Solution for #2.7 (Problem 2 of Problem Set #3)

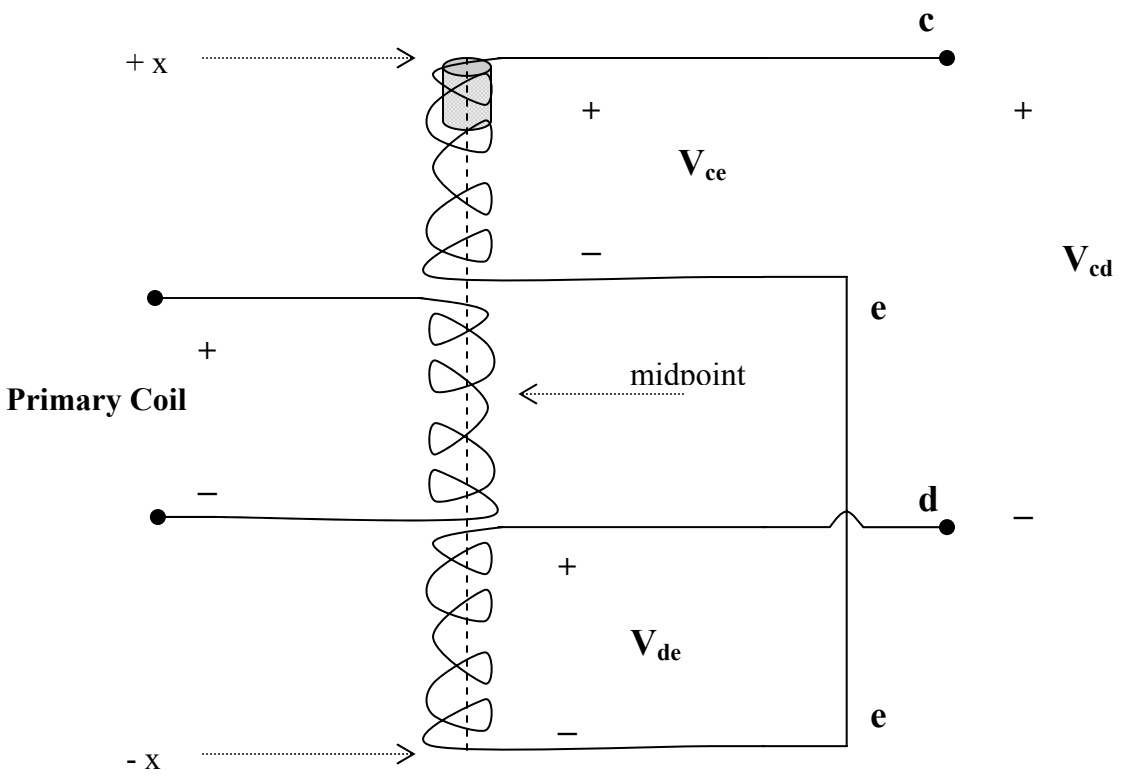

Figure 1. Diagram of LVDT with corresponding node and voltage definitions.

The LVDT is a type of transformer; therefore, the input must be varying sinusoidally in time (i.e. AC) with a specific frequency. The output will also be time varying.

The secondary coils are connected such that we know that the output voltage can be expressed as: $V_{cd} = V_{ce} - V_{de}$ (**with the node voltages defined as shown in the above figure).

In this example, I am making several assumptions to enable us to better understand what is happening:

1. The location of interest is between +x and –x.
2. The slug will move from +x at t=0 to –x at $t=t_{end}$ where t_{end} is assumed to equal 3 time periods of the AC frequency (for simplicity).

Figure 2. depicts the location of the slug with respect to time. The voltages over each of the secondary coils are shown in Figure 3. Finally, the output voltage is shown in Figure 4.

With the slug defined as moving from the upper coil towards the lower coil, the voltage over the upper coil (V_{ce}) will decrease in amplitude, and the voltage over the lower coil (V_{de}) will increase in amplitude. In short, the slug is made of magnetic material which increases the interaction between the primary coil and the secondary coil that the slug is closest to.

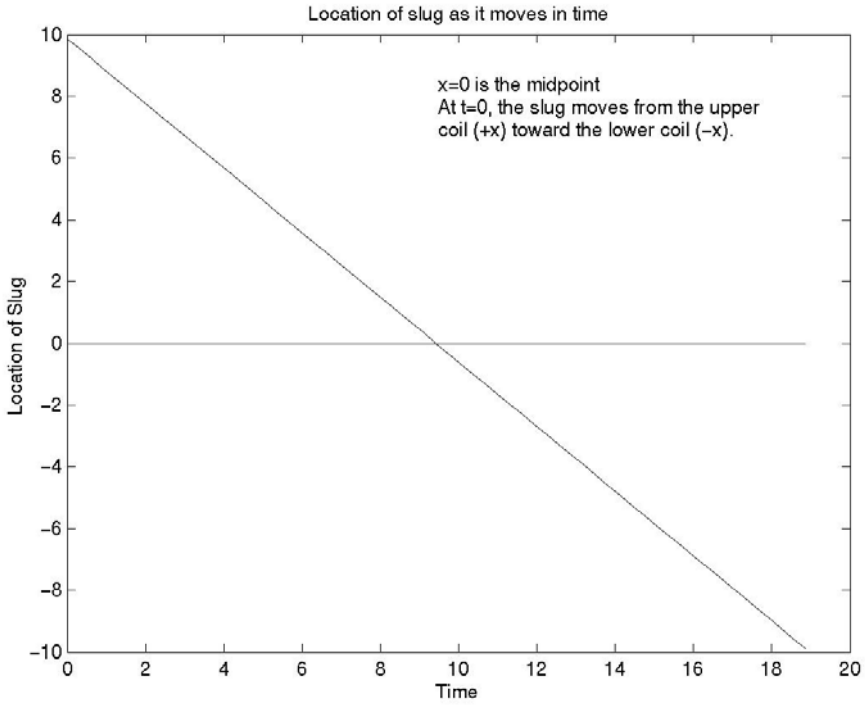

Figure 2. Location of Slug with respect to time.

