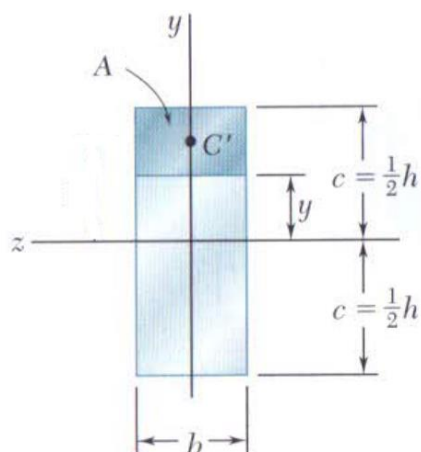


Mechanics of Materials (I)

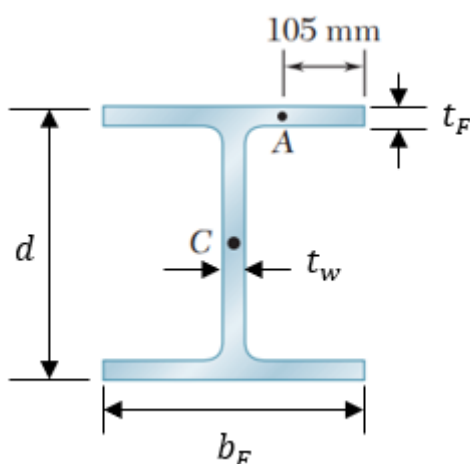
Exam III (6/24/2021)

1. (15%) (a) Consider a narrow rectangular beam subjected to a shear force V . Determine where the maximum shearing stress will be occurred.
 (b) Give an example for which plane stress condition can be used
 (c) Fixed supports only prevent rotation. (True/False)
 (d) Roller supports only prevent translation in vertical direction. (True/False)
 (e) $EIy''' = -q$ (True/False)

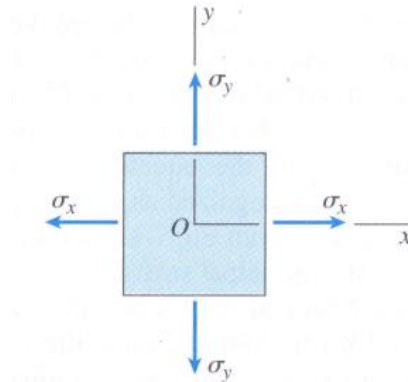
2. (10%) Determine the first moment with respect to the neutral axis of the shaded area A and the shearing stress at any point of the cross section.



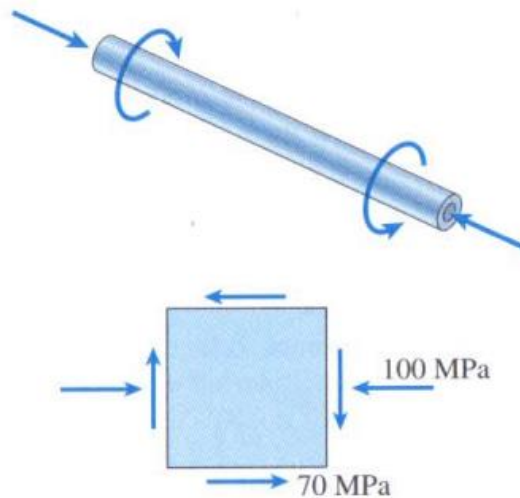
3. (18%) Knowing that a $W360 \times 122$ rolled-steel beam is subjected to a 250-kN vertical shear, determine the shearing stress at the centroid C of the section. ($d = 363$ mm, $b_F = 257$ mm, $t_F = 21.70$ mm, $t_w = 13.0$ mm, $I = 367 \times 10^{-6} m^4$)



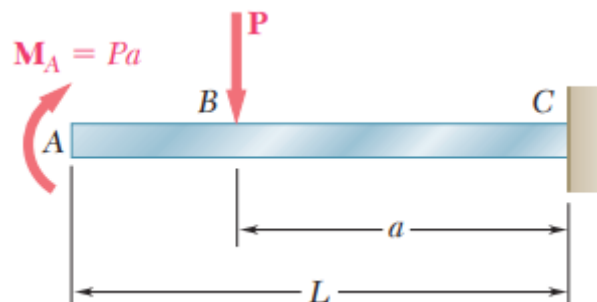
4. (10%) Suppose an element is subjected to a biaxial stress as shown in the figure. Construct the corresponding Mohr's circle and determine the maximum shear stress ($\sigma_y > \sigma_x > 0$).



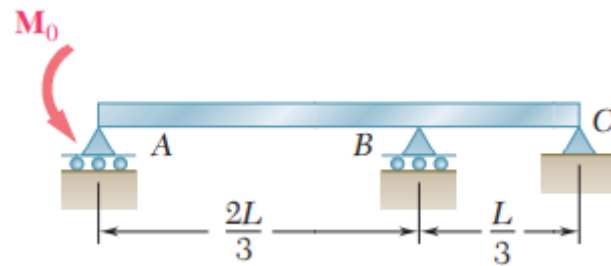
5. (20%) A propeller shaft subjected to combined torsion and axial thrust is designed to resist a shear stress of 70 MPa and a compressive stress of 100 MPa (see figure). Determine the principal stresses and show them on a sketch of a properly oriented element.



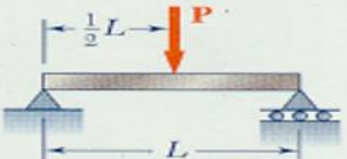
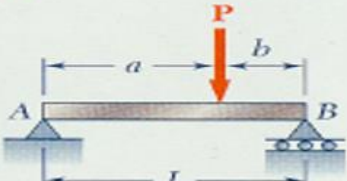

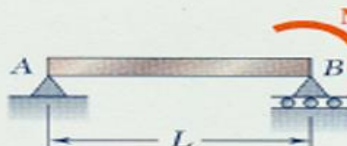
6. (12%) For the cantilever beam and loading shown, determine the slope and deflection at the free end.



7. (15%) For the uniform beam shown, determine the reaction at each of the three supports



Beam and Loading	Equation of Elastic Curve
<p>5</p>	<p>For $x < a$:</p> $y = \frac{Pb}{6EI} [x^3 - (L^2 - b^2)x]$ <p>For $x = a$: $y = -\frac{Pa^2b^2}{3EI}$</p>
<p>6</p>	$y = -\frac{w}{24EI} (x^4 - 2Lx^3 + L^3x)$
<p>7</p>	$y = -\frac{M}{6EI} (x^3 - L^2x)$

Beam and Loading	Equation of Elastic Curve
<p>4</p> 	<p>For $x \leq \frac{1}{2}L$:</p> $y = \frac{P}{48EI} (4x^3 - 3L^2x)$
<p>5</p> 	<p>For $x < a$:</p> $y = \frac{Pb}{6EIL} [x^3 - (L^2 - b^2)x]$ <p>For $x = a$: $y = -\frac{Pa^2b^2}{3EIL}$</p>
<p>6</p> 	$y = -\frac{w}{24EI} (x^4 - 2Lx^3 + L^3x)$
<p>7</p> 	$y = -\frac{M}{6EIL} (x^3 - L^2x)$