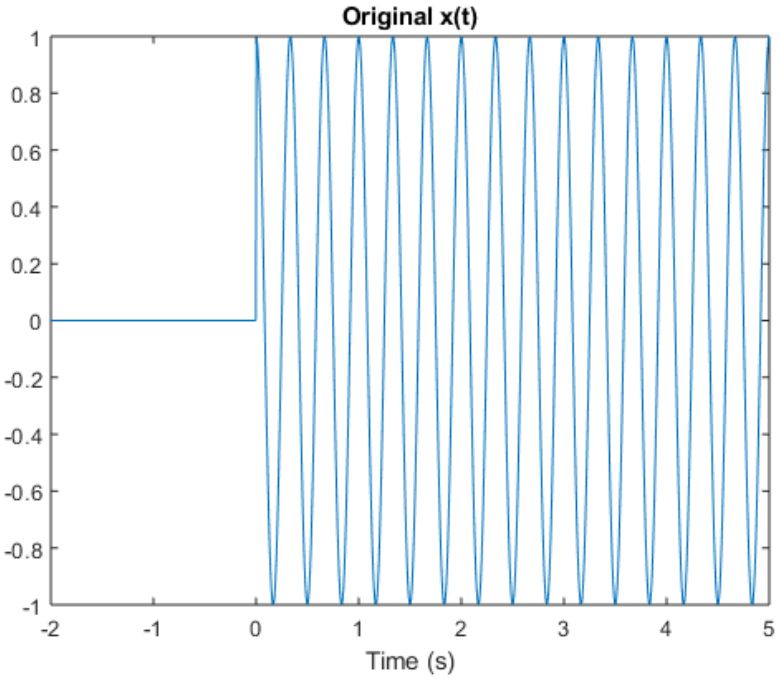
EE3032 – Dr. Durant – Quiz 1, Winter 2019–20, Week 1

Problem 2

Given $x(t) = u(t)\cos(6\pi t)$, which is plotted in the figure above, plot the following functions. Note that $u(t)$ is 1 for $t \geq 0$ and 0 otherwise; thus, it forces the product to 0 when $t < 0$. So, the sinusoid continues forever off the right side of the graph.

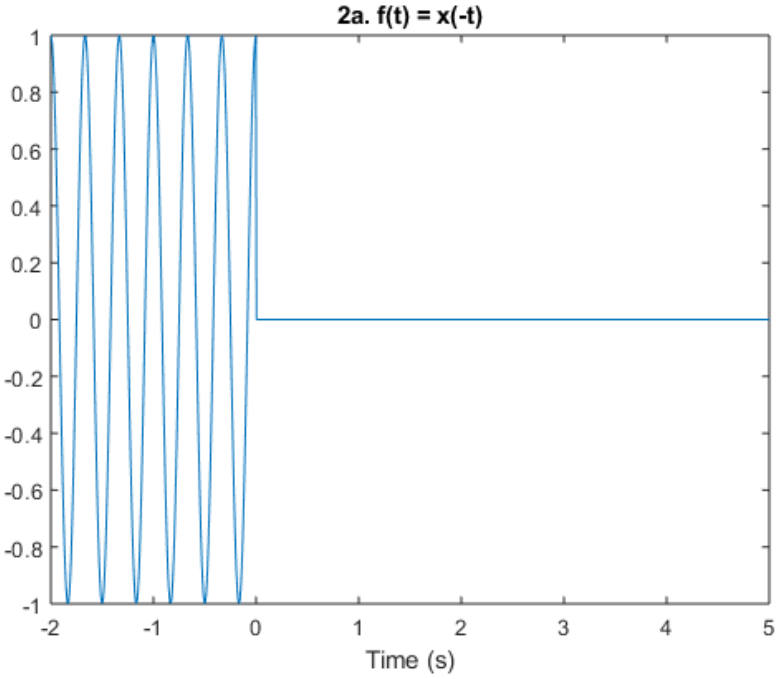
```
t = linspace(-2,5,1000); % 1000 points with t on [-2,5] s
xh = @(t)((t>=0) .* cos(6*pi*t)); % "function handle" to compute given any t (single/scalar or multiple/vector)
% " >= " returns 1 (true) or 0 (false) depending on whether inequality is true.
% " .* " multiplies 2 arrays of the same size, element-by-element, yielding the same size result
x = xh(t); % Call the function and evaluate it at the t, which is a vector, yielding a result vector.
figure
plot(t,x),title('Original x(t)'),xlabel('Time (s)')
```



a. $f(t) = x(-t)$

This is a time reversal, so it is a mirror image about the y axis:

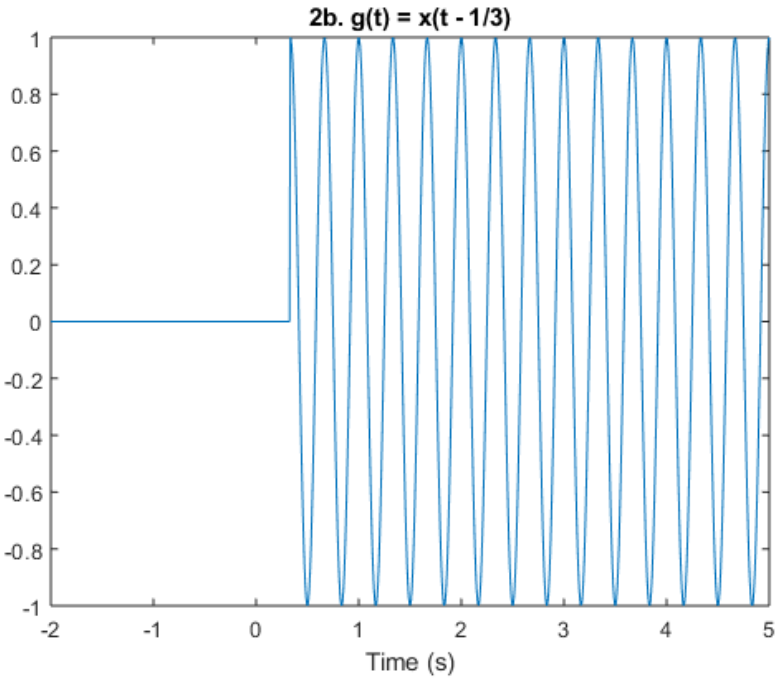
```
f = xh(-t);
figure
plot(t,f),title('2a. f(t) = x(-t)'),xlabel('Time (s)')
```



b. $g(t) = x(t - 1/3)$

This is a delay by 1/3 of a second:

```
g = xh(t-1/3);
figure
plot(t,g),title('2b. g(t) = x(t - 1/3)'),xlabel('Time (s)')
```



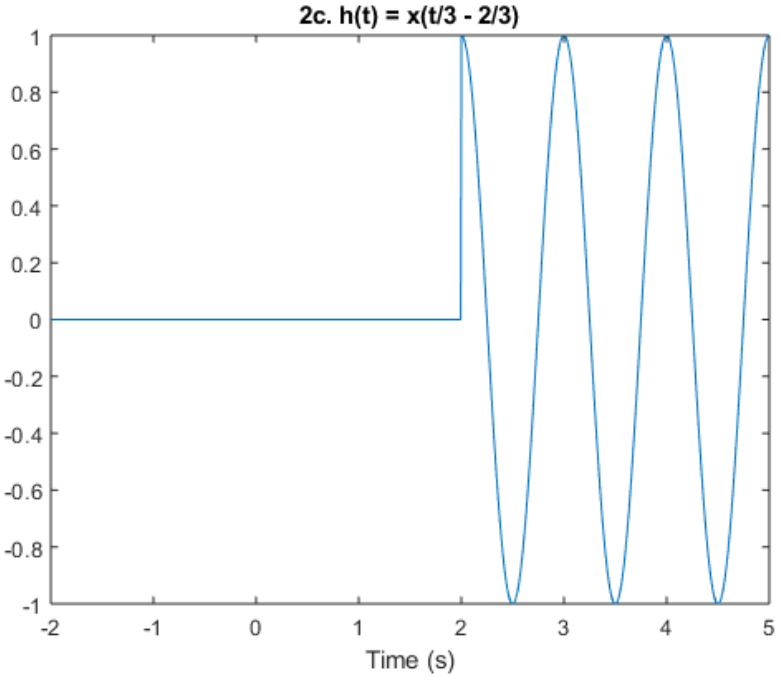
c. $h(t) = x(t/3 - 2/3)$

This is a delay of 2/3 s ***followed by*** an expansion of time by 3x. So the feature at t=0 in the original moves to 2/3 and finally to 3(2/3) = 2 s. Here is another way of looking at it:

h(t) = x(1/3(t-2)). So, this is equivalent to first expanding time by 3x and then delaying by 2. So, the frequency decreases from 3 Hz to 1 Hz.

```
h = xh(t/3 - 2/3);
```

```
figure
plot(t,h),title('2c. h(t) = x(t/3 - 2/3)'),xlabel('Time (s)')
```



