Problem #1 (20 pts)

13.64 a) Use the convolution integral to find the output voltage of the circuit in Fig. P13.50(a) if the input voltage is the rectangular pulse shown in Fig. P13.64.

b) Sketch $v_o(t)$ versus t for the time interval $0 \le t \le 10$ ms.

Figure P13.64

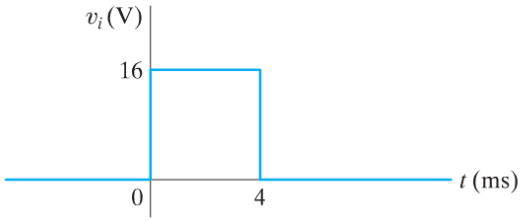
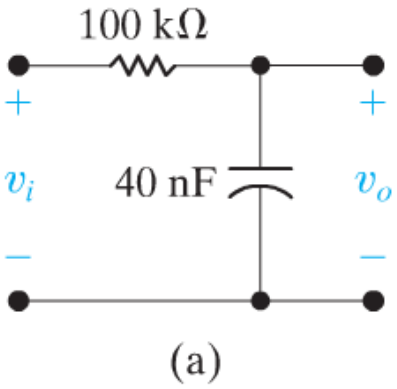


Figure P13.50



Problem #2 (20 pts)

14.37 PSPICE MULTISIM Assume the bandreject filter in Problem 14.36 is loaded with a 1 kΩ resistor.

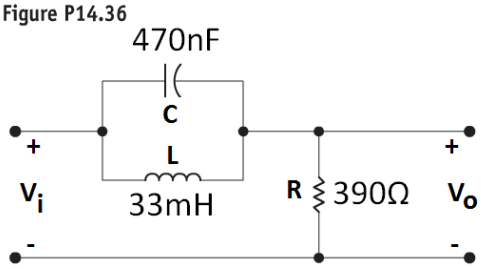
a) What is the quality factor of the loaded circuit?

b) What is the bandwidth (in kilohertz) of the loaded circuit?

c) What is the upper cutoff frequency in kilohertz?

d) What is the lower cutoff frequency in kilohertz?

Figure P14.36



Problem #3 (20 pts)

15.24 Scale the bandpass filter in Problem 14.22 so that the center frequency is 200 kHz and the quality factor is still 8, using a 2.5 nF capacitor. Determine the values of the resistor, the inductor, and the two cutoff frequencies of the scaled filter.

Figure P14.22

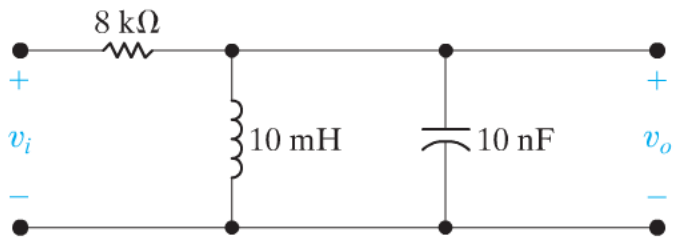


TABLE OF LAPLACE TRANSFORMS

An Abbreviated List of Laplace Transform Pairs

$f(t)$ $(t > 0^-)$	Type	$F(s)$
$\delta(t)$	(impulse)	1
$u(t)$	(step)	$\frac{1}{s}$
t	(ramp)	$\frac{1}{s^2}$
e^{-at}	(exponential)	$\frac{1}{s+a}$
$\sin \omega t$	(sine)	$\frac{\omega}{s^2+\omega^2}$
$\cos \omega t$	(cosine)	$\frac{s}{s^2+\omega^2}$
te^{-at}	(damped ramp)	$\frac{1}{(s+a)^2}$
$e^{-at}\sin \omega t$	(damped sine)	$\frac{\omega}{(s+a)^2+\omega^2}$
$e^{-at}\cos \omega t$	(damped cosine)	$\frac{s+a}{(s+a)^2+\omega^2}$

An Abbreviated List of Operational Transforms

$f(t)$	$F(s)$
$Kf(t)$	$KF(s)$
$f_1(t) + f_2(t) - f_3(t) + \cdots$	$F_1(s) + F_2(s) - F_3(s) + \cdots$
$\frac{df(t)}{dt}$	$sF(s) - f(0^-)$
$\frac{d^2 f(t)}{dt^2}$	$s^2F(s) - sf(0^-) - \frac{df(0^-)}{dt}$
$\frac{d^n f(t)}{dt^n}$	$s^n F(s) - s^{n-1} f(0^-) - s^{n-2}\frac{df(0^-)}{dt} - s^{n-3}\frac{df^2(0^-)}{dt^2} - \cdots - \frac{d^{n-1}f(0^-)}{dt^{n-1}}$
$\int_0^t f(x)\,dx$	$\frac{F(s)}{s}$
$f(t-a)u(t-a), a>0$	$e^{-as}F(s)$
$e^{-at}f(t)$	$F(s+a)$
$f(at), a>0$	$\frac{1}{a}F\left(\frac{s}{a}\right)$
$tf(t)$	$-\frac{dF(s)}{ds}$
$t^n f(t)$	$(-1)^n\frac{d^n F(s)}{ds^n}$
$\frac{f(t)}{t}$	$\int_s^\infty F(u)\,du$

Filter Type	Transfer Function
Low Pass	$H(s) = \frac{\omega_c}{s + \omega_c}$
High Pass	$H(s) = \frac{s}{s + \omega_c}$
Band Pass	$H(s) = \frac{\beta s}{s^2 + \beta s + \omega_0^2}$
Band Reject	$H(s) = \frac{s^2 + \omega_0^2}{s^2 + \beta s + \omega_0^2}$
Resistor Scaling	$R' = k_m R$
Inductor Scaling	$L' = \frac{k_m}{k_f} L$
Capacitor Scaling	$C' = \frac{1}{k_m k_f} C$