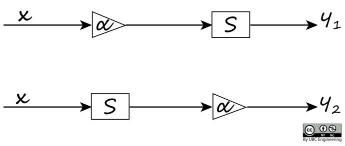
Somith Das **2019W2_ELEC_221_201**
Assignment Problem_Set_2 due 01/28/2020 at 11:59pm PST

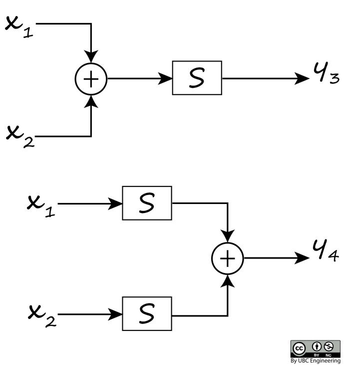
The continuous time system S is described by $y(t) = \dfrac{[x(t)]^2}{8x(6t-2)}$, where $x(t)$ is the input and $y(t)$ is the output of the system.

a) In the two diagrams below, find the outputs y_1 and y_2 in terms of the input x if $\alpha = 2$:



$y_1 =$ ______________ $y_2 =$ ______________

b) In the two diagrams below, find the outputs y_3 and y_4 in terms of the inputs x_1 and x_2:



$y_3 =$ ______________ $y_4 =$ ______________

Enter "x1" for x_1 and "x2" for x_2.

c) Is the system S additive? [?/Yes/No]

d) Is the system S linear? [?/Yes/No]

e) Is the system S causal? [?/Yes/No]

f) Is the system S memoryless? [?/Yes/No]

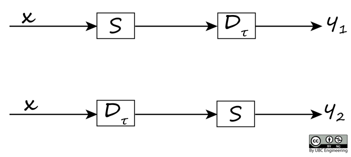
Part **c** will only be marked correct if part **b** is correct. Parts **d** to **f** will only be marked correct if parts **a** and **b** are both correct._

Correct Answers:

- `2*[x(t)]^2/[8*x(6*t-2)]`
- `2*[x(t)]^2/[8*x(6*t-2)]`
- `[x1(t)+x2(t)]^2/(8*[x1(6*t-2)+x2(6*t-2)])`
- `[x1(t)]^2/[8*x1(6*t-2)]+[x2(t)]^2/[8*x2(6*t-2)]`
- `No`
- `No`
- `No`
- `No`

The continuous time system S is described by $y(t) = x(t-2) + x(6-t)$, where $x(t)$ is the input and $y(t)$ is the output of the system.

a) In the two diagrams below, find the outputs y_1 and y_2 in terms of the input signal x. Here, D_τ shows a delay system that introduces a delay of τ.

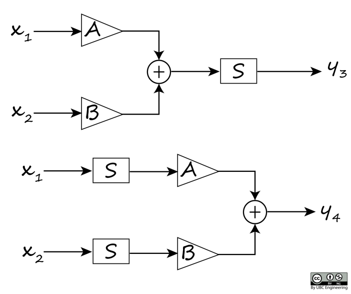


$y_1(t) =$ ______________ $y_2(t) =$ ______________

Use "T" to represent τ in your solutions.

b) Is the system S time-invariant? [?/Yes/No]

c) In the two diagrams below, find the outputs y_3 and y_4 in terms of the input signals x_1 and x_2.



$y_3 =$ ______________ $y_4 =$ ______________

Use "x1" to represent x_1 and "x2" to represent x_2 in your solutions.

d) Is the system S linear? [?/Yes/No]

e) Is the system S causal? [?/Yes/No]

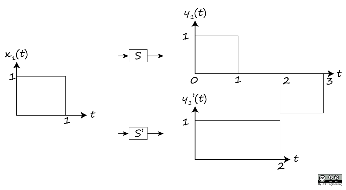
f) Is the system S memoryless? [?/Yes/No]

*Part **b** will only be marked correct if part **a** is correct. Part **d** will only be marked correct if part **c** is correct. Parts **e** to **f** will only be marked correct if parts **a** and **c** are both correct.*

