SIMG-261-20142 EXAM #1 5 March 2015

Closed Book, No Notes, TURN OFF ALL PHONES, PAGERS, iPods, etc.; PUT THEM AWAY OUT OF SIGHT

Show your work. If you solve problems "by inspection", then write down the thought process that led to your conclusion. You may leave square roots in expressions without evaluating numerically.

S**ELECT 4 of first 5 (15% each) and SELECT 1 from #6 - #7 (40%)**

Staple and submit **ONLY** the selected problems **IN NUMERICAL ORDER.**

1. (15%) Find expressions for AND SKETCH the even and odd parts of $e^{+i\cdot 2\pi\frac{x}{4}} = \exp\left[+i\cdot 2\pi\frac{x}{4}\right]$. The x-axes of the sketches include at least $-8 \leq x \leq +8$.

2. (15%) Find expressions for AND SKETCH the magnitude and the phase of $e+^{i\cdot 2\pi\frac{x}{4}} = \exp\left[+i\cdot 2\pi\frac{x}{4}\right]$. The x-axes of the sketches should include at least $-8 \leq x \leq +8$.

3. (15%) Find expressions for AND SKETCH the even and odd parts of $e^{+i\pi\frac{x^2}{4}} = \exp\left[+i\cdot\pi\left(\frac{x}{2}\right)^2\right]$. The x-axes of the sketches should include at least $-4 \leq x \leq +4$.

4. (15%) Find expressions for AND SKETCH the magnitude and the phase of $e^{+i\pi\frac{x^2}{4}} = \exp\left[+i\cdot\pi\left(\frac{x}{2}\right)^2\right]$. The x-axes of the sketches should include at least $-4 \leq x \leq +4$.

5. (15%) Find the projection of the vector $\underline{\mathbf{v}}_1 = \begin{bmatrix} 1 \\ -1 \\ +1 \end{bmatrix}$ onto the reference vector $\underline{\mathbf{a}}_0 = \begin{bmatrix} 1 \\ e^{-i\frac{\pi}{4}} \\ -i \end{bmatrix}$ (HINT: be careful!)

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6. (40%) Evaluate the projections of the 4-D input vector $\underline{\mathbf{x}} = \begin{bmatrix} -2 \\ i \\ 2 \\ -i \end{bmatrix}$ onto each of the 4 eigenvectors of a 4×4 shift-invariant matrix.

7. (40%) By any method (but state how) determine the four eigenvalues of the 4×4 circulant matrix listed and use to determine if $\underline{\mathbf{A}}^{-1}$ exists.

$$\underline{\mathbf{A}} = \begin{bmatrix} +1 & +1 & -1 & -1 \\ -1 & +1 & +1 & -1 \\ -1 & -1 & +1 & +1 \\ +1 & -1 & -1 & +1 \end{bmatrix}$$