2$

$\nu = 1.33 \times 10^{-5} \text{ N/mm}^2$

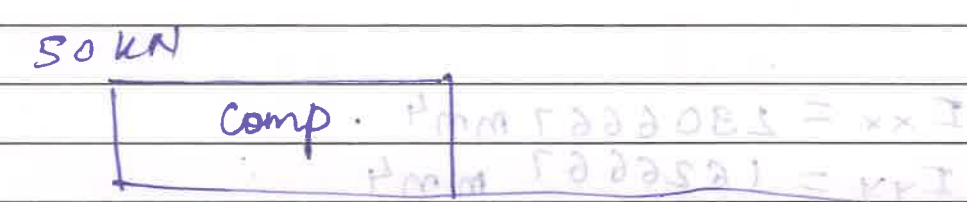
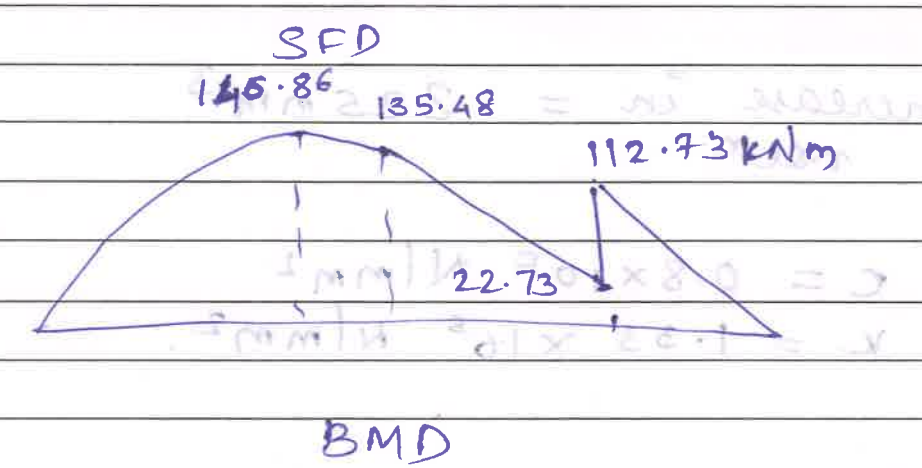
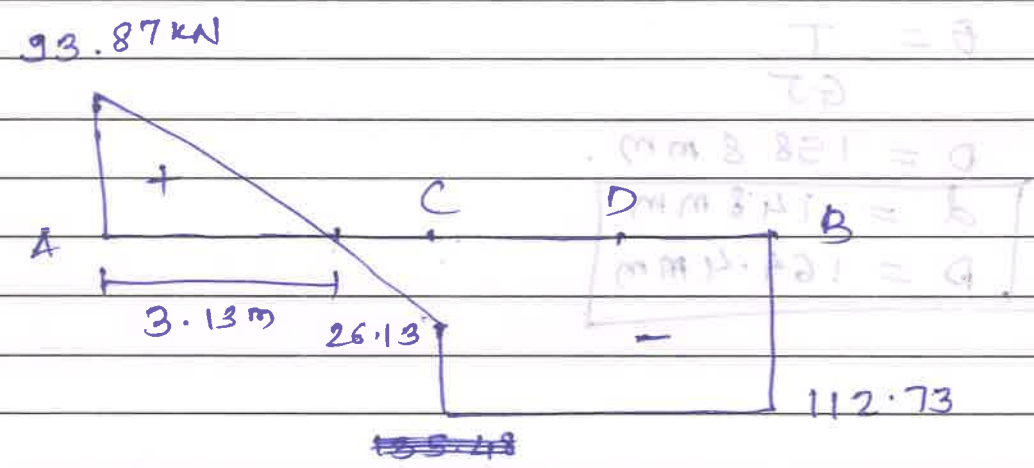
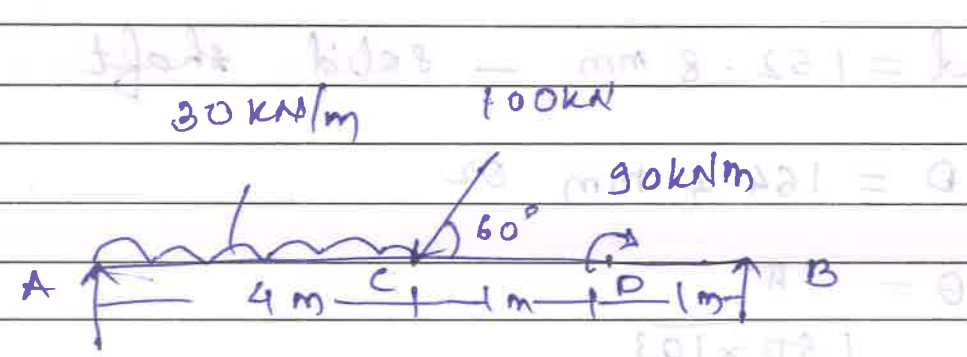
Q.4

b)

$I_{xx} = 2906667 \text{ mm}^4$

$I_{yy} = 1626667 \text{ mm}^4$

Q.5
a)



axial force dia.

Q.5

b)

$$T = 35810 \text{ Nm}$$

$$T_{\max} = 1.2 \times 35810 \\ = 42972 \text{ Nm}$$

$$d = 58.11 \text{ mm}$$

$$\frac{T}{I_p} = \frac{C\theta}{x}$$

$$d = 58.74 \text{ mm}$$

$$\therefore D = 157 \text{ mm.}$$

Q.6

b)

$$\sigma_s = 169.04 \text{ N/mm}^2$$

$$\sigma_c = 84.52 \text{ N/mm}^2$$

$$l = 340.526 \text{ mm.}$$

$$T = 32810 \text{ Nm}$$

2.9
(d)

$$T_{max} = 1.5 \times 32810$$

$$= 49215 \text{ Nm}$$

$$b = 28.11 \text{ mm}$$

$$\frac{D}{T} = \frac{1}{41}$$

$$b = 28.11 \text{ mm}$$

$$D = 1157 \text{ mm}$$

$$D = 162.07 \text{ mm}$$

2.9
(d)

$$D = 84.25 \text{ mm}$$

$$r = 340.25 \text{ mm}$$

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