ECE102, Fall 2018 **Homework #2**

Signals & Systems Prof. J.C. Kao

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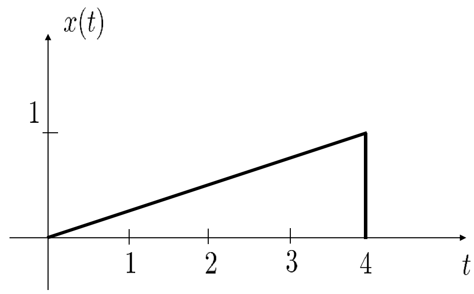
Due Wednesday, 17 Oct 2018, by 11:59pm to Gradescope.
Covers material up to Lecture 4.
100 points total.

1. (23 points) **Elementary signals.**

   (a) (12 points) Consider the signal $x(t)$ shown below. Sketch the following:



i. $x(t)\left(u(t-1)-u(2t-3)\right)$

Solution:
$u(2t-3)=1$ when $2t-3\geq 0$ or $t\geq 3/2$ and 0 otherwise. Thus, $u(2t-3)=u(t-3/2)$. In this way, $(u(t-1)-u(2t-3))=(u(t-1)-u(t-3/2))$, which represents a rectangle defined over $1\leq t\leq 3/2$. Therefore, only the values of $x(t)$ that are between 1 and 3/2 are persevered after its multiplication with the rectangle, as shown in Fig 1.

ii. $x(t)\delta(t-1)-\int_{-\infty}^{6}x(\tau)\delta(\tau-5)d\tau+\int_{-\infty}^{\infty}x(t)\left(u(\tau-4)-u(\tau-5)\right)d\tau$

Solution:
We will go over each term. Using the sampling property for the first term, we have:

$$x(t)\delta(t-1)=x(1)\delta(t-1)=\frac{1}{4}\delta(t-1)$$

Using also the sampling property, for the second term, we have:

$$x(\tau)\delta(\tau-5)=x(5)\delta(\tau-5)=0$$

The third term can be reduced as follows:

$$\int_{-\infty}^{\infty}x(t)\left(u(\tau-4)-u(\tau-5)\right)d\tau=x(t)\int_{4}^{5}1d\tau=x(t)$$

Therefore, we have to sketch the following:

$$\frac{1}{4}\delta(t-1) + x(t)$$

which is shown in Fig 1.

iii. $\frac{d}{dt}x(t)$

Solution:
$x(t)$ can be expressed as follows:

$$x(t) = \frac{1}{4}tu(t) - \frac{1}{4}tu(t-4) = \frac{1}{4}tu(t) - \frac{1}{4}(t-4)u(t-4) - u(t-4) = \frac{1}{4}r(t) - \frac{1}{4}r(t-4) - u(t-4)$$

Therefore,

$$\frac{d}{dt}x(t) = \frac{1}{4}u(t) - \frac{1}{4}u(t-4) - \delta(t-4)$$

The derivative of $x(t)$ is shown in Fig 1.

iv. $x(t) - \frac{1}{2}r(t) + \frac{1}{2}r(t-4) + 2u(t-4)$

Solution:
We know that $x(t) = \frac{1}{4}r(t) - \frac{1}{4}r(t-4) - u(t-4)$. Therefore,

$$x(t) - \frac{1}{2}r(t) + \frac{1}{2}r(t-4) + 2u(t-4) = -\frac{1}{4}r(t) + \frac{1}{4}r(t-4) + u(t-4) = -x(t)$$

$-x(t)$ is shown in Fig 1.

