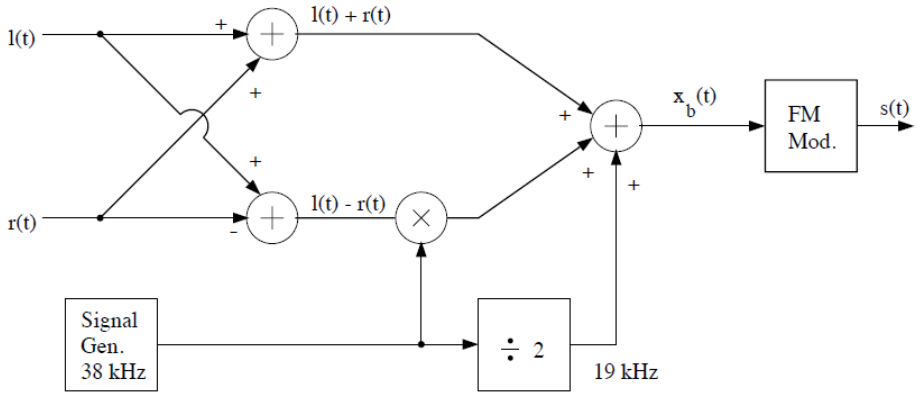
ECE 440 – Spring 2019
Homework 2

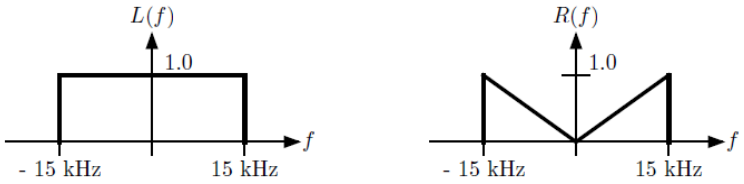
Due before class on Wednesday 02/06

All page numbers correspond to the 7^{th} edition of the book. If you have a different edition, you can find the scanned problems on Blackboard.

1. Determine whether the following are acceptable autocorrelation functions for a real signal. If that is not the case, specify why.
   (a) $R_1(\tau) = 2\cos(10\pi\tau) + \cos(30\pi\tau)$
   (b) $R_2(\tau) = 4\Lambda(\tau/2)$
   (c) $R_3(\tau) = 2\sin(10\pi\tau)$
   (d) $R_4(\tau) = e^{-\tau}(\tau + 1)$
2. Problem 3.8, pg. 153, parts (a), (b), (c)
3. Problem 3.20, pg. 154.
4. Problem 3.21, pg. 154. A short discussion, rather than an exact numerical answer is expected. Explain the practical trade-offs in the design of the receiver.
5. (Problem 4.9.) A transmitter uses a carrier frequency of 1000Hz, so that the unmodulated carrier is $A_c\cos(2\pi f_c t)$. Determine both the phase and frequency deviation for
   (a) $x_c(t) = \cos[2\pi 1000t + 40\sin(5t^2)]$
   (b) $x_c(t) = \cos[2\pi 600t]$
6. (First midterm, Spring 2016)
   (a) The block diagram below is used as part of the transmitter for stereophonic (different signals for right and left ear) FM broadcasting.



Suppose that the output of the 38kHz signal generator is $2\cos(2\pi f_1 t)$ and the output of the frequency divider block is $2\cos(2\pi f_2 t)$ where $f_1 = 38$ kHz and $f_2 = 19$ kHz and that the CTFTs of the left $l(t)$ and right $r(t)$ signals are real-valued (to make the sketching simple) and given by:



Sketch the spectrum $X_b(f)$, showing the steps that you took to find it (graphically is enough).

(b) If we wanted to use a digital modulation instead of FM, we would need to sample $x_b(t)$. What is the minimum number of samples we would have to take per second in order to avoid aliasing?