COMPUTER LAB 3 – ELECTRICAL TRANSFER FUNCTION

Learning Objectives
- To review electrical transfer function material using MATLAB.
- To verify your solutions

Where Learning Outcomes Assessed:
- In Prac lab report, mid-semester and final exam.

You will need to demonstrate some of the skills developed in this computer lab in your pre-lab submission.

The circuit below shows a filter commonly used as the output stage of a switch mode power supply. In a switch mode power supply, $v_{in}(t)$ is switched between 0 and the DC input supply voltage, in this case 12V. At $t = 0$, $v_{in}(t)$ is switched to 12 V. The filter smooths the switched input so that it is close to DC at the desired output level (see figure below circuit). The desired output level is set by controlling the proportion of time the input is switched on. For example, if we want 6V at the output, the 12V input would only be switched on 50% of the time. The proportion of time that the input is switched on is called the *duty cycle*.
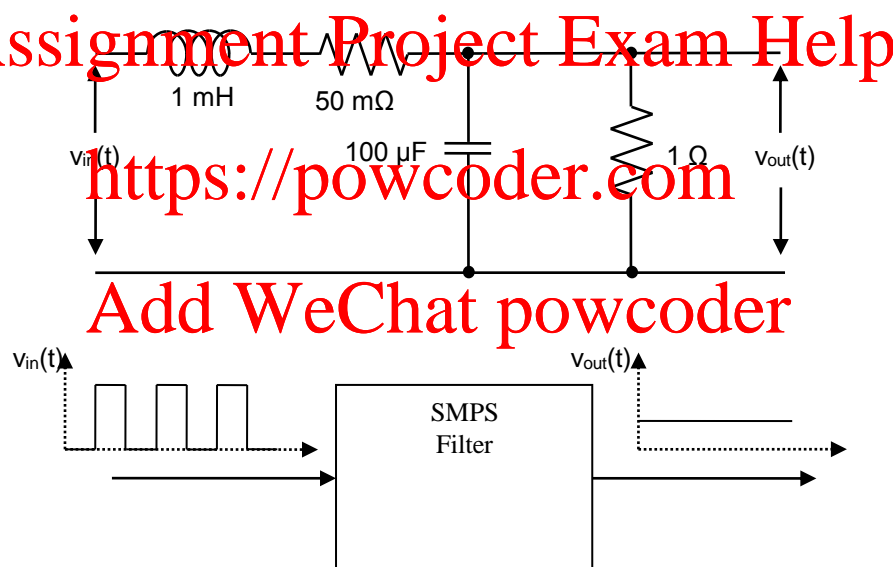
In this computer lab, you will examine the start-up behaviour of the system.

(a) Enter the circuit into Simulink in Matlab by inserting the appropriate electrical components. Run the simulation (play button in the toolbar) and note the time response by opening the scope box (double click) Assume that the capacitor and inductor are de-energised. How long will it take for v_{out} to reach 6V following 12V step input?

(b) You are told the transfer function of the SMPS filter was calculated to be (you should be able to confirm):

$$\frac{V_{out}(s)}{V_{in}(s)} = \frac{1/LC}{s^2 + \left(\dfrac{1}{R_2 C} + \dfrac{R_1}{L}\right)s + \dfrac{R_1 + R_2}{R_2 LC}}$$

Use Simulink to simulate response to 12V step input (i.e. 12/s), and compare with response to part (a).