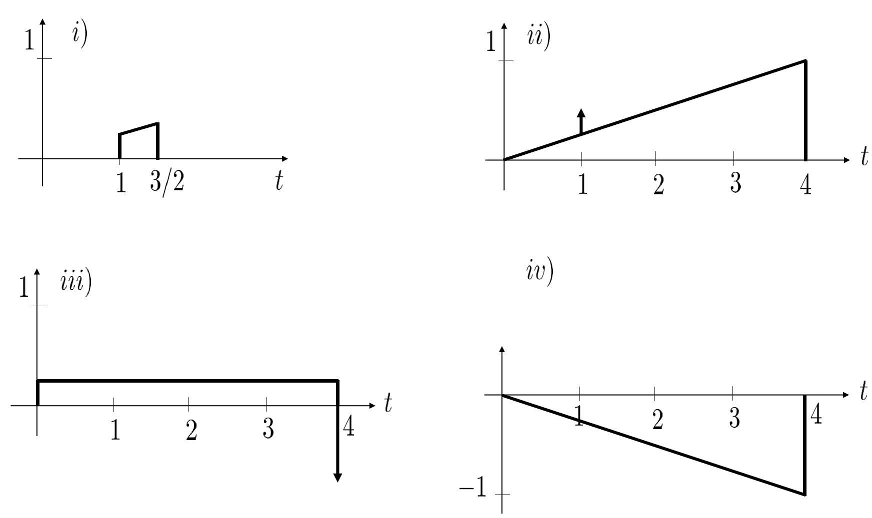


Figure 1: Figures for Problem 1.a

(b) (8 points) Evaluate these integrals:

i. $\int_{-\infty}^{\infty} f(t+1)\delta(t+1)dt$

Solution:
Using the sifting property, we first have: $f(t+1)\delta(t+1) = f(0)\delta(t+1)$. Therefore,

$$\int_{-\infty}^{\infty} f(t+1)\delta(t+1)dt = f(0)\int_{-\infty}^{\infty} \delta(t+1)dt = f(0).$$

ii. $\int_{t}^{\infty} e^{-2\tau}u(\tau-1)d\tau$

Solution:
To evaluate this integral, we have to consider two cases; the first one is when $t \geq 1$ and the second one is when $t < 1$. This is because $u(\tau - 1)$ is one when $\tau \geq 1$ and zero otherwise. Thus, if $t \geq 1$, then:

$$\int_{t}^{\infty} e^{-2\tau}u(\tau-1)d\tau = \int_{t}^{\infty} e^{-2\tau}d\tau = \frac{e^{-2\tau}}{-2}\Big|_{t}^{\infty} = \frac{e^{-2t}}{2}$$

If $t < 1$, then:

$$\int_{t}^{\infty} e^{-2\tau}u(\tau-1)d\tau = \int_{1}^{\infty} e^{-2\tau}d\tau = \frac{e^{-2\tau}}{-2}\Big|_{t}^{\infty} = \frac{e^{-2}}{2}$$

.

iii. $\int_{0}^{\infty} f(t)(\delta(t-1)+\delta(t+1))dt$

Solution:
The integral can be decomposed as follows:

$$\int_{0}^{\infty} f(t)\delta(t-1)dt + \int_{0}^{\infty} f(t)\delta(t+1)dt$$

Using the sifting property for the first integral, we have:

$$\int_{0}^{\infty} f(t)\delta(t-1)dt = \int_{0}^{\infty} f(1)\delta(t-1)dt = f(1)$$

The second integral is zero, because $\delta(t+1)$ is centred at $t = -1$ and the limits of the integration do not include $t = -1$. Therefore,

$$\int_{0}^{\infty} f(t)(\delta(t-1)+\delta(t+1))dt = f(1)$$

iv. $\int_{-\infty}^{\infty} f(\tau)\delta(t-\tau)\delta(t-2)d\tau$

Solution:
The integral can be equivalently written as:

$$\delta(t-2)\int_{-\infty}^{\infty} f(\tau)\delta(t-\tau)d\tau$$

Then applying the sifting property, we have:

$$\delta(t-2)\int_{-\infty}^{\infty} f(t)\delta(t-\tau)d\tau = \delta(t-2)f(t)\int_{-\infty}^{\infty}\delta(t-\tau)d\tau = f(2)\delta(t-2)$$

(c) (4 points) Let b be a positive constant. Show the following property for the delta function:

$$\delta(bt) = \frac{1}{b}\delta(t)$$

Solution:

We know that $\delta(t)$ is defined as follows:

$$\delta(t) = \lim_{\Delta\to 0} \mathrm{rect}_\Delta(t)$$

Therefore,

$$\delta(bt) = \lim_{\Delta\to 0} \mathrm{rect}_\Delta(bt)$$

The rectangle $\mathrm{rect}_\Delta(bt)$ is shown in Fig. 2. Let $\Delta' = \Delta/b$, then the same rectangle can be written as:

$$\mathrm{rect}_\Delta(bt) = \frac{1}{b}\mathrm{rect}_{\Delta'}(t)$$

Therefore,

$$\delta(bt) = \lim_{\Delta\to 0} \mathrm{rect}_\Delta(bt) = \lim_{\Delta'\to 0} \frac{1}{b}\mathrm{rect}_{\Delta'}(t) = \frac{1}{b}\delta(t)$$

