

Sample Set 1 MID-SEMESTER TEST

MULTIPLE CHOICE QUESTIONS

1. What is the signal processing unit, A in Figure A1.

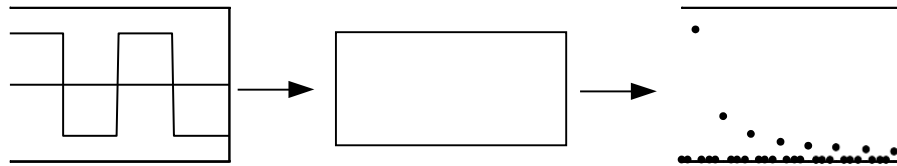


Figure A1

- (a) Low pass filter
 - (b) Modulator
 - (c) Rectifier
 - (d) Fourier Transform
2. What is the purpose of sampling?
- (a) Convert a continuous-time analog signal to a discrete time signal
 - (b) Convert a discrete time signal to a continuous-time analog signal
 - (c) Convert a continuous-time analog signal to a higher frequency continuous analog signal
 - (d) Convert a discrete time signal to a continuous-time digital signal
3. The first two samples of a discrete time signal $x(n) = \cos(0.5\pi n)u(n) + 2\sin(0.5\pi n)\delta(n-1)$ are :
- (a) $\{0\}$
 - (b) $\{2.0000, 0.7071\}$
 - (c) $\{1, 2\}$
 - (d) $\{2, 1\}$
4. If aliasing occurs, what is the most likely result?
- (a) Signal distortion
 - (b) Signal amplitude amplification
 - (c) Signal amplitude reduction
 - (d) No changes to the signal

5. A square wave having period $T = 1$ ms, is filtered by an ideal low pass filter having cutoff frequency $f_c = 4$ kHz. What are the frequency components at the output of the low pass filter?
- 1 kHz and 10 kHz.
 - 1 kHz and 4 kHz.
 - 1 kHz and 3 kHz.
 - 0.1 kHz
6. A signal consisting of 2 kHz, 3 kHz and 6 kHz frequency components is sampled at 10 kHz. After sampling, what frequency components are there between 0 and 5 kHz?
- 2 kHz, 5 kHz, 7 kHz
 - 2 kHz, 3 kHz, 4 kHz
 - 2 kHz, 3 kHz, 5 kHz, 6 kHz
 - 2 kHz, 5 kHz, 8 kHz
7. Spectrum of a continuous signal, $x(t)$, shown in Figure A7. What is the proper sampling frequency for this signal?

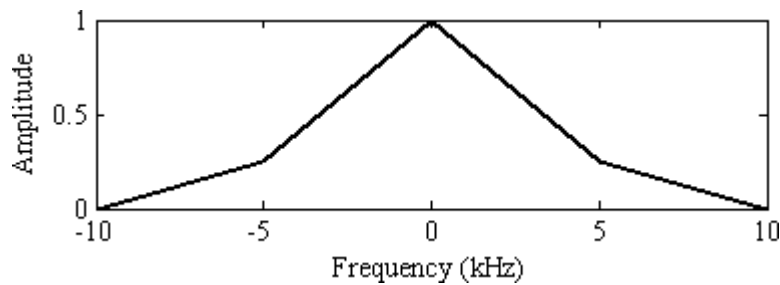


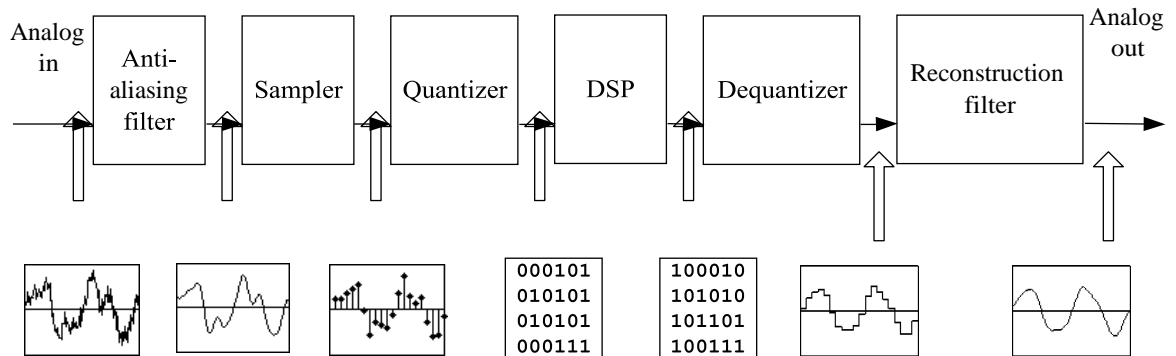
Figure A7

- $f_s = -4$ kHz
 - $f_s = 4$ kHz
 - $f_s = -2$ kHz
 - $f_s = +20$ kHz
8. A system is described by the following equation: $y(n) = \delta(n-2) - x(n-4)$. What is the output if $x(n) = \delta(n)$?
- $\{0, 0, 1, 1\}$
 - $\{0, 1, 0, -1\}$
 - $\{1, 0, 0, -1\}$
 - $\{1, 1, -1, -1\}$

