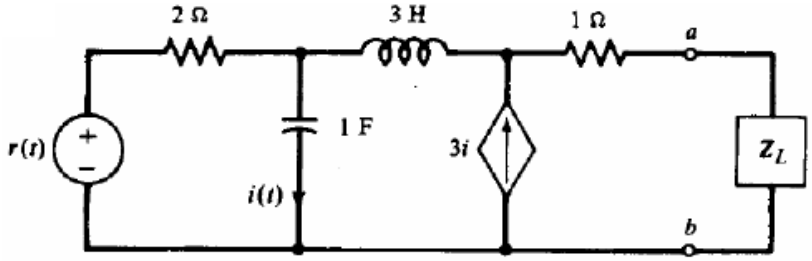
EE422G Homework #5 (17 points)

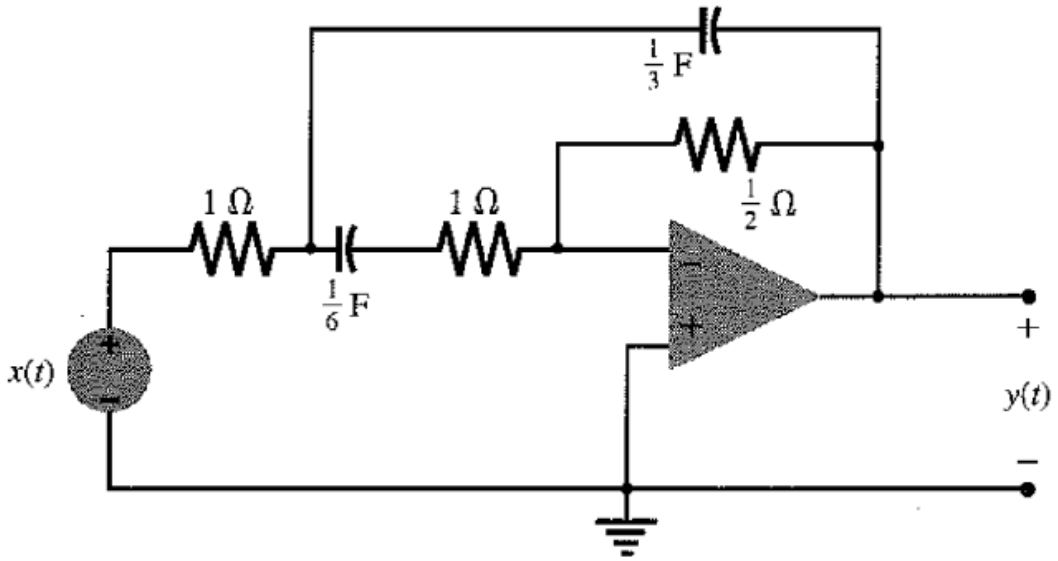
Due date: February 15, 2007

Reminder: each homework worths 10 points. Any points beyond that are bonuses which can be used to compensate points that you have lost in previous homework and quizzes.

1. (2 points) Find the Thevenin and Norton equivalent circuits between the ports a and b. The input voltage $r(t) = tu(t)$ is a "ramp-up" signal. Assume all initial conditions are zero.

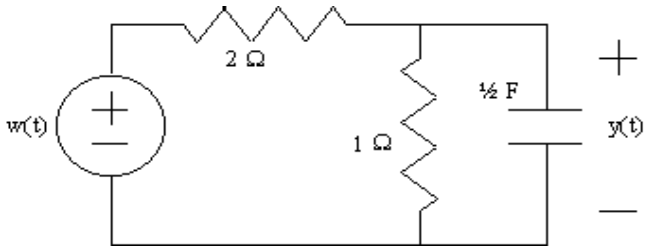


2. (2 points) Assume all initial conditions are zero. Find the transfer function of the following circuit.



3. (4 points)

   (a) (2 points) Find the transfer function $H(s) = \frac{Y(s)}{W(s)}$ for the following circuit:



(b) (2 points) A dynamic System is governed by the following differential equation with initial conditions $\left.\frac{dy}{dt}\right|_{t=0} = 1$ and $y(0) = 0$,

$$\frac{d^2}{dt^2}y(t) + 2\frac{d}{dt}y(t) + y(t) = x(t) \tag{1}$$

Given the input $X(s) = 1$, write down the laplace transform of the zero-state response and the zero-input response.

4. (3 points) (Bounded and Transient signals) Without computing the inverse Laplace transform, determine which of the following signals are bounded and which are transient:

   (a) $X(s) = \frac{s-2}{s^2+7s+12}$

   (b) $X(s) = \frac{s+3}{s^2-2s+2}$

   (c) $X(s) = \frac{s^2-1}{s^4-4s^3+8s^2-8s+4}$

5. (6 points) (Zero-state and Zero-input responses) You are asked to investigate an unknown dynamic system. The only information you have is that it is governed by a first-order differential equation relating the input $x(t)$ and output $y(t)$:

$$\frac{d}{dt}y(t) + ay(t) = bx(t)$$

with unknown output initial condition $y(0) = c$.

   (a) (2 points) Write down the zero-input and zero-state response of the system based on the unknowns a, b and c.

   (b) (3 points) In order to identify the system, you input the following signal $x(t) = e^{-t}u(t)$ and find that the output can be well-approximated by $y(t) = \left(\frac{19}{4}e^{-5t} + \frac{1}{4}e^{-t}\right)u(t)$. Find a, b and c.

   (c) (1 point) What is the steady state response of this system?