ECE161A
Discrete Time Signal Processing

September 27, 2007
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Problem Set #1
Due: Oct 4, 2007

Part of this first homework is refresh your mind regarding infinite sums. The sums will be used when we study the Z-Transform and in discrete time Fourier analysis. Those of you studying probability will find the sums useful there too.

I encourage you to work together on your homework but what you hand in must be written up alone.

1. Which ones of the following sequences are bounded sequences (A and α are complex numbers and $|\alpha| < 1$)?
   - $x_1[n] = A\alpha^n$
   - $x_2[n] = A\alpha^n u[n]$
   - $x_3[n] = A\alpha^n u[-n]$
   - $x_4[n] = 11\sin(|a|n)$
   - $x_5[n] = (1 - \frac{3}{n^3})u[n-3]$
2. Compute the following sums:
   - $\sum_{i=-\infty}^{520} b^i, |b| > 1$
   - $\sum_{i=-3}^{111} (\frac{1}{5})^i$
   - $\sum_{i=-2}^{\infty} i(\frac{1}{19})^i$
   - $\sum_{k=0}^{\infty} (\frac{1}{3} + j\frac{1}{3})^k$
3. A discrete-time signal $x[n]$ is defined as

$$x[n] = \begin{cases} 1 + \frac{3n}{5} & \text{for } -5 \le n \le -1 \\ 1 & \text{for } 0 \le n \le 5 \\ 0 & \text{otherwise} \end{cases}$$

   a) Sketch the signal $x[n]$ for $-9 < n < 8$.

   b) Sketch the signals that result if we:
      (a) First time-reverse $x[n]$ and then delay the resulting signal by 3 samples.
      (b) First delay $x[n]$ by 3 samples and then time reverse the resulting signal.

   c) Sketch the signal $x[-n+3]$ using a table.

   d) Compare the results in parts (b) and (c) and derive a rule for obtaining the signal $x[-n+k]$ from $x[n]$.

   e) Can you find a rule for obtaining the signal $x[-mn+k]$ from $x[n]$ for all positive integers m and k?

4. Compute the energy of the following:
   - $x_1[n] = A\alpha^n u[n]$
   - $x_2[n] = \frac{3}{n^2} u[n-2]$
5. Compute the average power and the energy of the following:
   - $x_1[n] = (-1)^n$
   - $x_2[n] = nu[n]$
   - $x_3[n] = 4\cos(2\pi n/5) + 3cos(3\pi n/5)$

6. Determine the fundamental period of these sequences:
   - $x_1[n] = e^{j0.5\pi n}$
   - $x_2[n] = \sin(.8\pi n + .8\pi)$
   - $x_3[n] = \text{Re}(e^{j\pi n/5}) + \text{Im}(e^{j\pi n/10})$
7. Problem 2.38 of the textbook, page 110.