Note: we can extend this argument to $b < 0$. In general for any $b \neq 0$, we have:

$$\delta(bt) = \frac{1}{|b|}\delta(t)$$

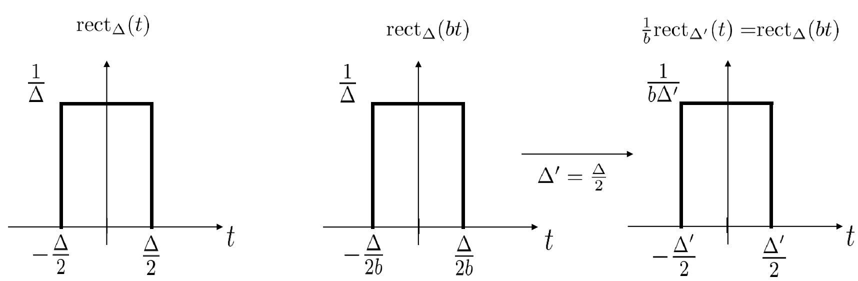
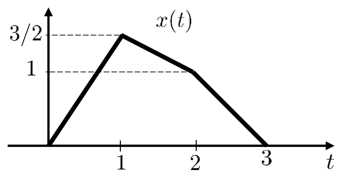


Figure 2:

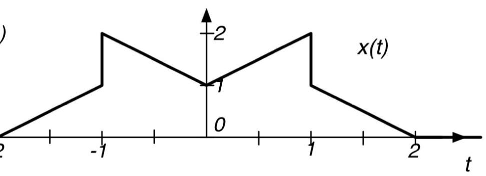
2. (23 points) **Expression for signals.**

(a) (15 points) Write the following signals as a combination (sums or products) of unit triangles $\Delta(t)$ and unit rectangles $\mathrm{rect}(t)$.

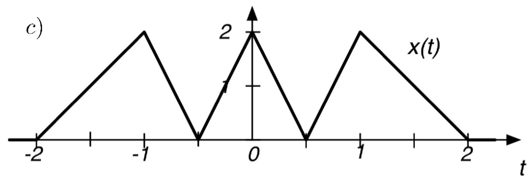
a)



b)



c)



Solution:

i. Fig. a)We can see this signal as the sum of two shifted unit triangles, where the first one is scaled by 3/2, i.e., $x(t) = \frac{3}{2}\Delta(t-1) + \Delta(t-2)$.

ii. Fig. b) We can express this signal as the sum of two triangles one shifted to the left and the second to the right. Now the parts of these two triangles that are lifted by one for $-1 \leq t \leq 1$ can be obtained by adding a rectangle function. Therefore, $x(t) = \Delta(t-1) + \Delta(t+1) + \mathrm{rect}(t/2)$.

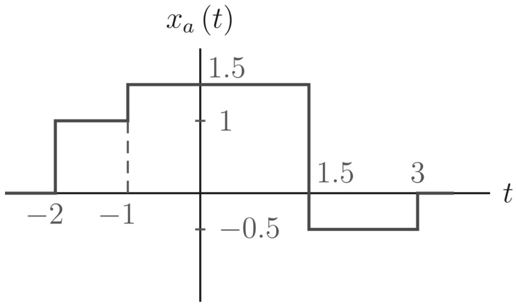
iii. Fig. c) One way to represent this signal is to find an expression for each triangle in terms of the unit triangle. The central triangle can be expressed as: $2\Delta(2t)$. The triangle that is on the right side can be expressed as the sum of two triangles that are time-scaled and shifted: $2\Delta(2(t-1)) + \Delta(2(t-3/2))$. Similarly, the part that is on the left can be expressed as follows: $2\Delta(2(t+1)) + \Delta(2(t+3/2))$. Therefore, $x(t) = 2\Delta(2(t+1)) + \Delta(2(t+3/2)) + 2\Delta(2t) + 2\Delta(2(t-1)) + \Delta(2(t-3/2))$

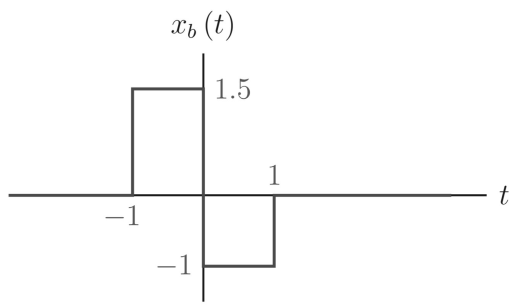
(b) (8 points) Express each of the signals shown below using scaled and time shifted unit-step functions.

