Lecture II

Simple One-Dimensional Vibrating Systems

One method of producing a sound relies on a physical object (*e.g.* various types of musical instruments – stringed and wind instruments in particular) to be made to vibrate, by whatever means possible. This vibration is (clearly) mechanical in nature.

Mechanical vibration explicitly means a ***displacement*** of the (at least some portions of the) matter/material the object is comprised of ***from its equilibrium position/configuration*** – which requires the input of ***energy*** to the object in order to accomplish this – initially in the form of (static) ***potential*** energy (*P.E.*) , which as time progresses, is subsequently transformed into ***kinetic*** (motional) energy (*K.E.*). As time progresses further, the energy oscillates back and forth between potential and kinetic energy, the total energy, $E_{tot} = P.E.(t) + K.E.(t)$ remaining ***constant*** in time, if no energy losses (energy dissipation processes) are present in the mechanical system.

The mechanically vibrating object couples to the air surrounding it, transferring energy in this process - sound waves in the air are created, which propagate outwards from the source (the vibrating object) to an observer's ear(s). Thus a sound is heard (perceived). Thus, by ***energy conservation***, some of the initial energy input to the mechanically vibrating system ***is*** radiated away in the form of sound energy. Eventually the mechanically vibrating system ceases to do so, because of this, and other (frictional) dissipative energy loss mechanisms present.

A simple example of a vibrating system is a mass on a spring (a crude model of a vibrating musical instrument) which undergoes so-called 1-D simple harmonic motion:

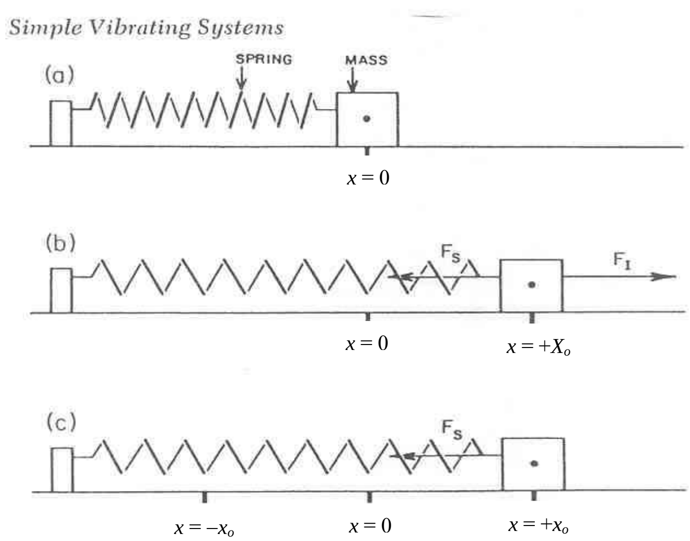

FIG. 1. A n[...] to a spring and restin[...]oth table. (a) Equilibrium position. (b) Mass displaced and held in new position. (c) Mass released.