

# EE155/255 F17 Homework 1

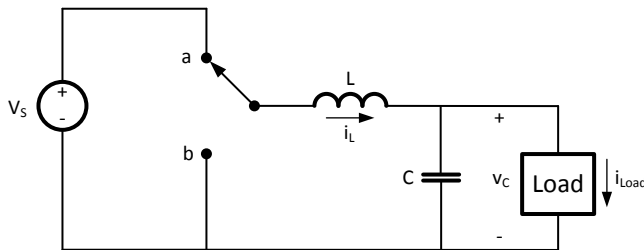
## Periodic Steady-State Analysis

---

Assigned 9/25/17

Due 10/2/17

Consider the buck converter shown below with  $L = 100\mu\text{H}$ ,  $C = 100\mu\text{F}$ ,  $V_S = 10\text{V}$ , and  $I_{\text{Load}} = 10\text{A}$ . Suppose the converter is operating in periodic steady state with a switching frequency of  $f = 100\text{kHz}$ , a duty factor of  $d_a = 50\%$  and  $V_C = 5\text{V}$ .



**Part 1:** Answer the following short-answer questions:

- What are the minimum and maximum values of inductor current  $I_L$  over one switching cycle?
- If the input voltage changes to  $20\text{V}$  and the steady-state output remains at  $5\text{V}$ , what must happen to the duty factor,  $d_a$ ?
- What are the minimum and maximum values of  $I_L$  under the conditions of part (B)?

**Part 2:** Suppose the converter is in steady state with  $V_S=10\text{V}$  and  $d_a = 50\%$ , and we change the duty factor to  $d_a = 40\%$ . Assume the load is resistive with  $R_L = 10\Omega$ . Calculate the quality factor,  $Q$ , of this parallel RLC system. Considering only frequencies lower than the  $100\text{kHz}$  switching frequency, sketch the waveform that appears across  $V_C$ . You need not give a closed form expression for this waveform.