Solution:

i. $x_a(t) = u(t+2) + 0.5u(t+1) - 2(t-1.5) + 0.5u(t)$

ii. $x_b(t) = 1.5u(t+1) - 2.5u(t) + u(t-1)$





3. (34 points) **System properties.**

   (a) (21 points) A system with input $x(t)$ and output $y(t)$ can be time-invariant, causal or stable. Determine which of these properties hold for each of the following systems. Explain your answer.

      i. $y(t) = |x(t)| + x(2t)$

      Solution:
      Time-invariance: If we delay the input by τ, i.e., $x_\tau(t) = x(t-\tau)$, the output is:

      $$y_\tau(t) = |x_\tau(t)| + x_\tau(2t) = |x(t-\tau)| + x(2t-\tau)$$

      On the other hand,
      $$y(t-\tau) = |x(t-\tau)| + x(2(t-\tau))$$
      Since $y(t-\tau) \neq y_\tau(t)$, the system is time-variant.
      Causality: Since the output can depend on future values of the input, the system is not causal. For instance, the output at $t=2$ depends on $x(4)$.
      Stability: If $|x(t)| \leq B_x$ for any t, then

      $$|y(t)| = ||x(t)| + x(2t)| \leq |x(t)| + |x(2t)| \leq 2B_x$$

      The output is also bounded, the system is then stable.

      ii. $y(t) = \int_{t-T}^{t+T} x(\lambda)d\lambda$, where T is positive and constant.

      Solution:
      Time-invariance: If we delay the input by τ, i.e., $x_\tau(t) = x(t-\tau)$, the output is:

      $$y_\tau(t) = \int_{t-T}^{t+T} x_\tau(\lambda)d\lambda = \int_{t-T}^{t+T} x(\lambda-\tau)d\lambda$$

      Let $\lambda' = \lambda - \tau$, then

      $$y_\tau(t) = \int_{t-T-\tau}^{t+T-\tau} x(\lambda')d\lambda' = \int_{(t-\tau)-T}^{(t-\tau)+T} x(\lambda')d\lambda'$$

      which is equal to $y(t-\tau)$. The system is then time-invariant.

Causality: The system is integrating values of $x(t)$ from $t-T$ to $t+T$. The output depends on future values of $x(t)$, therefore it is not causal.
Stability: If $|x(t)| \leq B_x$ for any t, then

$$|y(t)| = \left| \int_{t-T}^{t+T} x(\lambda) d\lambda \right| \leq \int_{t-T}^{t+T} |x(\lambda)| \, d\lambda \leq \int_{t-T}^{t+T} B_x d\lambda = 2TB_x$$

The output is also bounded, the system is then stable.

iii. $y(t) = (t+1) \int_{-\infty}^{t} x(\lambda) d\lambda$

Solution:
Time-invariance: If we delay the input by τ, i.e., $x_\tau(t) = x(t-\tau)$, the output is:

$$y_\tau(t) = (t+1) \int_{-\infty}^{t} x_\tau(\lambda) d\lambda = (t+1) \int_{-\infty}^{t} x(\lambda - \tau) d\lambda$$

Let $\lambda' = \lambda - \tau$, then

$$y_\tau(t) = (t+1) \int_{-\infty}^{t-\tau} x(\lambda') d\lambda'$$

On the other hand,

$$y(t-\tau) = (t-\tau+1) \int_{-\infty}^{t-\tau} x(\lambda) d\lambda$$

Therefore $y(t-\tau) \neq y_\tau(t)$. The system is then time variant.
Causality: The system is integrating values of $x(t)$ up to time t. The output does not depend on future values of $x(t)$, the system is then causal.
Stability: Even if $x(t)$ is absolutely bounded, the integral:

$$\int_{-\infty}^{t} x(\lambda) d\lambda$$

cannot in general be bounded, the system is unstable. For instance, suppose $x(t) = 1$, then $\int_{-\infty}^{t} 1 d\lambda \to \infty$. Another example, suppose $x(t) = u(t)$, then

$$y(t) = (t+1) \int_{-\infty}^{t} u(\lambda) d\lambda = (t+1) \int_{0}^{t} 1 d\lambda = (t+1)t$$