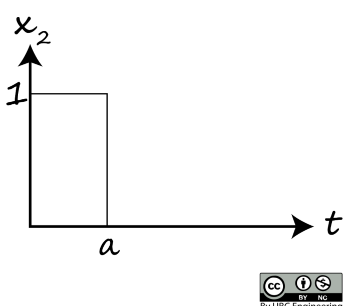
Correct Answers:

- `x(t-T-2)+x(6-t+T)`
- `x(t-T-2)+x(6-t-T)`
- `No`
- `A*[x1(t-2)+x1(6-t)]+B*[x2(t-2)+x2(6-t)]`
- `A*[x1(t-2)+x1(6-t)]+B*[x2(t-2)+x2(6-t)]`
- `Yes`
- `No`
- `No`

Consider a continuous-time LTI system S where for the input signal $x_1(t)$, the output is $y_1(t)$ as shown in the figure below.

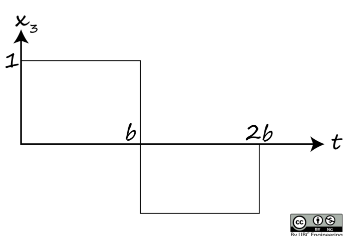


a) Find the output $y_2(t)$ for the input signal $x_2(t)$ defined as in the following graph. Enter your answer as an expression in terms of the Heaviside function, $u(t)$. Assume $a = 0.3$.



$y_2(t) =$__________ $y_2'(t) =$__________

b) Find the output $y_3(t)$ if this time the input signal $x_3(t)$ is defined as in the following graph. Enter your answer as an expression in terms of the Heaviside function, $u(t)$. Assume $b = 14$.



$y_3(t) =$__________ $y_3'(t) =$__________

c) What is the impulse response of this system? In your answers, use $D(t)$ instead of $\delta(t)$.

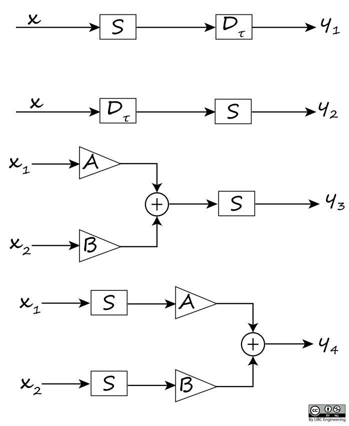
$h(t) =$__________ $h'(t) =$__________

*Part **c** will only be marked correct if parts **a** and **b** are both correct.*

Correct Answers:

- `u(t)-u(t-0.3)-u(t-2)+u(t-2-0.3)`
- `u(t)-u(t-0.3)+u(t-1)-u(t-1-0.3)`
- `u(t)-2*u(t-14)+u(t-28)-u(t-2)+2*u(t-14-2)-u(t-28-2)`
- `u(t)-2*u(t-14)+u(t-28)+u(t-1)-2*u(t-14-1)+u(t-28-1)`
- `D(t)-D(t-2)`
- `D(t)+D(t-1)`

For each of the continuous-time systems 1 to 4 given below, determine the outputs y_1, y_2, y_3, and y_4 in terms of the inputs x, x_1 and x_2, and the other variables A, B and τ as obtained from the figure. D_τ is a delay system where if the input is x, the output $y = D_\tau(x)$ is given by $y(t) = x(t-\tau)$. *In your answers, enter "T" for* τ.



a) System 1: $y(t) = -8[x(t) + x(t-13)]$

$y_1(t) =$__________ $y_2(t) =$__________ $y_3(t) =$__________ $y_4(t) =$__________

Is System 1:	
Linear?	[?/Yes/No]
Time-invariant?	[?/Yes/No]
Causal?	[?/Yes/No]
Memoryless?	[?/Yes/No]

b) System 2: $y(t) = x(t-6) + x(12-t)$

$y_1(t) =$__________ $y_2(t) =$__________ $y_3(t) =$__________ $y_4(t) =$__________

Is System 2:

Linear?	[?/Yes/No]
Time-invariant?	[?/Yes/No]
Causal?	[?/Yes/No]
Memoryless?	[?/Yes/No]

c) System 3: $y(t) = x(t)cos(22t)$

$y_1(t) =$ ________ $y_2(t) =$ ________ $y_3(t) =$ ________ $y_4(t) =$ ________

Is System 3:

Linear?	[?/Yes/No]
Time-invariant?	[?/Yes/No]
Causal?	[?/Yes/No]
Memoryless?	[?/Yes/No]

d) System 4: $y(t) = [3x(t) + 9x(-t)]u(t)$

$y_1(t) =$ ________ $y_2(t) =$ ________ $y_3(t) =$ ________ $y_4(t) =$ ________

Is System 4:

Linear?	[?/Yes/No]
Time-invariant?	[?/Yes/No]
Causal?	[?/Yes/No]
Memoryless?	[?/Yes/No]

Correct Answers:

- `-8*[x(t-T)+x(t-13-T)]`
- `-8*[x(t-T)+x(t-13-T)]`
- `A*(-8)*[x1(t)+x1(t-13)]+B*(-8)*[x2(t)+x2(t-13)]`
- `A*(-8)*[x1(t)+x1(t-13)]+B*(-8)*[x2(t)+x2(t-13)]`
- `Yes`
- `Yes`
- `Yes`
- `No`
- `x(t-T-6)+x(12-t+T)`
- `x(t-T-6)+x(12-t-T)`
- `A*[x1(t-6)+x1(12-t)]+B*[x2(t-6)+x2(12-t)]`
- `A*[x1(t-6)+x1(12-t)]+B*[x2(t-6)+x2(12-t)]`
- `Yes`
- `No`
- `No`
- `No`
- `x(t-T)*cos(22*(t-T))`
- `x(t-T)*cos(22*t)`
- `A*x1(t)*cos(22*t)+B*x2(t)*cos(22*t)`
- `A*x1(t)*cos(22*t)+B*x2(t)*cos(22*t)`
- `Yes`
- `No`
- `Yes`
- `Yes`
- `[3*x(t-T)+9*x(-t+T)]*u(t-T)`
- `[3*x(t-T)+9*x(-t-T)]*u(t)`
- `A*[3*x1(t)+9*x1(-t)]*u(t)+B*[3*x2(t)+9*x2(-t)]*u(t)`
- `A*[3*x1(t)+9*x1(-t)]*u(t)+B*[3*x2(t)+9*x2(-t)]*u(t)`
- `Yes`
- `No`
- `Yes`
- `No`

The impulse response of an LTI system is given by: $h(t) = 3[u(t) - u(t-7)]$

a) Express the output of the system $y(t)$ as a single integral where the integrand is a function of $\nu = t - \tau$. Express $f(\nu)$ in terms of $x(\nu)$. Enter ν as "v".

$$\int_{b_0}^{b_1} f(\nu)d\nu = \int_{\_\_\_\_}^{\_\_\_\_} \_\_\_\_\_\_\_\_ d\nu$$

b) Find the unit-step response $s(t)$ of the system and express this piecewise function as a combination of ramp functions, $r(t)$.

$s(t) =$ ____________

Correct Answers:

- `t`
- `t-7`
- `3*x(v)`
- `3*[r(t)-r(t-7)]`

The impulse response of an LTI system is given by: $h(t) = e^{qt}u(t)$, where q is a real number.

a) What is the condition on parameter q so that the system is BIBO stable?

$q =$ [?/</>/=/<=/>=] ___

b) Now suppose that $q = -6$. Calculate the output of the system $y_1(t)$ at $t = 6.5$ and $t = 12$ when the input is given by $x(t) = u(t-3) - u(t-8)$.

$y_1(6.5) =$ ___ $y_1(12) =$ ___

c) Find the expression that describes the output of the system $y_2(t)$ for $0 < t < 4$ when $q = -6$ and the input is $x(t) = \sum_{k=-\infty}^{\infty} \delta(t-4k)$.

$y_2(t) =$ ___ for $0 \le t < 4$

Hint: Use the shifting property of the delta function and the geometric series.

Correct Answers:

- <
- 0
- 0.166666666540291
- 6.29189090713125E-12
- e^(-6*t)/[1-e^(-24)]