

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN
Department of Electrical and Computer Engineering

ECE 401 SIGNAL AND IMAGE ANALYSIS
Spring 2017

EXAM 2 SOLUTIONS

Tuesday, March 28, 2017

Problem 1 (10 points)

$$h[n] = \delta[n] + 0.9\delta[n - 3] + 0.8\delta[n - 10]$$

Problem 2 (10 points)

(a) No, not linear.

$$y_3[n] = \frac{1}{N} \sum_{m=0}^{N-1} (a^2 x_1^2[n - m] + 2abx_1[n - m]x_2[n - m] + b^2 x_2^2[n - m]) \neq ay_1[n] + by_2[n]$$

(b) Yes, time-invariant.

$$y_2[n] = \frac{1}{N} \sum_{m=0}^{N-1} x_2^2[n - m] = \frac{1}{N} \sum_{m=0}^{N-1} x_1^2[n - m - n_0] = y_1[n - n_0]$$

Problem 3 (10 points)

(a) $Y_k = 0$ for all $|k| > 1$.

(b)

$$|Y_k| = \begin{cases} 0 & |k| > 1 \\ |X_k| \left(\frac{\sin(\pi/2)}{3 \sin(\pi/6)} \right) = \frac{2}{3} |X_k| & k = \pm 1 \\ X_k & k = 0 \end{cases}$$

Problem 4 (10 points)

$$h[n] = \frac{\sin(\pi n/3) - \sin(\pi n/6)}{\pi n}$$