Name Answers

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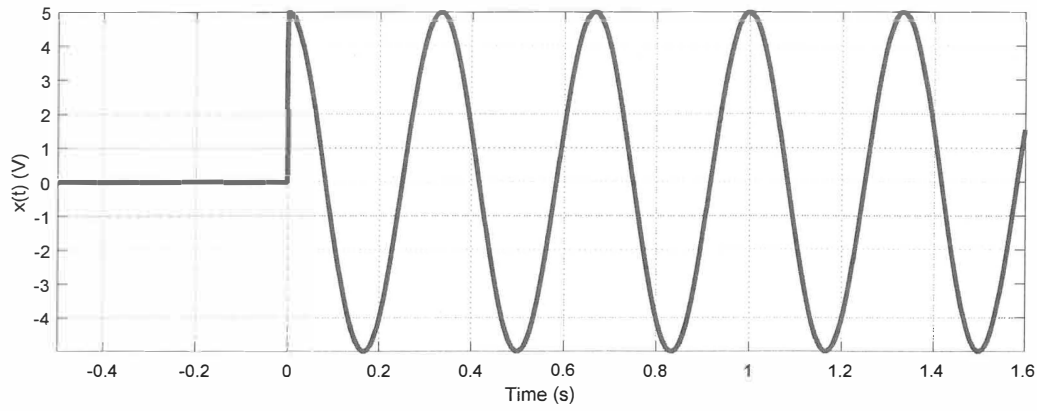


✓1.3 ~~(2~~ points) What is the purpose of quantization?

✓2.7 ~~(4.5~~ points) Given $x(t) = u(t)\cos(6\pi t)$, which is plotted in the figure above, plot the following functions. Note that $u(t)$ is 1 for $t \geq 0$ and 0 otherwise; thus, it forces the product to 0 when $t < 0$. So, the sinusoid continues forever off the right side of the graph.

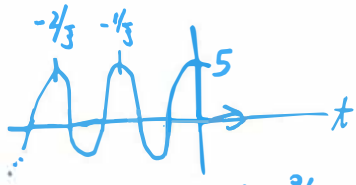
a. $f(t) = x(-t)$
b. $g(t) = x(t - \frac{1}{3})$
c. $h(t) = x(\frac{t}{3} - \frac{2}{3})$

✓3. (1 point) Is $x(t)$ even, odd, both, or neither? Neither

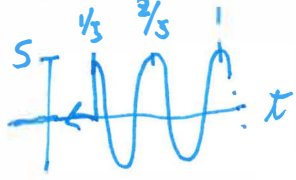
✓4. (2.5 points) Sketch an example of an odd function.

① Convert a continuous, analog voltage to a discrete level/step.

② (a) reversal



(b) delay by $\frac{1}{3}$s = 1 cycle



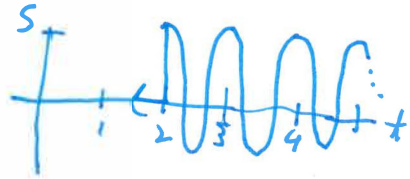
(c) expand time by 3x

$h(t) = x(\frac{t}{3} - \frac{2}{3}) = x(\frac{1}{3}(t-2))$

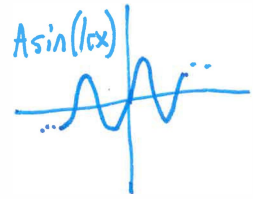
time scaling

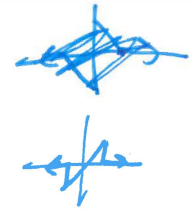
delay of feature @ $t=0$

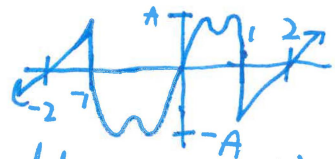
Freq. is now $\frac{3\text{Hz}}{3} = 1\text{Hz}$



④ Some examples







Note: odd → $x(-t) = -x(t)$

Let $t=0$ → $x(-0) = -x(0)$ ∴ $x(0) = 0$