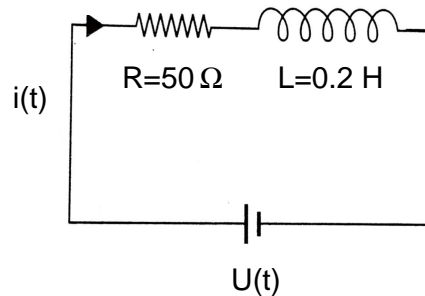


In this worksheet, we will solve a 1<sup>st</sup> order differential equation using a *FUNCTION* sub-program. The use of the *INTENT* descriptor and the logical *IF* construct will be practiced.

A series RL circuit with  $R = 50 \Omega$  and  $L = 0.2 \text{ H}$  has a sinusoidal voltage source applied, as shown in the figure below.



The sinusoidal voltage is given by

$$U(t) = \begin{cases} U_0 \sin(\omega t) & \text{if } t \leq \frac{1}{2} T_{\text{final}}, \\ \frac{2}{3} U_0 \sin(2\omega t) & \text{if } t > \frac{1}{2} T_{\text{final}}, \end{cases} \quad (1)$$

where  $U_0 = 150 \text{ V}$ ,  $\omega = 500 \text{ s}^{-1}$ , and  $T_{\text{final}} = 10\pi/\omega$ . The current  $i(t)$  is determined by the differential equation

$$50 i(t) + 0.2 \frac{di(t)}{dt} = U(t), \quad (2)$$

where  $t$  is the time in seconds. The initial condition for the current is  $i(0) = 0$ .

## Task

Write a structured Fortran program which solves Eq. (2) for times  $0 < t \leq T_{\text{final}}$ . Use a temporal step size of  $dt = 0.00001$  seconds. The results for  $i(t)$  are to be shown graphically.

## Code Design

- Include a short preamble at the beginning of your program.
- There is not keyboard input.
- Use a *FUNCTION* sub-program to compute the source term of the differential equation.
- Make us of the *intent(in)* descriptor in the *FUNCTION* sub-program.
- Show the results for  $i(t)$  graphically for  $0 < t \leq T_{\text{final}}$ .

**Submission Instructions:** Create a gzipped archive named `ws18.tgz` which contains your Fortran source code and the pdf file of your plot. Email the archive to `ewhart317@gmail.com`. Put `PHYS 317 WS 18` in the subject line.