UNIVERSITY OF SASKATCHEWAN
ELECTRICAL ENGINEERING 455.3

Assignment Quiz 1
September 22, 1997

4

Instructor: B.L. Daku
Time: 15 minutes
Note: No aids

Name:
Student Number:

1. Determine one of the angles of x (in degrees), where

$$x(n) = \sum_{n=0}^{3} \left[(2)^{\frac{n}{2}} (\cos(\frac{\pi}{4}n + \frac{\pi}{4}) + j \sin(\frac{\pi}{4}n + \frac{\pi}{4})) \right]. \quad (1)$$

$S = \frac{1-z^N}{1-z}$

$z = 2^{n/2}\left(\cos(\frac{\pi}{4}n + \frac{\pi}{4}) + j\sin(\frac{\pi}{4}n + \frac{\pi}{4})\right)$

$= 2^{\frac{n}{2}} e^{j(\frac{\pi}{4}n + \pi/4)}$

$S = \frac{1-z^4}{1-z} \quad \& \quad \frac{1 - 2^{4/2} e^{j(\frac{\pi}{4}4 + \pi/4)}}{1 - 2^{1/2} e^{j(\frac{\pi}{4} + \pi/4)}}$

$= \frac{1 - 4 \cdot e^{j\,5\pi/4}}{1 - \sqrt{2}\, e^{j(\pi/2)}}$

$= \frac{1 - 4\cos(5\pi/4) - j4\sin(5\pi/4)}{1 - \sqrt{2}\cos(\pi/2) - j\sqrt{2}\sin(\pi/2)}$

$= \frac{1 + 2\sqrt{2} + j2\sqrt{2}}{1 - j\sqrt{2}}$

$= \frac{3.8284 + j2.8284}{1 - j1.4142}$

$= \frac{4.7599 \angle 36.457^\circ}{.3333 \angle .471^\circ}$

$= 8.2444 \angle -18.279^\circ$

UNIVERSITY OF SASKATCHEWAN
ELECTRICAL ENGINEERING 455.3

Assignment Quiz 2
October 1, 1997

8

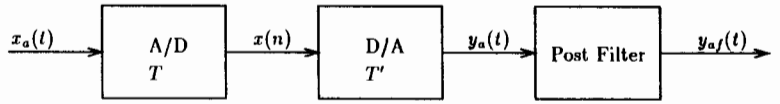
Instructor: B.L. Daku
Time: 15 minutes
Note: No aids

Name:
Student Number:

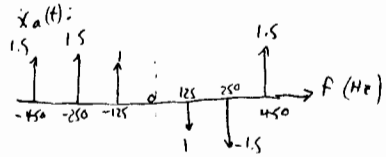
1. Consider the simple signal processing system shown in the following figure. The sampling periods of the A/D and D/A converters are $T = 5$ ms and $T' = 1$ ms, respectively. Determine $x(n)$, $y_a(t)$ and $y_{af}(t)$ of the system, if the input is

$$x_a(t) = 3\cos(900\pi t) + 2\sin(250\pi t) + 3\sin(500\pi t) \quad (1)$$

The postfilter removes any frequency component above $\frac{F_s}{2}$, where $F_s = \frac{1}{T}$.



A/D:
$T = 5$ ms
$\therefore f_s = 200$ samples/s



$f_f = \frac{f_s}{2} = 100$

$t = \frac{n}{F_s}$

$X(n) = 3\cos\left(2\left(\frac{450}{200}\right)\pi n\right) + 2\sin\left(\left(\frac{125}{200}\right)2\pi n\right) + 3\sin\left(\left(\frac{250}{200}\right)2\pi n\right)$

$= 3\cos\left(2\pi n \frac{9}{4}\right) + 2\sin\left(2\pi n\left(\frac{5}{8}\right)\right) + 3\sin\left(\left(\frac{5}{4}\right)2\pi n\right)$

$= 3\cos\left(2\pi n\left(\frac{1}{4}\right)\right) + 2\sin\left(2\pi n\left(\frac{-3}{8}\right)\right) + 3\sin\left(\left(\frac{1}{4}\right)2\pi n\right)$

$X(n) = 3\cos(2\pi n\frac{1}{4}) - 2\sin\left(2\pi n\left(\frac{3}{8}\right)\right) + 3\sin\left(2\pi n\left(\frac{1}{4}\right)\right)$ ✓ 3

$n = t \cdot f_s$ ✓ 1

$\therefore y_a(t) = 3\cos\left(2\pi t \frac{200}{4}\right) - 2\sin\left(2\pi t \frac{200}{2}\left(\frac{3}{8}\right)\right) + 3\sin\left(2\pi t \frac{200}{4}\right)$ ✓ 2

$y_a(t) = 3\cos(100\pi t) - 2\sin(150\pi t) + 3\sin(100\pi t)$

50 Hz 75 Hz 50 Hz

* filter removes freq above $\frac{F_s}{2} = \frac{1}{T \cdot 2} = 100$ Hz * all freq of $y_a(t)$ are below

$y_{af}(t) = 3\cos(100\pi t) - 2\sin(150\pi t) + 3\sin(100\pi t)$

$= y_a(t)$ ✓ 3