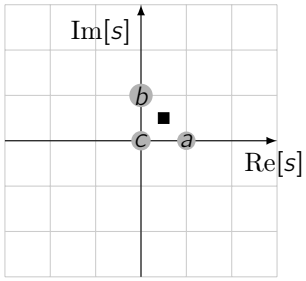
Domanda 1

Where will the sequence of the powers of the complex number ■, i.e., $■^k$ for $k \to +\infty$, converge?



Potenziali risposte:

I: *a*

II: *b*

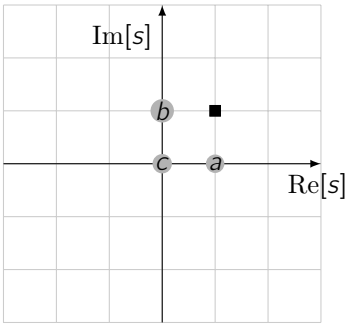
III: *c*

IV: it will diverge

V: I do not know

Domanda 2

Where will the sequence of the powers of the complex number ■, i.e., $■^k$ for $k \to +\infty$, converge?



Potenziali risposte:

I: *a*

II: *b*

III: *c*

IV: it will diverge

V: I do not know

Domanda 3

One may use the concept of "impulse response" to describe a nonlinear system.

Potenziali risposte:

I: true

II: false

III: it depends on the nonlinear system

IV: I do not know

Domanda 4

One may use the concept of "transfer function" to describe a nonlinear system. .

Potenziali risposte:

I: true

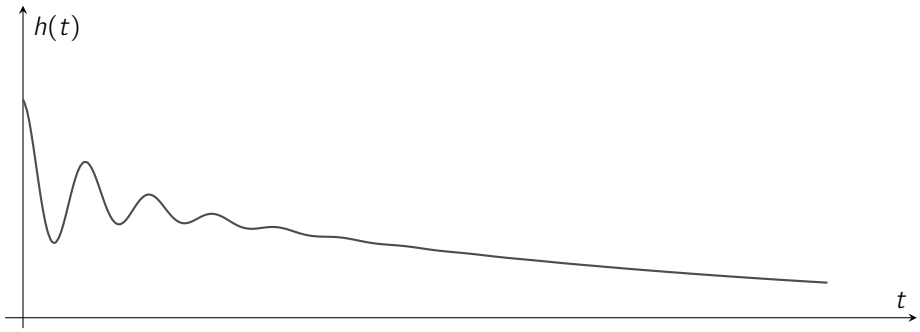
II: false

III: it depends on the nonlinear system

IV: I do not know

Domanda 5

Which type of LTI system may produce the impulse response $h(t)$ represented in the picture?



Potenziali risposte:

I: first order

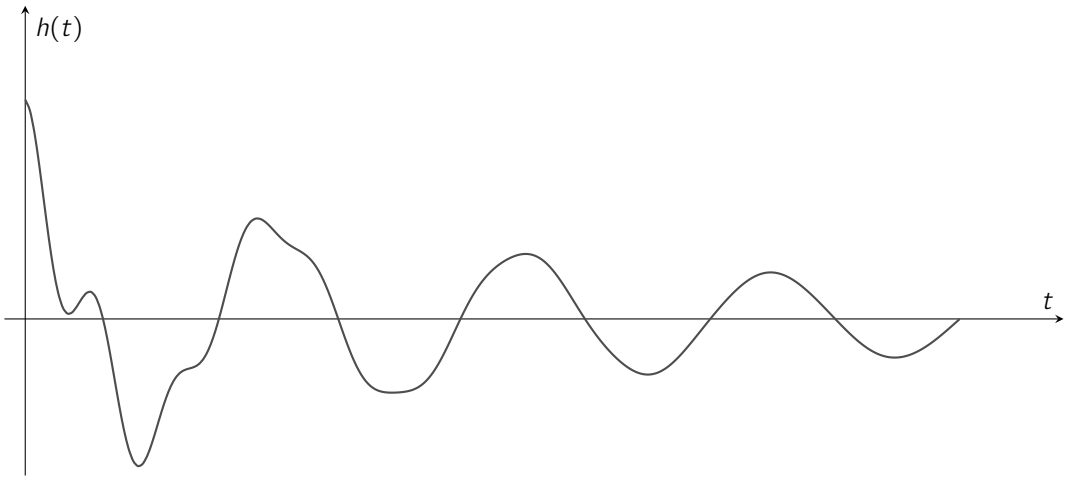
II: second order

III: at least third order

IV: I do not know

Domanda 6

Which type of LTI system may produce the impulse response $h(t)$ represented in the picture?



Potenziali risposte:

I: first order

II: second order

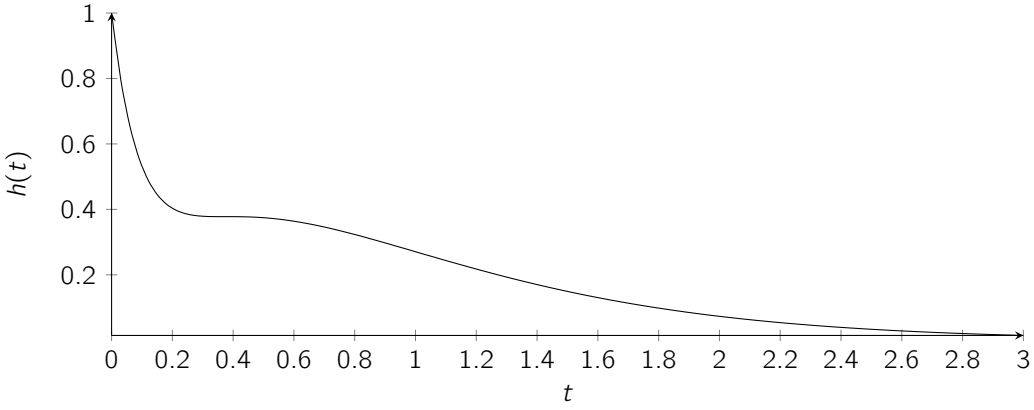
III: third order

IV: at least fourth order

V: I do not know

Domanda 7

Which type of LTI system may produce the impulse response $h(t)$ represented in the picture?



Potenziali risposte:

I: first order

II: second order

III: at least third order

IV: I do not know

Domanda 8

For which value of a are the equilibria of the continuous-time autonomous LTI system $\dot{y} = ay$ asymptotically stable?

Potenziali risposte:

I: $a < 0$

II: $a \leq 0$

III: $a = 0$

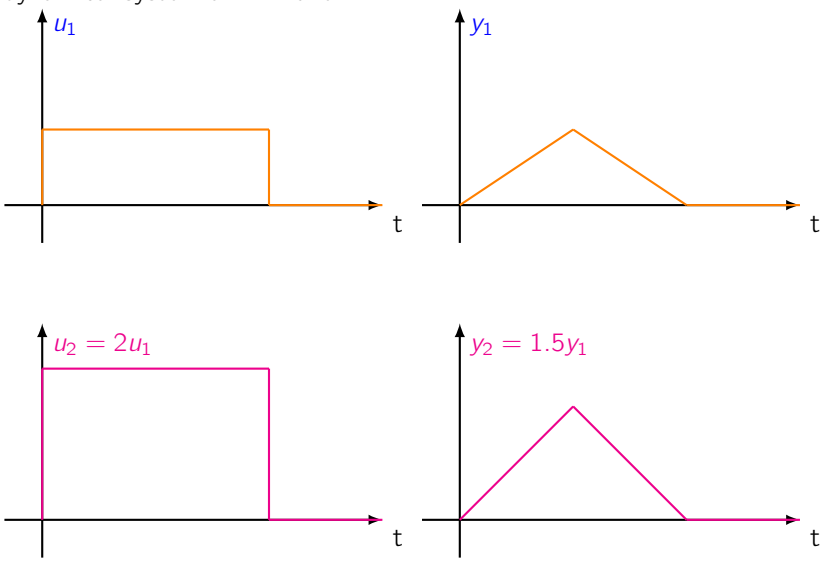
IV: $a \geq 0$

V: $a > 0$

VI: I do not know

Domanda 9

Consider a dynamical system whose response to the input u_1 below, starting from null initial conditions, is the output y_1. Consider also that the response of this system to the input u_2 below, again starting from null initial conditions, is the output u_2. Is this dynamical system an LTI one?



Potenziali risposte:

I: yes

II: no

III: it depends on the actual values of u_1 and y_1

IV: I do not know

Domanda 10

The impulse response associated to the system $\dot{y} = -0.5y + 3u$ is equal to ...

Potenziali risposte:

I: $e^{0.5t}$

II: $e^{-0.5t}$

III: $0.5e^{0.5t}$

IV: $-0.5e^{-0.5t}$

V: $3e^{0.5t}$

VI: $3e^{-0.5t}$

VII: $e^{0.5t}$ for $t \geq 0$, 0 otherwise

VIII: $e^{-0.5t}$ for $t \geq 0$, 0 otherwise

IX: $0.5e^{0.5t}$ for $t \geq 0$, 0 otherwise

X: $-0.5e^{-0.5t}$ for $t \geq 0$, 0 otherwise

XI: $3e^{0.5t}$ for $t \geq 0$, 0 otherwise

XII: $3e^{-0.5t}$ for $t \geq 0$, 0 otherwise

XIII: I do not know

Domanda 11

The impulse response of a LTI system contains all the information that is needed to compute the trajectories of that system for every input u and initial condition y_0.

Potenziali risposte:

I: true

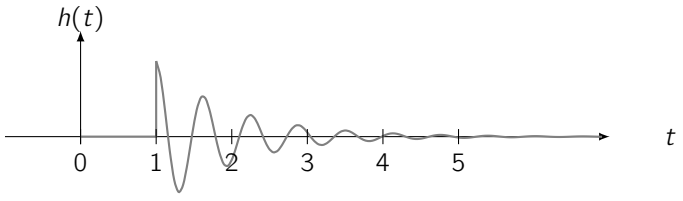
II: false

III: it depends

IV: I do not know

Domanda 12

Consider the impulse response $h(t)$ given by the plot below, where the distance between consecutive marks in the axes indicate one unit.



Assume that for $t < 0$ the LTI system characterized by this impulse response is in equilibrium, i.e., that $y(t) = 0$ for $t < 0$, and that and also $u(t) = 0$ for $t < 0$. Assume then $u(t)$ to be a Dirac delta centered in $t - 10$, i.e., $u(t) = \delta(t - 10)$. Then the output of the system at time 10.0001 is ...

Potenziali risposte:

I: $y(10.0001) < 0$

II: $y(10.0001) = 0$

III: $y(10.0001) > 0$

IV: I do not know

Domanda 13

The convolution of a rectangular signal with itself leads to ...

Potenziali risposte:

I: another rectangle

II: a triangle

III: a trapezoid

IV: it depends on the length of the rectangle

V: I do not know

Domanda 14

Convolution is a nonlinear operator.

Potenziali risposte:

I: true

II: false

III: it depends on the actual signals that are convolved

IV: I do not know

Domanda 15

The equilibria of the system

$$\dot{x} = f(x) = x^2 - 2x - 3$$

are ...

Potenziali risposte:

I: -1

II: 3

III: both -1 and 3

IV: I do not know

Domanda 16

The origin $(\boldsymbol{u}, \boldsymbol{y}) = (\mathbf{0}, \mathbf{0})$ is always an equilibrium for a LTI system of the type $\dot{\boldsymbol{y}} = A\boldsymbol{y} + B\boldsymbol{u}$.

