MAT 320 Quiz 3 Answer Sheet

Fall 2022

Quiz ID: ZFM Name: _____

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2. ☐
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Submit electronic answers at

http://azrael.digipen.edu/cgi-bin/MAT320quiz.pl

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MAT 320 **Quiz 3** Fall 2022

1. Write $2\cos 3t$ as an exponential sum:
   a) $e^{i3t} + e^{-i3t}$ b) $ie^{i3t} - ie^{-i3t}$ c) $e^{i3t} - e^{-i3t}$ d) $2e^{i3t} + 2e^{-i3t}$ e) $2e^{i3t} - 2e^{-i3t}$

2. What is the dynamic range of a signal that starts at volume V, then goes as quiet as $\frac{1}{8}V$ and then as loud as $4V$? Express the dynamic range (from quietest to loudest) in dB.
   a) 18dB b) 30dB c) 36dB d) 24dB e) 12dB

3. What is the frequency of the phasor $e^{i\frac{\pi}{4}t}$ in Hz if t is measured in seconds?
   a) 4 b) 8 c) $\frac{1}{8}$ d) $\frac{1}{4}$ e) 2

4. Suppose that f_1 is the phasor $e^{i\frac{\pi}{4}t}$ and f_2 is the same phasor delayed by 1 second, where t is measured in seconds. What is the sum of these two phasors when $t = 1$?
   a) $1 + \frac{\sqrt{2}}{2}$ b) $\frac{\sqrt{2}}{2}i$ c) $\frac{\sqrt{2}}{2} + \frac{\sqrt{2}}{2}i$ d) $1 + \frac{\sqrt{2}}{2}i$ e) $1 + \frac{\sqrt{2}}{2} + \frac{\sqrt{2}}{2}i$

5. Find the complex dot product of the vectors:

$$(2 - i, i) \bullet (1 - i, 2 + i)$$

   a) $3 + 4i$ b) $4 - 3i$ c) $4 + 3i$ d) $3 - 4i$ e) $-3 + 4i$

6. Suppose we use sampling rate $f_s = 44100$ Hz. What is the frequency of smallest positive value which is an alias of the frequency 22100 Hz, but is not equal to this frequency?
   a) 22500 b) 40000 c) 22000 d) 2050 e) 4000

7. Let $\{\mathbf{u}_0, \mathbf{u}_1, \mathbf{u}_2\}$ be the Fourier basis of $\mathbb{C}^3$, where $\mathbf{u}_k$ is the vector obtained by sampling the phasor $e^{i\frac{2\pi}{3}kt}$ at the t-values $0, 1, 2$. What is the sum $\mathbf{u}_1 + \mathbf{u}_2$?
   a) $\begin{pmatrix} 2i \\ i \\ i^2 \end{pmatrix}$ b) $\begin{pmatrix} 2 \\ -1 \\ -1 \end{pmatrix}$ c) $\begin{pmatrix} 3 \\ e^{i\frac{\pi}{3}} \\ e^{i\frac{2\pi}{3}} \end{pmatrix}$ d) $\begin{pmatrix} 3 \\ e^{-i\frac{2\pi}{3}} \\ e^{-i\frac{4\pi}{3}} \end{pmatrix}$ e) $\begin{pmatrix} 3 \\ 0 \\ 0 \end{pmatrix}$

8. Let $\{\mathbf{u}_0, \mathbf{u}_1, \mathbf{u}_2\}$ be the Fourier basis of $\mathbb{C}^3$, where $\mathbf{u}_k$ is the vector obtained by sampling the phasor $e^{i\frac{2\pi}{3}kt}$ at the t-values $0, 1, 2$. What is the complex inner product $\mathbf{u}_1 \bullet \mathbf{u}_2$?
   a) 2 b) 1 c) i d) 0 e) -2