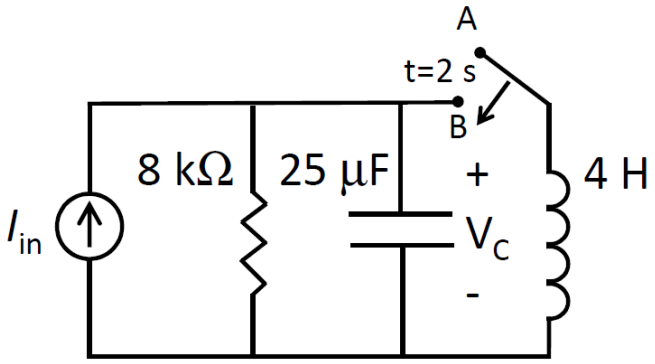
ECE 202: Linear Circuit Analysis II – Fall 2013

HOMEWORK SET 6: DUE TUESDAY, SEPTEMBER 17, 5 PM IN MSEE 180

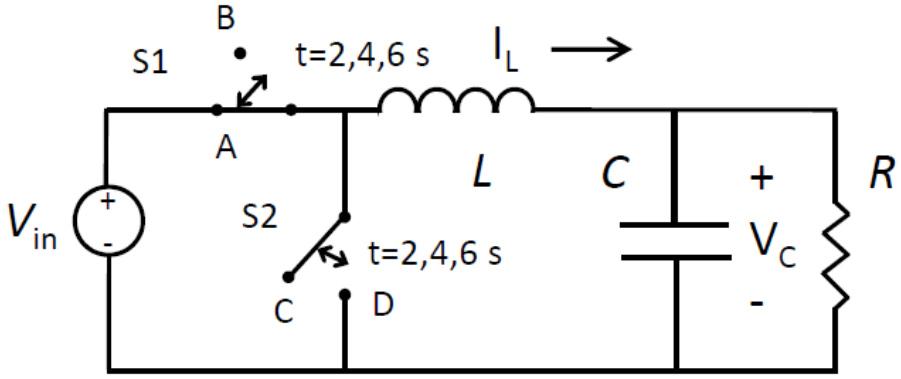
ALWAYS CHECK THE ERRATA on the web.

Main Topics: The Past, N&M cont. Switching in linear circuits; Switched capacitor circuits.

21. The switch in the circuit of figure below has been in position A for a very long time. At $t = 2$ s, the switch moves to position B. Calculate $v_C(t)$ for all times $t \geq 0$, given that $i_{in}(t) = 5r(t)$ mA for ALL time. Plot $v_C(t)$ for $0 \leq t \leq 5$ s in MATLAB.



22-23. Synchronous Buck Converter Circuit: In the circuit below, R=2 Ω, L=250 mH, C=500 mF. Assume that $v_{in}(t) = 12u(t)$ V, $i_L(0^-) = 0$, and $v_C(0^-) = 0$ V. Suppose further that switch S1 opens at t =2 s (from position A to B), closes at t =4 s (from B to A), and opens again at t=6 s; while switch S2 closes at t =2 s (from C to D), opens at t =4 s (from D to C), and closes again at t =6 s.



(a) For $0 \leq t \leq 2$ s, compute the inductor current (from left to right) with the switch closed by first computing $I_L(s)$.

(b) Compute approximately $i_L(2^-) = i_L(2^+)$.

(c) Draw the equivalent circuit valid for $2 \leq t \leq 4$ s.

(d) Compute $V_C(s)$.

(e) Compute $v_C(t)$ for $2 \leq t \leq 4$ s.

(f) Determine the capacitor voltage for $4 \leq t \leq 6$ s.

(g) Determine the capacitor voltage for $6 \leq t < 8$ s.

(h) Plot $v_C(t)$ for $0 \leq t \leq 8$ sec in MATLAB.

24. For the circuit below, assume all inductor currents are initially zero, and $v_{in}(t) = 5u(t)$. The circuit switches from A to B at t=1 s; moves back from B to A at t=2 s; and continues in this periodic cycle every 2 seconds. Determine $i_{out}(t)$ for $0 \le t \le 6$ s, and for one 2 s cycle in the limit as $t \rightarrow \infty$.
Hint: after enough cycles, the output also becomes periodic, i.e., $i_{out}(t) = i_{out}(t+2)$.