Massachusetts Institute of Technology
Department of Electrical Engineering and Computer Science

6.02 Fall 2011 **Solutions to Chapter 14** Updated: April 16, 2012

Please send information about errors or omissions to hari; questions are best asked on piazza.

1. See PS6 (for a very similar problem & solution).

2. The solution to this problem is similar to, but not identical to, the solution to Problem 4 at http://web.mit.edu/6.02/www/s2012/handouts/tutprobs/modulation.html

   This problem is a little more subtle because the spectral coefficients of $y[n]$ don't overlap in the same way as in the problem on the web site, but the approach to solving the problem is identical.

3. (a) Figure 1 plots the time-domain waveform for $y[n]$ (along with $x[n]$):

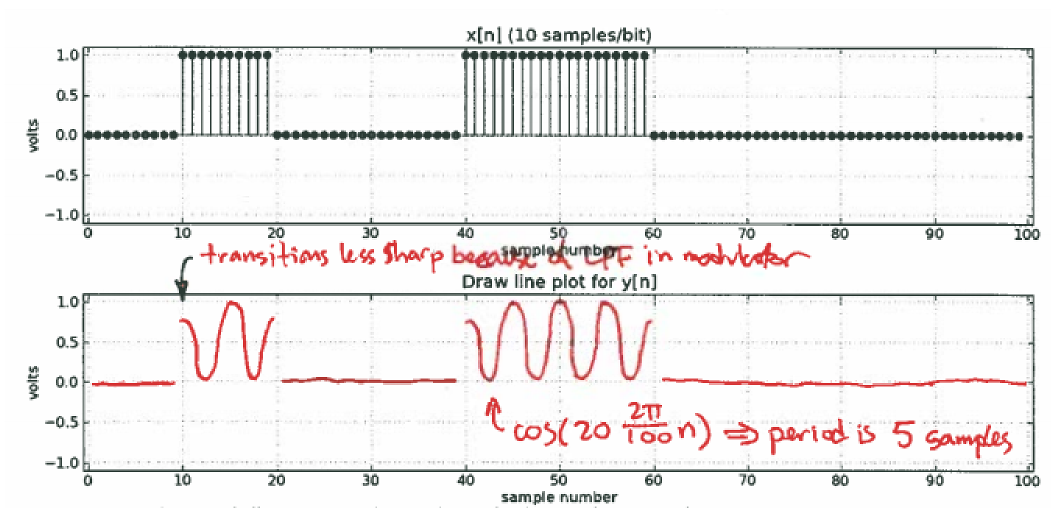

Figure 1: $y[n]$ for Problem 3, Part (a).

   (b) If we remove the LPF in each modulator, the transmissions will no longer be band-limited, so each transmission will cover a much larger spectrum. The spectral components of any given transmission that overlap with another transmission's frequency will show up as noise at the latter.

4. For the real part: $k = -12$ is $+0.5$, $k = -6$ is -0.5, $k = +6$ is -0.5, and $k = +12$ is $+0.5$. For the imaginary part, $k = -9$ is -0.5 and $k = +9$ is $+0.5$.

   Why?

   - $\cos(6\frac{2\pi}{36}n) \Rightarrow$ 6 cycles in 36 samples, so 3 samples is half a cycle, and cos changes to $-\cos$.

- $\cos(9\frac{2\pi}{36}n) \Rightarrow$ 9 cycles in 36 samples, so 4 samples is 3/4 of a cycle, and cos changes to $-\sin$.
- $\cos(12\frac{2\pi}{36}n) \Rightarrow$ 12 cycles in 36 samples, so 3 samples is one cycle, and cos remains cos.

5. Figure 2 plots the spectrum for $p[n], q[n], r[n]$, and $s[n]$.

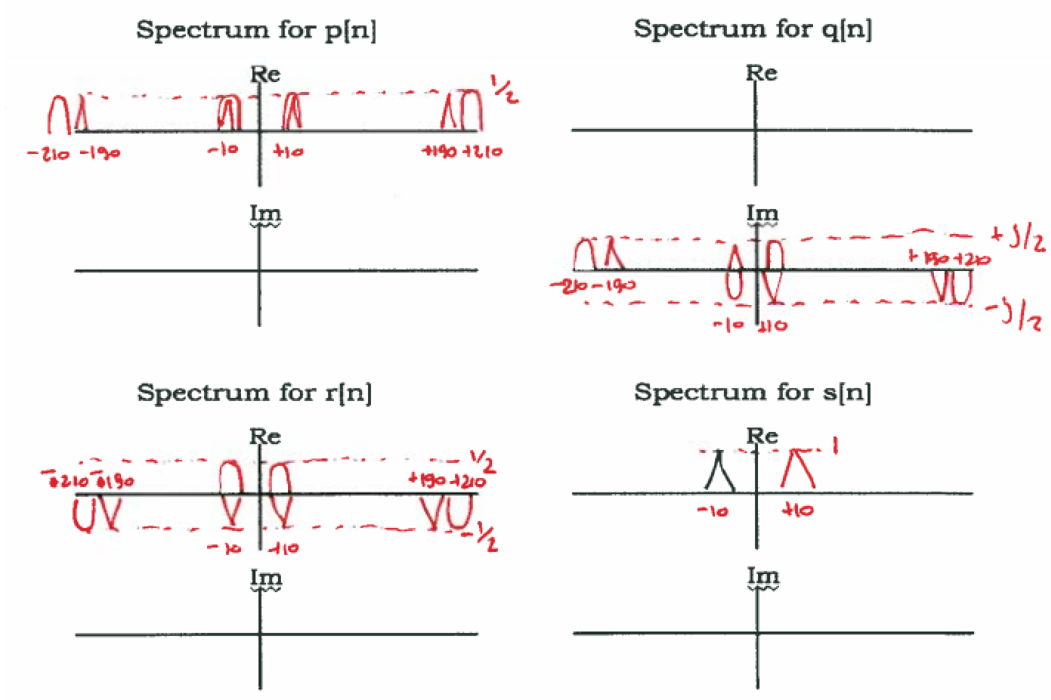

Figure 2: Plots for Problem 5.