Potenziali risposte:

I: true

II: false

III: it depends

IV: I do not know

Domanda 17

The origin is always an equilibrium for a generic system of the type $\dot{\boldsymbol{y}} = \boldsymbol{f}(\boldsymbol{y}, \boldsymbol{u})$.

Potenziali risposte:

I: true

II: false

III: it depends

IV: I do not know

Domanda 18

Is the continuous time LTI system characterized by the impulse response

$$h(t) = \begin{cases} e^{-2t} & \text{if } t \geq 0 \\ 0 & \text{otherwise} \end{cases}$$

BIBO stable?

Potenziali risposte:

I: yes

II: no

III: it depends

IV: I don't know

Domanda 19

Is the continuous time LTI system characterized by the impulse response

$$h(t) = \begin{cases} 1 & \text{if } t \geq 0 \\ 0 & \text{otherwise} \end{cases}$$

BIBO stable?

Potenziali risposte:

I: yes

II: no

III: it depends

IV: I don't know

Domanda 20

Is the continuous time LTI system characterized by the impulse response

$$h(t) = \begin{cases} \frac{1}{t+1} & \text{if } t \geq 0 \\ 0 & \text{otherwise} \end{cases}$$

BIBO stable?

Potenziali risposte:

I: yes

II: no

III: it depends

IV: I don't know

Domanda 21

Is the transfer function corresponding to the impulse response

$$h(t) = \begin{cases} \frac{1}{t+1} & \text{if } t \geq 0 \\ 0 & \text{otherwise} \end{cases}$$

a rational transfer function?

Potenziali risposte:

I: yes

II: no

III: it depends

IV: I don't know

Domanda 22

Is the transfer function corresponding to the impulse response

$$h(t) = \begin{cases} \frac{1}{t+1} & \text{if } t \geq 0 \\ 0 & \text{otherwise} \end{cases}$$

a rational transfer function?

Potenziali risposte:

I: yes

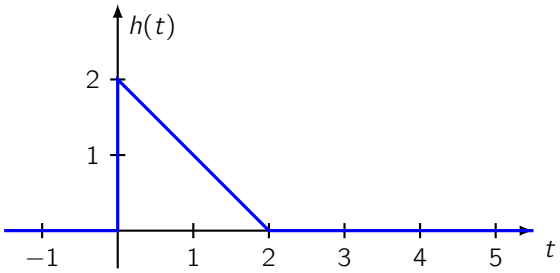
II: no

III: it depends

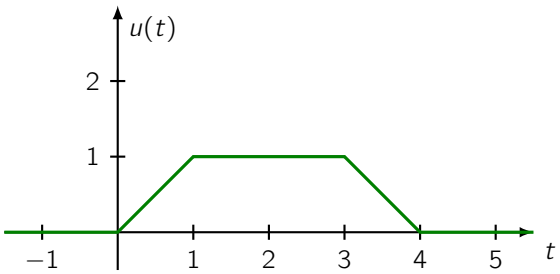
IV: I don't know

Domanda 23

Consider a continuous time LTI system with impulse response $h(t)$ is equal to



and the input signal $u(t)$ equal to



The forced response of the system at $t = 5$ is then equal to ...

Potenziali risposte:

I: 1

II: 1/6

III: 6

IV: I don't know

Domanda 24

Can a delayed LTI system (i.e., a LTI system whose impulse response contains a delay) be BIBO stable?

Potenziali risposte:

I: yes

II: no

III: it depends

IV: I do not know

Domanda 25

Can a non-causal LTI system be BIBO stable?

Potenziali risposte:

I: yes

II: no

III: it depends

IV: I do not know

Domanda 26

Can a continuous time LTI system whose transfer function have some poles on the imaginary axis be BIBO stable?

Potenziali risposte:

I: yes

II: no

III: it depends

IV: I do not know

Domanda 27

Consider a continuous time input output LTI system of order 4 for which all the poles of its transfer function are distinct. Must the associated impulse response comprise at least one mode of the type $e^{\lambda t}$ with $\lambda \in \mathbb{R}$?