$(t+1)t$ cannot be bounded as $t \to \infty$, because $(t+1)t \to \infty$ as $t \to \infty$.

iv. $y(t) = 1 + x(t) \cos(\omega t)$

Solution:
Time-invariance: If we delay the input by τ: $x_\tau(t) = x(t-\tau)$, the output is:

$$y_\tau(t) = 1 + x_\tau(t) \cos(\omega t) = 1 + x(t-\tau) \cos(\omega t)$$

On the other hand,

$$y(t-\tau) = 1 + x(t-\tau) \cos(\omega(t-\tau))$$

Since $y(t-\tau) \neq y_\tau(t)$. The system is then time-variant.
Causality: Since the output does not depend on any future values of the input, the system is causal.
Stability: If $|x(t)| \leq B_x$ for any t, then

$$|y(t)| = |1 + x(t)\cos(\omega t)| \leq 1 + |x(t)| \leq 1 + B_x$$

The output is also bounded, the system is then stable.

v. $y(t) = \cos(\omega t + x(t))$

Solution:
Time-invariance: If we delay the input by τ: $x_\tau(t) = x(t-\tau)$, the output is:

$$y_\tau(t) = \cos(\omega t + x_\tau(t)) = \cos(\omega t + x(t-\tau))$$

On the other hand,

$$y(t-\tau) = \cos(\omega(t-\tau) + x(t-\tau))$$

Since $y(t-\tau) \neq y_\tau(t)$. The system is then time-variant.
Causality: Since the output does not depend on any future values of the input, the system is causal.
Stability: Since the output is always bounded ($|y(t)| \leq 1$), the system is stable.

vi. $y(t) = \int_{-\infty}^{t/2} x(\lambda)d\lambda$

Solution:
Time-invariance: If we delay the input by τ, i.e., $x_\tau(t) = x(t-\tau)$, the output is:

$$y_\tau(t) = \int_{-\infty}^{t/2} x_\tau(\lambda)d\lambda = \int_{-\infty}^{t/2} x(\lambda-\tau)d\lambda$$

Let $\lambda' = \lambda - \tau$, then

$$y_\tau(t) = \int_{-\infty}^{t/2-\tau} x(\lambda')d\lambda'$$

On the other hand,

$$y(t-\tau) = \int_{-\infty}^{(t-\tau)/2} x(\lambda)d\lambda$$

Therefore $y(t-\tau) \neq y_\tau(t)$. The system is then time variant.
Causality: The system is integrating values of $x(t)$ up to time $t/2$. Since for $t = -1$, the value of x at $t/2 = -1/2$ is considered as a future value, the system is not causal.
Stability: Even if $x(t)$ is absolutely bounded, the integral:

$$\int_{-\infty}^{t/2} x(\lambda)d\lambda$$

cannot in general be bounded, the system is unstable.

vii. $y(t) = \frac{1}{1+x^2(t)}$

Solution:
Time-invariance: If we delay the input by τ, i.e., $x_\tau(t) = x(t-\tau)$, the output is:

$$y(t) = \frac{1}{1+x_\tau^2(t)} = \frac{1}{1+x^2(t-\tau)}$$

On the other hand,

$$y(t-\tau) = \frac{1}{1+x^2(t-\tau)}$$

Therefore $y(t-\tau) = y_\tau(t)$. The system is then time invariant.
Causality: The output depends on present value of the input. The system is then causal.
Stability: We have the denominator:

$$1 + x^2(t) \geq 1 \implies \frac{1}{1+x^2(t)} \leq 1$$

for any t. This implies that $y(t) \leq 1$. Moreover $y(t) > 0$, therefore for any t, we always have $|y(t)| \leq 1$. The system is always stable.

(b) (4 points) Consider a system H that takes a signal $x(t)$ as input and returns the even part of $x(t)$ as output, i.e.,

$$x_e(t) = H(x(t))$$

where $x_e(t)$ is the even part of $x(t)$. Is it time invariant? Is it stable?