9. A 6 kHz wave is sampled at 18 kHz. How many samples are there in one cycle?
- (a) 2
 - (b) 3
 - (c) 4
 - (d) 5
10. The output of the reconstruction filter is a
- (a) continuous-time and continuous-amplitude signal.
 - (b) continuous-time and discrete-amplitude signal.
 - (c) discrete-time and continuous-amplitude signal.
 - (d) discrete-time and discrete-amplitude signal.

SECTION B

B1 A typical DSP system is shown below.



- (a) What are functions of Quantizer and Reconstruction filter?
- (b) Given the sampling frequency is 10kHz, signal $x(n)$ is composed of three sine wave:
- $$x(n) = \cos(0.1\pi n) + 2\sin(0.25\pi n) + \sin(0.3\pi n)$$
- (i) Find the magnitude of the first two samples, $x(0)$ and $x(1)$.
- (ii) Derive the equation for the continuous time signal $x(t)$.
- (iii) If the signal $x(n)$ is applied to a high pass filter of 1.3 kHz, what will be frequency at the output of the high pass filter.

B2 A digital signal system is described by the difference equation

$$y(n) = 0.9 y(n-2) + x(n-1)$$

Assume that $y(n) = 0$ when $n < 0$,

- (a) Compute the system impulse response, $h(n)$ for a given input signal $x(n) = \delta(n)$ for $n = 0, 1, 2, 3$.
- (b) Sketch the equivalent digital network for this system.
- (c) Is this system stable based on the system impulse response?

B3 Answer the following short questions. Please note that the questions are not related to each other.

- (a) Given a sequence,

$$x(n) = \{1, 2, 3, 4, 5, 6, 7\}$$

Find $x_1(n) = 2x(n-2) + x(n)$ and $x_2(n) = x(3n) + x(n-2)$

- (b) Given the signal, $y(n) = 2^{0.1n} \sin(0.1\pi n)$, plot the first 4 signal samples and indicate their amplitude values.

B4 Given a special device that transmits a signal, $x_1(n) = \delta(n) + 2\delta(n-1) + 3\delta(n-2)$ and $x_2(n) = u(n) - u(n-2)$.

- (a) Determine the convolution of $x_1(n) * x_2(n)$.
- (b) Find the cross-correlation of $y(n) = x_1(n) \otimes x_2(n)$ where ' \otimes ' denotes **cross correlation**?
- (c) Evaluate the autocorrelation of $x_1(n)$.

END OF PAPER

Appendix

The z-transform is defined as $X(z) = \sum_{n=-\infty}^{\infty} x[n]z^{-n}$

Sequence	Transform
$\delta[n]$	1
$u[n]$	$\frac{1}{1 - z^{-1}}$
$\delta[n - m]$	z^{-m}
$a^n u[n]$	$\frac{1}{1 - az^{-1}}$
$na^n u[n]$	$\frac{az^{-1}}{(1 - az^{-1})^2}$
$[\cos \omega_0 n]u[n]$	$\frac{1 - [\cos \omega_0]z^{-1}}{1 - [2 \cos \omega_0]z^{-1} + z^{-2}}$
$[\sin \omega_0 n]u[n]$	$\frac{[\sin \omega_0]z^{-1}}{1 - [2 \cos \omega_0]z^{-1} + z^{-2}}$
$[r^n \cos \omega_0 n]u[n]$	$\frac{1 - [r \cos \omega_0]z^{-1}}{1 - [2r \cos \omega_0]z^{-1} + r^2 z^{-2}}$
$[r^n \sin \omega_0 n]u[n]$	$\frac{[r \sin \omega_0]z^{-1}}{1 - [2r \cos \omega_0]z^{-1} + r^2 z^{-2}}$

Some z-transform properties:	
Sequence	Transform
$x[n]$	$X(z)$
$x_1[n]$	$X_1(z)$
$x_2[n]$	$X_2(z)$
$ax_1[n] + bx_2[n]$	$aX_1(z) + bX_2(z)$
$x[n - m]$	$z^{-m}X(z)$