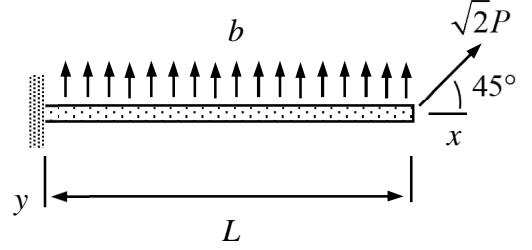


Name _____ Student number _____

Assignment 3 (4p)

Consider the xy – plane beam of length L shown. Material properties E and G , cross-section properties A , I are constants, and $S = 0$. Write down the boundary value problem according to the Bernoulli beam model in terms of axial displacement $u(x)$ and transverse displacement $v(x)$. Start with the generic equilibrium and constitutive equations of the Timoshenko beam model



$$\left\{ \begin{array}{l} \frac{dN}{dx} + b_x \\ \frac{dQ_y}{dx} + b_y \\ \frac{dQ_z}{dx} + b_z \end{array} \right\} = 0, \quad \left\{ \begin{array}{l} N \\ Q_y \\ Q_z \end{array} \right\} = \left\{ \begin{array}{l} EA \frac{du}{dx} - ES_z \frac{d\psi}{dx} + ES_y \frac{d\theta}{dx} \\ GA \left(\frac{dv}{dx} - \psi \right) - GS_y \frac{d\phi}{dx} \\ GA \left(\frac{dw}{dx} + \theta \right) + GS_z \frac{d\phi}{dx} \end{array} \right\}$$

$$\left\{ \begin{array}{l} \frac{dT}{dx} + c_x \\ \frac{dM_y}{dx} - Q_z + c_y \\ \frac{dM_z}{dx} + Q_y + c_z \end{array} \right\} = 0, \quad \left\{ \begin{array}{l} T \\ M_y \\ M_z \end{array} \right\} = \left\{ \begin{array}{l} -GS_y \left(\frac{dv}{dx} - \psi \right) + GS_z \left(\frac{dw}{dx} + \theta \right) + GI_{rr} \frac{d\phi}{dx} \\ ES_y \frac{du}{dx} - EI_{zy} \frac{d\psi}{dx} + EI_{yy} \frac{d\theta}{dx} \\ -ES_z \frac{du}{dx} + EI_{zz} \frac{d\psi}{dx} - EI_{yz} \frac{d\theta}{dx} \end{array} \right\}$$