Solution:
The system is given by:

$$y(t) = \frac{1}{2}(x(t) + x(-t))$$

Time-invariance: If we delay the input by τ: $x_\tau(t) = x(t-\tau)$, the output is:

$$y_\tau(t) = \frac{1}{2}(x_\tau(t) + x_\tau(-t)) = \frac{1}{2}(x(t-\tau) + x(-t-\tau))$$

On the other hand,

$$y(t-\tau) = \frac{1}{2}(x(t-\tau) + x(-(t-\tau))) = \frac{1}{2}(x(t-\tau) + x(-t+\tau))$$

Since $y(t-\tau) \neq y_\tau(t)$, the system is then time-variant.
Stability: Assume that $|x(t)| \leq B_x$. Then,

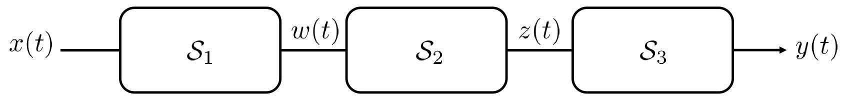
$$|y(t)| = \frac{1}{2}|x(t) + x(-t)| \leq \frac{1}{2}(|x(t)| + |x(-t)|) \leq B_x$$

Therefore, the system is stable.

(c) (5 points) Consider the following three systems:

$$\mathcal{S}_1 : w(t) = x(t/2)$$
$$\mathcal{S}_2 : z(t) = \int_{-\infty}^{t} w(\tau)d\tau$$
$$\mathcal{S}_3 : y(t) = \mathcal{S}_3(z(t))$$

The three systems are connected in series as illustrated here:



Choose the third system $\mathcal{S}_3$, such that overall system is equivalent to the following system:

$$y(t) = \int_{-\infty}^{t-1} x(\tau)d\tau$$

Solution: We first express $z(t)$ in terms of $x(t)$:

$$z(t) = \int_{-\infty}^{t} w(\tau)d\tau = \int_{-\infty}^{t} x(\tau/2)d\tau$$

Let $\tau' = \tau/2$, then $d\tau' = d\tau/2$ and $\tau \leq t \implies \tau' = \tau/2 \leq t/2$,

$$z(t) = 2\int_{-\infty}^{t/2} x(\tau')d\tau'$$

To obtain the required $y(t)$ from $z(t)$, we need first to do a time-scaling by 2 for $z(t)$. This step gives us:

$$z(2t) = 2\int_{-\infty}^{t} x(\tau')d\tau'$$

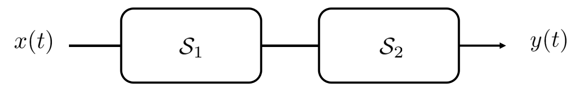
The second step is to do a right shift by 1:

$$z(2(t-1)) = 2\int_{-\infty}^{t-1} x(\tau')d\tau'$$

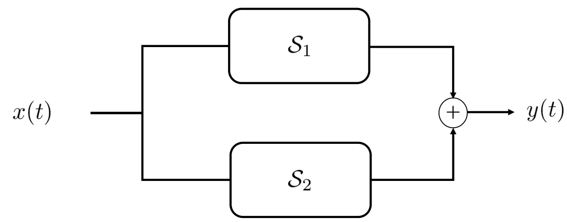
Therefore, the third system is as follows:

$$y(t) = \frac{1}{2}z(2(t-1))$$

(d) (4 points) In part (c), you saw an example of three systems connected in series. In general, systems can be interconnected in series or in parallel to form what we call cascaded systems. The figure below shows the difference between a series cascade and a parallel cascade. *Note that parts (c) and (d) are unrelated.*



(a) Series Cascade



(b) Parallel Cascade

i. (2 points) Show that the series cascade of any two time-invariant systems is also time-invariant.

Solution:
Suppose the output of $\mathcal{S}_1$ is $y_1(t)$ when the input is $x(t)$, and that the output of $\mathcal{S}_2$ is $y(t)$ when the input is $y_1(t)$. If we delay $x(t)$ by τ (the input to the first system is now $x(t-\tau)$), then the output of the first system is $y_1(t-\tau)$. This is because the system is time-invariant. $y_1(t-\tau)$ is now the input to the second system. Again, since the second system is time-invariant, the output of the second system is $y(t-\tau)$. Therefore, for the overall system, when we apply $x(t-\tau)$ as input, we get $y(t-\tau)$ as output. The series cascade is then time-invariant.

ii. (2 points) Show that the parallel cascade of any two time-invariant systems is also time-invariant.

