ANALOG SYSTEMS : PROBLEM SET 8

Problem 1

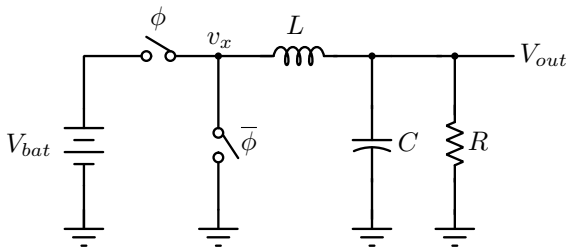

Figure 1: Circuit for Problem 1.

Fig. 1 shows a buck converter. The battery voltage V_{bat} is 5 V. ϕ and $\overline{\phi}$ are complementary switch drive signals. The duty cycle of ϕ is denoted by D. The switching frequency is 1.5 MHz. $L = 2.2\,\mu$H and $C = 22\,\mu$F. The load resistor $R = 10\Omega$.

- Determine D needed to achieve $\overline{V_{out}} = 3.3$ V.
- Determine the transfer function from v_x to V_{out}.
- Using the observation that the pole frequency of the LC filter is much lower than the switching frequency, determine the ripple in the inductor current and output voltage.
- Sketch the current waveforms in the inductor and capacitor in steady state.
- Sketch the voltage waveform V_{out} in steady state.

Problem 2

In class, we saw that the response of a "slow" linear time-invariant system to a rapidly varying input like v_i in Fig. **??** is approximately the same as that due to $\hat{v}_i$. In this problem, we will convince ourselves of this by working a specific example.

Assume that v_i has a frequency of 1 MHz, and a duty cycle of 10%. $RC = 1$ mS. On the same graph, plot $v_o(t)$ when the input is $v_i(t)$, and when it is $\hat{v}_i(t)$.

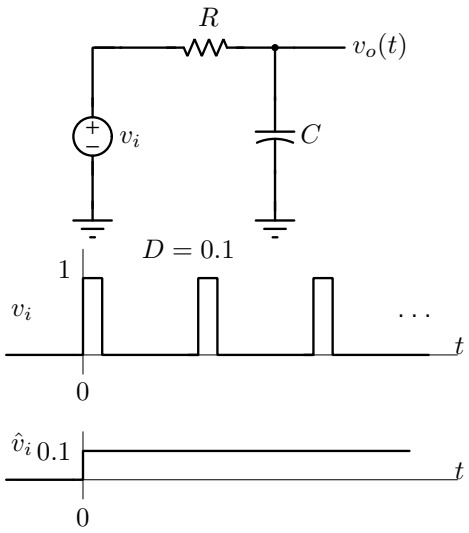

Figure 2: Circuit for Problem 2.