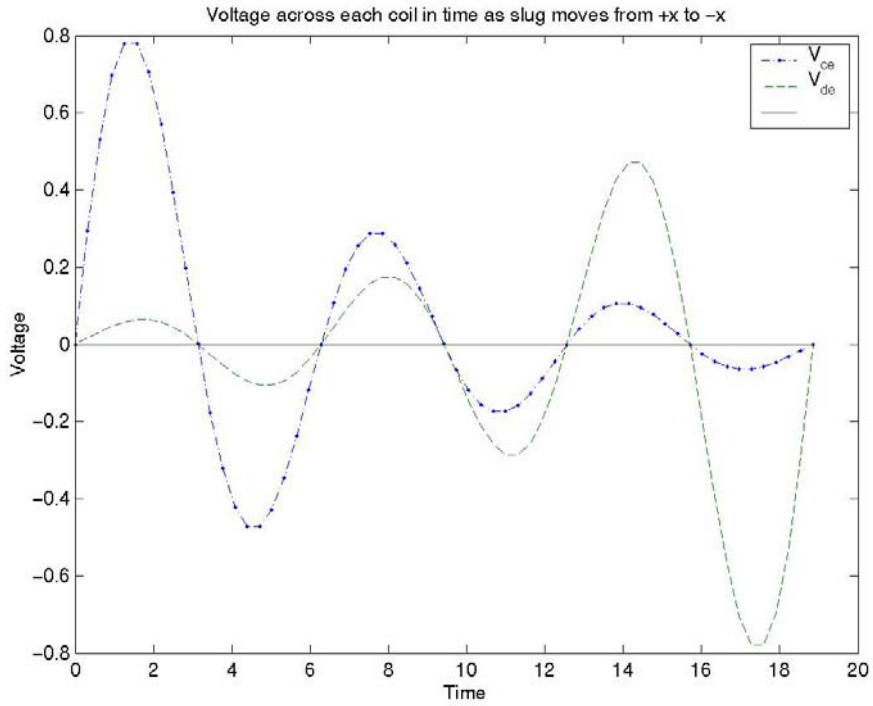

Figure 3. Voltage over each secondary coil.

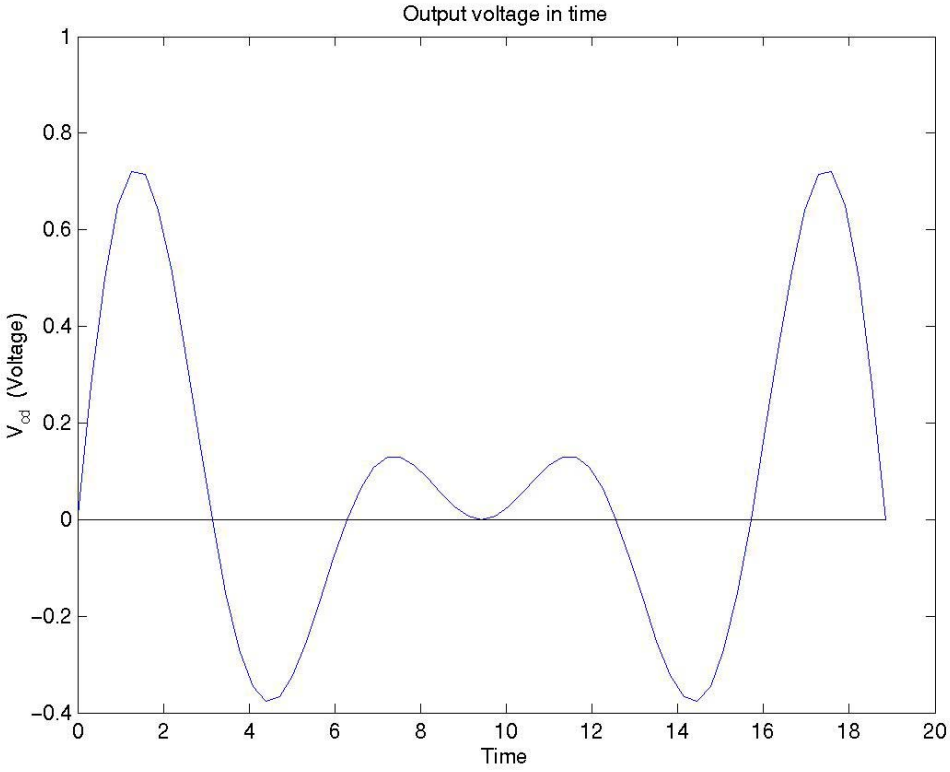

Figure 4. Output voltage.