Solution:
Suppose for input $x(t)$, we get the outputs $y_1(t)$ and $y_2(t)$ respectively from S_1 and S_2. Therefore, $y(t) = y_1(t) + y_2(t)$. If we delay the input by τ (the input is now $x(t-\tau)$), then we get $y_1(t-\tau)$ and $y_2(t-\tau)$ respectively from S_1 and S_2 because both systems are time-invariant. Therefore, the output is $y_1(t-\tau)+y_2(t-\tau)$ which is equal to $y(t-\tau)$. Thus, the overall system is time-invariant.

iii. (*Optional*) Can you think of two **time-variant** systems, whose series cascade is **time-invariant**? Can you think of two **time-variant** systems, whose parallel cascade is **time-invariant**?

Solution:
Yes, for series cascade: $S_1 : y(t) = x(t/2)$ and $S_2 : y(t) = x(2t)$
For parallel cascade: $S_1 : y(t) = x(t) - tx(t)$ and $S_2 : y(t) = x(t) + tx(t)$

4. (10 points) **Power and energy of complex signals**

   (a) (5 points) Is $x(t) = Ae^{j\omega t} + Be^{-j\omega t}$ a power or energy signal? A and B are both real numbers, not necessarily equal. If it is an energy signal, compute its energy. If it is a power signal, compute its power. (*Hint: Use the fact that the square magnitude of a complex number v is: $|v|^2 = v^*v$, where v^* is the complex conjugate of the complex number v.*)

   Solution:

   $x(t)$ is a periodic signal, therefore it is not an energy signal (its energy goes to infinity). It is a power signal. To calculate its power, we compute first the magnitude of $x(t)$:

$$\begin{aligned}
|x(t)|^2 = x(t)x(t)^* &= (Ae^{j\omega t} + Be^{-j\omega t})(Ae^{-j\omega t} + Be^{j\omega t}) \\
&= A^2 + ABe^{j2\omega t} + ABe^{-j2\omega t} + B^2 \\
&= A^2 + B^2 + 2AB\cos(2\omega t)
\end{aligned}$$

   Therefore, the power of $x(t)$:

$$\begin{aligned}
P &= \lim_{T\to\infty} \frac{1}{2T} \int_{-T}^{T} \left(A^2 + B^2 + 2AB\cos(2\omega t)\right) dt \\
&= \lim_{T\to\infty} \frac{1}{2T} \left(2TA^2 + 2TB^2 + AB \frac{\sin(2\omega t)}{\omega}\bigg|_{-T}^{T} \right) \\
&= \lim_{T\to\infty} \frac{1}{2T} \left(2TA^2 + 2TB^2 + 2AB \frac{\sin(2\omega T)}{\omega} \right) \\
&= A^2 + B^2
\end{aligned}$$

   (b) (5 points) Is $x(t) = e^{-(1+j\omega)t}u(t-1)$ an energy signal or power signal? Again, if it is an energy signal, compute its energy. If it is a power signal, compute its power.

   Solution:

   The magnitude of $x(t)$ is given by:

$$|x(t)| = e^{-t}u(t-1)$$

   Therefore, its energy is:

$$E = \int_{1}^{\infty} e^{-2t} dt = \frac{e^{-2t}}{-2}\bigg|_{t=1}^{\infty} = \frac{e^{-2}}{2}$$

   Therefore, it is an energy signal. Its power is then 0.

5. (15 points) **MATLAB**

   (a) (5 points) **Task 1**

   A complex sinusoid is denoted:

$$y(t) = e^{(\sigma + j\omega)t}$$

First compute a vector representing time from 0 to 10 seconds in about 500 steps (You can use `linspace`). Use this vector to compute a complex sinusoid with a period of 2 seconds, and a decay rate that reduces the signal level at 10 seconds to half its original value. What σ and ω did you choose? If your complex exponential is y, plot:

```
>> plot(y);
```

What is MATLAB doing here?

