ECE 473
Homework Assignment #2
Due: Friday, September 14, 2018

1. A mass of 10 kg hanging on a spring is pulled down a distance of 0.1 m and then released. The mass then oscillates with decreasing amplitude to 1/e of its initial value in 0.333 s. If s = 100 N/m, then determine the displacement $x = Ae^{-\beta t}\cos(\omega_d t+\phi)$ by providing values for the parameters A, β, ω_d, and ϕ.

2. Problem 1.4.2 in Kinsler et al.

3. Consider a wave with displacement y = 0.5 cos(50t+25x) m propagating on a string of linear density 0.005 kg/m, where x and t are in m and s, respectively. What are the (a) displacement amplitude, (b) phase speed (wave propagation speed) and direction, (c) frequency, (d) wavelength, (e) wave number, (f) tension in the string, (g) displacement at x = 1 m and t = 2 s and (h) particle speed at x = 3 m and t = 2 s?

4. Problem 2.8.2 in Kinsler et al. (show all work). An infinite string ($-\infty < x \leq 0$) of linear density ρ_L and under tension T is attached at x = 0 to a second infinite string ($0 < x < \infty$) under the same tension but of linear density $1.5\rho_L$. If a wave of angular frequency ω and amplitude A is traveling in the +x direction on the first string, find the amplitude of the wave traveling on the second string.

5. Variation of Problem 2.3.1 in Kinsler et al. (show all work). What forms do the equations of motion for an idealized string take if either (a) the linear density varies with position, or (b) the string hangs vertically supported only at the upper end? (c) Determine the phase speed of the wave on the string if $\rho_L = \rho_L(x) = \rho_L\left[\varepsilon + \left|\cos\left(\pi \frac{x}{L}\right)\right|\right]$ and the location of maximum phase speed on the string.

6. A string of density 0.04 kg/m is stretched with a tension of 1.5 N from a rigid support at x = 0.675 m to a device producing transverse periodic vibrations at the input to the string (x = 0). At a particular driving frequency and amplitude the nodes are spaced 0.15 m apart and the maximum amplitude is 0.08 m. Determine the (a) driving frequency and (b) amplitude of the vibration. (c) If the string tension is increased by 10%, determine the new spacing between nodes.

Note to graduate students taking the course for 4 credit hours: For the additional unit of credit, you are required to write a paper (typically about 8-10 pages, double spaced) that discusses in some detail any topic on acoustics for which the fundamentals of engineering acoustics are explicitly described (this should be a Typed Paper on Sound or what I like to call the **TPS report**). The paper is typically a summary of some acoustic topic and based on 4-5 peer-reviewed publications. The paper will be due Dec 12, 2018. However, topic and publications must be approved by me. For the approval process, prepare a one-page outline (including 4-5 peer-reviewed references) for submission **October 26, 2018.**