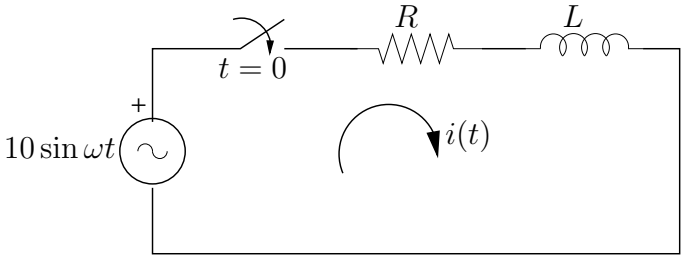
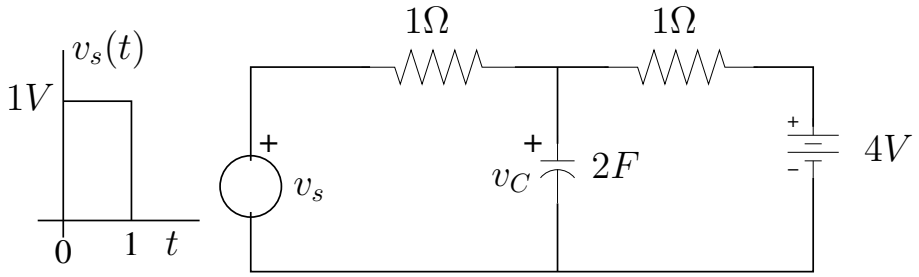
EC204: Networks & Systems
Problem Set 7

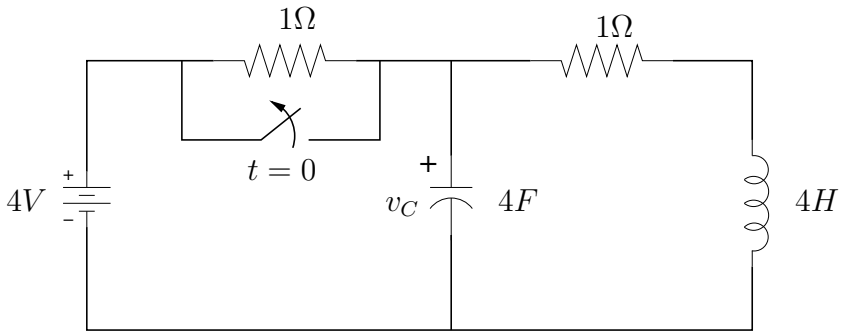
1. Determine $i(t)$ for $t \geq 0$ in the circuit shown below given that $i(0^-) = \rho$. Identify the steady state and transient components of the response.



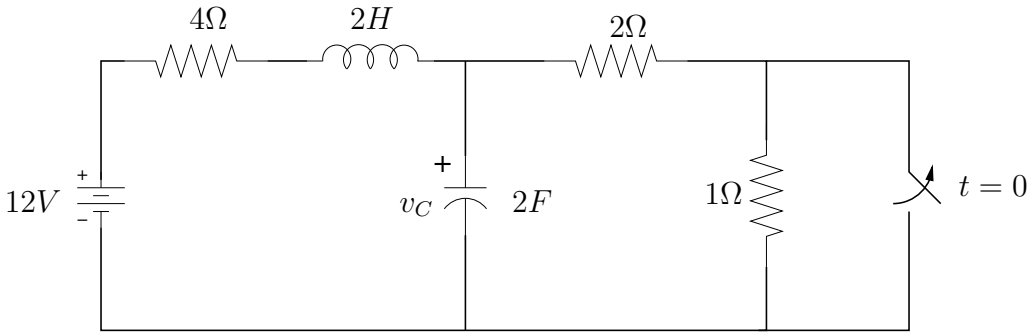
2. Determine $v_C(t)$ for $t \geq 0$ in the circuit shown below given that steady state conditions have been reached at $t = 0^-$ with $v_s = 0$.



3. Find $v_C(t)$ for $t \geq 0$ in the circuit shown below assuming that steady state has been reached before the switch is opened.

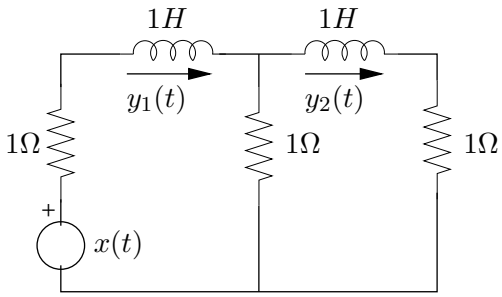


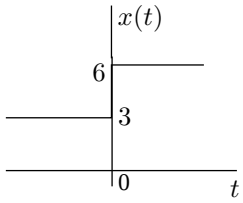
4. Find $\frac{dv_C}{dt}$, $\frac{d^2v_C}{dt^2}$, and $\frac{d^3v_C}{dt^3}$ all at $t = 0^+$ in the circuit shown below assuming that steady state has been reached before the switch is opened.



5. (a) Find $y_1(t)$ and $y_2(t)$ for $t \geq 0$ given that $x(t) = 3$ for $t < 0$ and $x(t) = 6$ for $t \geq 0$.

   (b) Identify the components of $y_1(t)$ and $y_2(t)$ corresponding to the characteristic (or natural) modes.





6. For an LTIC system described by the system function $H(s) = \frac{s+3}{(s+2)^3}$, find the following:

   (a) Impulse response

   (b) Steady state response to the input $10u(t)$

   (c) Steady state response to the input $e^{j2t}u(t)$.

7. The output of an LTI system (with zero initial conditions) to the input $u(t)$ is $[4e^{-t} - 3e^{-2t}]u(t)$. Find (a) the impulse response, (b) the system function, (c) the response to the input $e^{-4t}u(t)$, and (d) the steady state response to the input $\cos 2t$.

8. Sketch the pole-zero plot corresponding to the following system functions: (a) $\frac{s-2}{s^2+8s+15}$, (b) $\frac{s+1}{(s+2)^2(s+3)}$, (c) $\frac{2s^2+s+1}{s(s+2)}$, and (d) $\frac{2s+1}{(s+2)(s^2+1)^2}$. Which of the above system functions correspond to BIBO stable systems?

9. A system has a transfer function with poles $s = -1 \pm j$ and a zero at $s = -a$. The response of this system to a step input has a term of the form $K_2e^{-t}\sin(t+\phi)$. Express K_2 in terms of a. Plot the value of K_2 as a function of a for values of a between 0 and 5.