Exam 4 Study Tips

1. Stress and Stain

$$\Delta p = -Y\frac{\Delta l}{l} \qquad \Delta p = -B\frac{\Delta V}{V} \qquad \Delta p_{II} = -S\theta$$

(where $\Delta p = \frac{F_{perpendicular}}{A}$ and $\Delta p_{II} = \frac{F_{parallel}}{A}$)

B = Bulk modulus, Y = Young's modulus, S = Shear modulus

3. Oscillations

Definition of harmonic oscillator ($F = -kx$)

$T = 1/f$

Circular frequency $\omega = 2\pi f$

$$\omega_{pendulum} = \sqrt{\frac{g}{L}} \qquad \omega_{spring} = \sqrt{\frac{k}{m}}$$

Resonance (when it occurs)

2. Waves

$v = \lambda f$ i.e. velocity = wavelength x frequency

Principle Superposition

Pulse Reflection (inverted reflection from restricted boundary, not inverted from unrestricted boundary)

Speed of Sound in a Medium: $v = \sqrt{\frac{Stiffeness}{\rho}}$

string: $v = \sqrt{\frac{T}{\mu}}$ fluid: $v = \sqrt{\frac{B}{\rho}}$ solid rod: $v = \sqrt{\frac{Y}{\rho}}$

T = tension in string, B = Bulk modulus, Y = Young's modulus
μ = linear density = (string mass) / (string length)
ρ = density

Standing Waves

Definitions of node and antinode

Harmonics

Object	Both Ends Restricted	One end restricted	Neither End restricted
string	$f_n = \frac{nv}{2L}$ n=1, 2, 3,...	$f_n = \frac{nv}{4L}$ n=1, 3, 5, …	$f_n = \frac{nv}{2L}$ n=1, 2, 3, …
tube	$f_n = \frac{nv}{2L}$ n=1, 2, 3,...	$f_n = \frac{nv}{4L}$ n=1, 3, 5, …	$f_n = \frac{nv}{2L}$ n=1, 2, 3, …

Tube: restricted end = closed end. unrestricted end = open end
String: restricted end = fastened end. unrestricted end = loose end.

Doppler Effect

$$f_L = \left(\frac{v + v_L}{v - v_S} \right) f_S$$

where

$v_S > 0$ if source approaches listener
$v_L > 0$ if listener approaches source

Beat frequency = $|f_1 - f_2|$

3. Fluid Mechanics

Pressure

$$P = \frac{F_\perp}{A}$$

Gauge Pressure = pressure – (atmospheric pressure)
Barometer (determine height of fluid in)
Units

Pascal's Law and its application

$$\Delta P = \rho g \Delta h$$

Archimedes' Principle

Bouyant force (determine fraction of floating object that is submerged)

Specific gravity (condition for floating)

Continuity of Fluid Flow

Bernoulli's Equation

Poiseuille's Law

Surface Tension