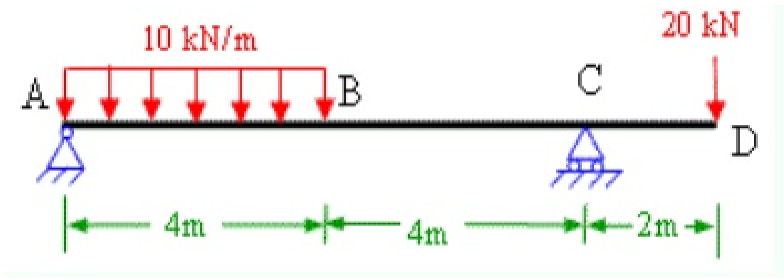
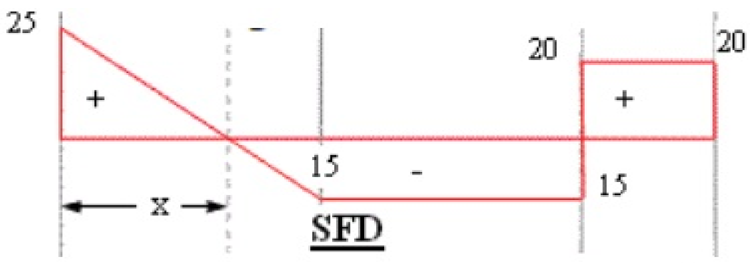
MoS ESE – Dec 2022 - Solution

Q1. a Theory 6 marks

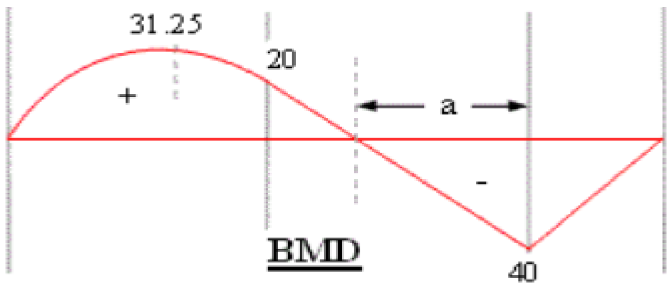
Q1. b $\mu = 0.25$ 3 marks , $K = 0.8 \times 10^5$ N/mm^2 4 marks

Q1.C.





3 marks



4 marks

Q2. a thory 4 marks

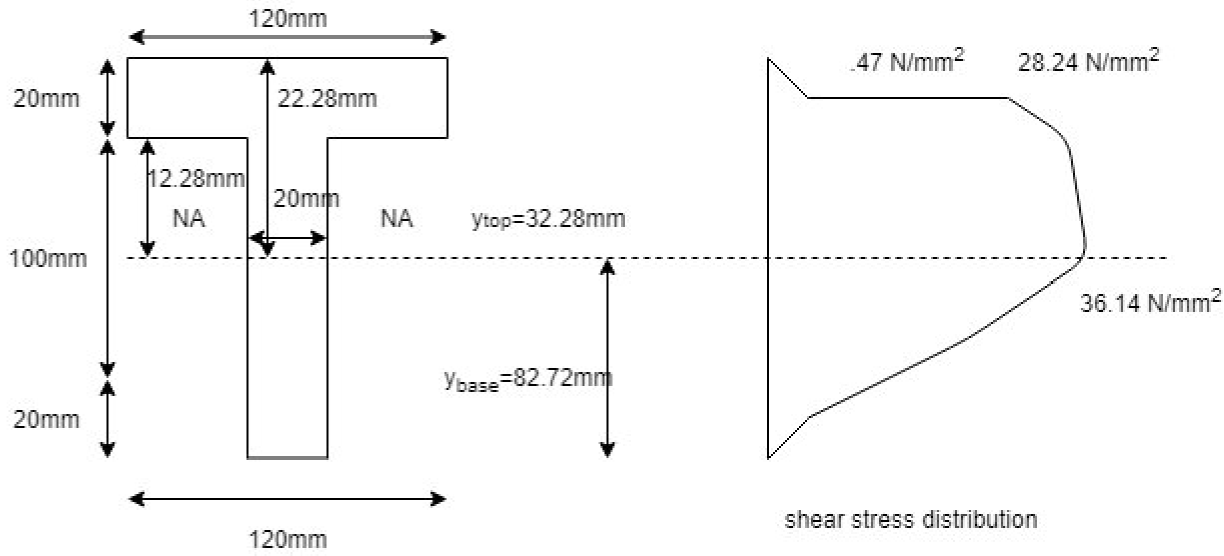
Q2. b.

Solution:
Calculation of bending moment for the above condition
$M = wL^2/8$
$= w\,(8)^2/8$
$= 8wX10^6$ 2 marks

Calculation of moment of inertia
$I = bd^3/12$
$= (300)\,(200^3)\,/12$
$= 2X10^8$ mm^4 2 marks

Calculation of Udl
$M/I = \sigma / y$
Substitute for above (where y = depth /2= 200/2 =100mm)
$8wX10^6 / 2X10^8 = 120 / 100$
$w = 3X10^4$ N/m or 30 N/mm^2 2 marks

Q3. a Theory
Q3. b



Q 4. a Theory 5 marks

Q. 4. B

σ_n = 65 N/mm², σ_t = 60.62 N/mm², σ_r = 60.62 N/mm² 5 marks

Q. 4 C

Given $\sigma_x = 60 \text{ N/mm}^2$

$\sigma_y = 20 \text{ N/mm}^2$

$\tau_{xy} = -26 \text{ N/mm}^2$

On substituting in Eq. (5.6), we get

$$\sigma_{1,2} = \frac{60+20}{2} \pm \sqrt{\left(\frac{60-20}{2}\right)^2 + (-26)^2}$$

$$= 40 \pm 32.8$$

$\therefore \quad \sigma_1 = 72.8 \text{ N/mm}^2$ and $\sigma_2 = 7.2 \text{ N/mm}^2$

Again substituting the values σ_x, σ_y and τ_{xy} in Eq. (5.2).

$$\tan 2\phi = \frac{2\tau_{xy}}{\sigma_x - \sigma_y}$$

$$= \frac{2 \times (-26)}{60-20} = -1.3$$

Since θ is general angle, the specific angles representing the principal planes are designated as ϕ_1 and ϕ_2.

$$\therefore \; 2\phi = -52.43^\circ, 127.57^\circ$$

using $2\phi = -52.43^\circ$

$$\sigma_n = \frac{60+20}{2} + \frac{60-20}{2} \cos(-52.43^\circ) - 26 \sin(-52.43^\circ).$$

$$= 72.8 \text{ N/mm}^2$$

Hence, we recognise that $\phi_1 = \frac{-52.43^\circ}{2}$ defines the major principal plane and

therefore, $\phi_2 = \frac{127.57^\circ}{2}$ should define the minor principal plane.

5 marks