Potenziali risposte:

I: yes

II: no

III: it depends

IV: I don't know

Domanda 28

Consider a continuous time input output LTI system of order 3 for which all the poles of its transfer function are distinct. Must the associated impulse response comprise at least one mode of the type $e^{\lambda t}$ with $\lambda \in \mathbb{R}$?

Potenziali risposte:

I: yes

II: no

III: it depends

IV: I don't know

Domanda 29

How would one Laplace-transform the ODE $\dddot{y} = \dot{y} + u$, assuming that all the initial conditions are 0?

Potenziali risposte:

I: $s^{-3}Y = s^{-1}Y + U$

II: $s^3Y = sY + U$

III: I do not know

Domanda 30

To what does $\frac{1}{s}$ correspond, from an intuitive perspective, if we consider Laplace transforms of continuous time signals?

Potenziali risposte:

I: a derivative

II: an integrator

III: a multiplication in frequency

IV: I do not know

Domanda 31

What is the time constant associated to the continuous time LTI system whose transfer function is $\frac{1}{s+3}$?

Potenziali risposte:

I: 0.3

II: 3

III: 1/3

IV: undefined

V: I do not know

Domanda 32

$\mathcal{L}(\ddot{x}) =?$

Potenziali risposte:

I: $s^2X(s) + sx(0) + \dot{x}(0)$

II: $s^2X(s) - sx(0) - \dot{x}(0)$

III: $s^2X(s) + s\dot{x}(0) + x(0)$

IV: $s^2X(s) - s\dot{x}(0) - x(0)$

V: I do not know

Domanda 33

$\mathcal{L}(t^n e^{at}) = ?$

Potenziali risposte:

I: $\frac{n!}{(s-a)^n}$

II: $\frac{n!}{(s-a)^{n+1}}$

III: $\frac{n!}{(s+a)^n}$

IV: $\frac{n!}{(s+a)^{n+1}}$

V: I do not know

Domanda 34

Consider writing the free evolution of a continuous time LTI system as a sum of modes, i.e.,

$$y_{\text{fe}}(t) = \sum_i c_i t^{m_i} \exp(\alpha_i t) \cos(\omega_i t + \phi_i).$$

Which of the various parameters above may change with the initial conditions (i.e., $y(0)$, $\dot{y}(0)$, $\ddot{y}(0)$, ...) of the system?

Potenziali risposte:

I: only the residuals c_i and the phase shifts ϕ_i

II: only the orders of the modes m_i

III: only the time constants $\left|\frac{1}{\alpha_i}\right|$

IV: only the frequencies ω_i

V: I do not know

Domanda 35

Which measurement unit is associated to s in a Laplace transform of a signal $y(t)$?

Potenziali risposte:

I: seconds

II: seconds^{-1}

III: hours

IV: hours^{-1}

V: none of the above

VI: I do not know

Domanda 36

The number of potentially different modes that compose the impulse response of a continuous time LTI system is ...

Potenziali risposte:

I: equal to the number of zeros of its transfer function, counted with their multiplicity

II: at most equal to the number of zeros of its transfer function, counted with their multiplicity

III: equal to the number of poles of its transfer function, counted with their multiplicity

IV: at most equal to the number of poles of its transfer function, counted with their multiplicity

V: I do not know

Domanda 37

Every continuous time LTI system admits a rational transfer function.

Potenziali risposte:

I: true

II: false

III: it depends on the system

IV: I do not know

Domanda 38

The BIBO stability properties of a continuous time LTI system depend on the position of the zeros of the transfer function of the system, assuming there are no zero poles cancellations.

Potenziali risposte:

I: true

II: false

III: it depends on the system

IV: I do not know

Domanda 39

Changing the zeros of a transfer function of an LTI system means changing the transient associated to the step response of that system.

Potenziali risposte:

I: true

II: false

III: it depends on the system

IV: I do not know