EECS 451 PROBLEM SET #3

ASSIGNED: Jan. 29, 2015. **READ:** Sects. 3.4.3-3.5.4 & 3.6.1-3.6.2.
DUE DATE: Feb. 05, 2015. **TOPICS:** z-transforms, their inverses, and ROCs.

Please box your answers. Show your work. Turn in all Matlab plots and Matlab code.

[20] 1. Compute z-transforms and ROCs for each of the following four signals.
Write each answer as a rational function (a ratio of two polynomials).

[5] (a) $\{1, 3, \underline{4}\}$. [5] (b) $(2^n + 1)u[n]$. [5] (c) $(\frac{1}{3})^n$u[n]+2^nu[–n–1]. [5] (d) 3^nu[n]+$(\frac{1}{2})^n$u[–n–1].

[20] 2. Compute the *causal* inverse z-transform of each of the following functions.
Do partial fractions in (d) and (e) *by hand*. You may check answers using `residue`.

[3] (a) $\frac{z+1}{2z}$. [3] (b) $\frac{z-1}{z-2}$. [4] (c) $\frac{2z+3}{z^2(z+1)}$. [5] (d) $\frac{z^2+3z}{z^2+3z+2}$. [5] (e) $\frac{z^2-z}{z^2-2z+2}$.

[20] 3. Compute the inverse z-transform of each of the following functions and ROCs:

[05] (a) $\frac{4z}{z-1}+\frac{5z}{z-2}+\frac{6z}{z-3}$ & $2 < |z| < 3$. [5] (b) $\frac{(1+j)z}{z-(3+4j)}+\frac{(1-j)z}{z-(3-4j)}$ & ROC making it stable.

[10] (c) $\frac{(3+4j)z}{z-(1+j)}+\frac{(3-4j)z}{z-(1-j)}+\frac{(1+j)z}{z-(3+4j)}+\frac{(1-j)z}{z-(3-4j)}$ & $\sqrt{2} < |z| < 5$. Simplify to a sum of two terms.

[20] 4. Compute the two-sided convolution $((\frac{1}{3})^n$u[n]+2^nu[–n–1])*$((\frac{1}{2})^n$u[n]) by:

[10] (a) Multiplying their z-transforms, intersecting their ROCs, and computing $\mathcal{Z}^{-1}$.
You need *not* compute the partial fraction expansion by hand! Use `residue`.

[10] (b) Truncating each signal to $-10 \le n \le 10$ and using `conv`. Compare your answers.
How? The truncated version of the first signal to be convolved is formed in Matlab as:
`[2.^[-10:-1] (1/3).^[0:10]]` End values are small, so truncation→little effect.

[20] 5. For each of the five ROCs below, is the associated inverse z-transform:
(i) Causal, anticausal, or two-sided; (ii) BIBO stable or unstable (2 points each).

(a) $2 < |z| < 3$. (b) $0.1 < |z| < 0.3$. (c) $0.1 < |z| \le \infty$. (d) $0 \le |z| < 2$. (e) $0.5 < |z| < 3$.

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