Welcome to PHYS 211 PLT

Topics for Today

1. Waves

2. Fluid Dynamics and Statics

1. Waves

General Wave Equation

The wave equation is a multivariable function of position with variables of position in another axis and time.

$$y(x,t) = A\cos(kx - \omega t)$$

Governing Differential Equation

$$\frac{\partial^2 f}{\partial x^2} - \frac{1}{v^2}\frac{\partial^2 f}{\partial t^2} = 0$$

Parameters of the Wave Equation

$$y(x,t) = A\cos(kx - \omega t)$$

$$k = 2\pi/\lambda \qquad \omega = 2\pi f \qquad v = \lambda f = \omega/k$$

K is not the Spring Constant!

If the sign between the cosine in the equation is negative, the wave is moving to the right.
If the sign between the cosine in the equation, the wave is moving to the left

Wave Energy

Recall:

$$y(x,t) = A\cos(kx - \omega t)$$

This equation represents the position of an element on the string. Since this position is dependent on time, there exists a velocity equation. Therefore, any element of the string has a kinetic energy.

$$K_{max} \propto \omega^2 A^2$$

String Speed

$$v_{wave} = \sqrt{\frac{T}{\mu}}$$

2. Fluid Dynamics and Statics

What is Fluid Dynamics

Fluid Dynamics is Newton's Second Law (F=ma) applied to Fluids

Key Ideas:

- Bernoulli's Equation
- Hydrostatic Pressure
- Buoyant Force

Pressure

$$p = \frac{F}{A}$$

Pressure is the inverse relation of Force and Area

(Common Unit is the Pa)

Hydrostatic Pressure

$$P_2 - P_1 = \rho g h$$

Note that the change in pressure is only dependent upon height

Bernoulli's Expression

$$p_1 + \frac{1}{2}\rho v_1^2 + \rho g y_1 = p_2 + \frac{1}{2}\rho v_2^2 + \rho g y_2$$

Bernoulli's Equation equates the sum of the fluid pressures between two points along the motion of the fluid.
ρ = Density of the Fluid (997 kg/m^3 for water)
g = Gravitational Constant
v = Fluid Velocity

Conservation of Flow Rate

$$A_1 v_1 = A_2 v_2$$