

MECH 463 -- Tutorial 12

1. A uniform rod of cross-section area A is made of a material with Young's modulus E and mass density ρ . Formulate the wave equation for longitudinal vibrations of the rod.



2. A uniform beam of length L , flexural rigidity EI , mass density ρ and cross-section area A is rigidly fixed at both ends. Using a method parallel to the method used in class for a stretched string, solve the wave equation for a beam undergoing transverse vibrations:

$$\frac{\partial^2 u}{\partial t^2} + c^2 \frac{\partial^4 u}{\partial x^4} = 0$$

where $c = \sqrt{EI/\rho A}$. Derive an equation to determine the natural frequencies of vibration. (Hint: the solution for this 4th-order equation has both trigonometric and hyperbolic terms.)