Solution:

We want the period to be of 2 seconds, this implies that $\omega = \pi$. We also want a decay rate that reduces the signal level at 10 seconds to half its original value, this implies:

$$e^{10\sigma} = \frac{1}{2} \implies \sigma = -\ln(2)/10$$

```
t=linspace(0,10,500); sigma=-log(2)/10; omega=pi;
y=exp((sigma+j*omega)*t); plot(y);
```

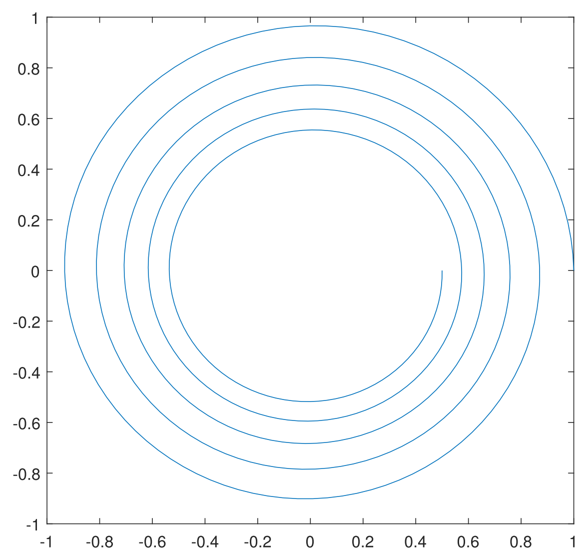


Figure 3: Task 1

When the MATLAB function `plot(y)` takes one argument `y` that is complex, it plots the imaginary part of `y` versus the real part of `y`.

(b) (5 points) **Task 2**

Use the `real()` and `imag()` MATLAB functions to extract the real and imaginary parts of the complex exponential, and plot them as a function of time (plot them separately, you can use `subplot` for this task). This should look more reasonable. Label your axes, and check that your signal has the required period and decay rate.

Solution:

```
subplot(2,1,1);
plot(t,real(y)); xlabel('t(sec)'); ylabel('Real pat of y(t)');
subplot(2,1,2);
plot(t,imag(y)); xlabel('t(sec)'); ylabel('Imaginary pat of y(t)');
```

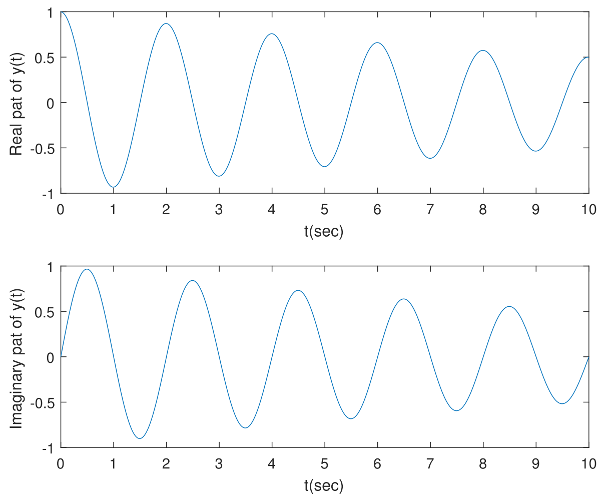


Figure 4: Task 2

(c) (5 points) **Task 3**

Use the `abs()` and `angle()` functions to plot the magnitude and phase angle of the complex exponential (plot them in the same figure). Scale the `angle()` plot by dividing it by `2*pi` so that it fits well on the same plot as the `abs()` plot (i.e. plot the angle in cycles, instead of radians, the function `angle(x)` returns the angle in radians).

Solution:

```
plot(t,abs(y),'g',t,angle(y)/(2*pi),'r');
xlabel('t(sec)'); ylabel('Magnitude and phase of y(t)'); grid on;
```

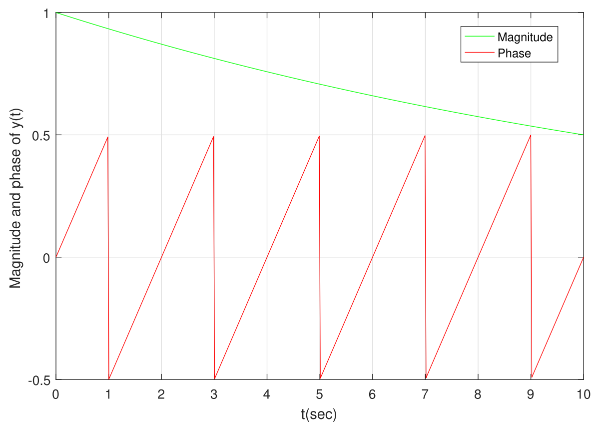


Figure 5: Task 3