Assignment 01

The due date for submitting this assignment has passed. Due on 2019-02-13, 23:59 IST.

Assignment submitted on 2019-02-08, 13:44 IST

Instructions:

1. Attempt all questions.
2. Submission deadline: 13th February 2019 23:59 IST
3. Solutions to be posted: 14th February 2019
4. Older browsers might show unnecessary vertical bars at the end of math equations.

1) The inverse of a causal LTI system, \( y(t) = x(t - m - n) \) is always causal.  
   
   No, the answer is incorrect. 
   Score: 0  
   Accepted Answers: False

2) Consider the causal LTI system described by the difference equation \( 2y[n] = 3y[n - 1] + y[n - 2] + x[n] \). The given system is BIBO stable.

   No, the answer is incorrect. 
   Score: 0  
   Accepted Answers: False

3) The composition of two linear maps is linear.

   No, the answer is incorrect. 
   Score: 0  
   Accepted Answers: False
4) Given the output of the LTI system \( y(t) = x(t) \ast h(t) \). The value of \( y(5t) \) is

- \( 25(x(t) \ast h(t)) \)
- \( \frac{1}{25}(x(5t) \ast h(5t)) \)
- \( 5(x(5t) \ast h(5t)) \)
- \( \frac{1}{5}(x(t) \ast h(t)) \)

No, the answer is incorrect.

Score: 0

Accepted Answers:
True

5) A reciprocal system is defined as \( y[n] = T(x[n]) = \frac{1}{x[n]} \). Which of the following statement(s) given below are true about the reciprocal system.

- Linear
- Time invariant
- Non-linear
- Time variant
- Series connection of two such systems is not a linear system

No, the answer is incorrect.

Score: 0

Accepted Answers:
Time invariant

6) Consider an LTI system described as

\[
x[n + 1] = \begin{bmatrix} -1 & 0 \\ 1 & 1 \end{bmatrix} x[n] + \begin{bmatrix} 3/4 \end{bmatrix} f[n]; \quad y[n] = \begin{bmatrix} 1 & 0 \end{bmatrix} x[n].
\]

Determine the number of modes present in the system? The transfer function of the system is given by \( H(z) = \frac{Y(z)}{F(z)} \)

- 0
- 1
- 2
- 4

No, the answer is incorrect.

Score: 0

Accepted Answers:
1

7) Determine the modes of the system with impulse response \( y(n) = \{1, \frac{3}{4}, \frac{1}{2}, \frac{5}{16}, \ldots\} \).

- \( \frac{1}{4} \) and \( -\frac{1}{4} \)

Score: 0

Accepted Answers:
1
Let an auto-regressive system with output \( y[n] \) for the forcing function \( f[n] \) be given by\[ y[n+2] + 2y[n+1] + y[n] = f[n+2] + 3f[n+1] + 5f[n]. \] Which among the following gives a state-space representation of the system?

- \( A = \begin{bmatrix} 0 & 1 \\ -1 & -2 \end{bmatrix}, \ b = \begin{bmatrix} 0 \\ 1 \end{bmatrix}, \ c = \begin{bmatrix} 4 \\ 1 \end{bmatrix}, \ d = 1 \)
- \( A = \begin{bmatrix} 0 & -1 \\ 1 & -2 \end{bmatrix}, \ b = \begin{bmatrix} 0 \\ 1 \end{bmatrix}, \ c = \begin{bmatrix} 4 \\ 1 \end{bmatrix}, \ d = 1 \)
- \( A = \begin{bmatrix} -1 & 0 \\ 2 & -1 \end{bmatrix}, \ b = \begin{bmatrix} 0.5 \\ -1 \end{bmatrix}, \ c = \begin{bmatrix} 8 \\ 3 \end{bmatrix}, \ d = 1 \)
- \( A = \begin{bmatrix} -2 & -1 \\ 1 & 0 \end{bmatrix}, \ b = \begin{bmatrix} 1 \\ 0 \end{bmatrix}, \ c = \begin{bmatrix} 1 \\ 4 \end{bmatrix}, \ d = 1 \)

No, the answer is incorrect.
Score: 0
Accepted Answers:
- \( A = \begin{bmatrix} 0 & 1 \\ -1 & -2 \end{bmatrix}, \ b = \begin{bmatrix} 0 \\ 1 \end{bmatrix}, \ c = \begin{bmatrix} 4 \\ 1 \end{bmatrix}, \ d = 1 \)

A discrete-time system with forcing function \( f[n] \) and output \( y[n] \) is represented using state variables \( u[n] \) and \( w[n] \) as \[ w[n+1] = 2u[n] + 3f[n], \]
\[ u[n+1] = w[n] + 2f[n], \]
\[ y[n] = u[n] + 3w[n] + f[n]. \]
Which of the following represent the state space parameters \((A, b, c^T, d)\) of the system?

- \( A = \begin{bmatrix} 0 & 1 \\ 2 & 0 \end{bmatrix}, \ b = \begin{bmatrix} 3 \\ 2 \end{bmatrix}, \ c^T = [1 \ 3], \ d = 1 \)
- \( A = \begin{bmatrix} 0 & 2 \\ 1 & 0 \end{bmatrix}, \ b = \begin{bmatrix} 3 \\ 2 \end{bmatrix}, \ c^T = [3 \ 1], \ d = 1 \)
- \( A = \begin{bmatrix} 0 & 1 \\ 2 & 0 \end{bmatrix}, \ b = \begin{bmatrix} 2 \\ 3 \end{bmatrix}, \ c^T = [1 \ 3], \ d = 1 \)
The state space representation of a LTI system has \( \mathbf{A} \) and \( \mathbf{b} \). Then which of the following statements should hold true always for \( \mathbf{A}' \) to also represent the same system?

1. \( \det(\mathbf{A}) = \det(\mathbf{A}') \)
2. eigenvalues of \( \mathbf{A} \) = eigenvalues of \( \mathbf{A}' \)
3. \( \text{Trace}(\mathbf{A}) = \text{Trace}(\mathbf{A}') \)

Which of the following statements are true:

- Only 1 and 2
- Only 1 and 3
- Only 2 and 3
- 1, 2 and 3
- None of the above

No, the answer is incorrect.
Score: 0

Accepted Answers:
- 1, 2 and 3

11. Let \( S_1 \) and \( S_2 \) be two different subspaces in the vector space \( V \) such that \( S_1 \nsubseteq S_2 \) and \( S_2 \nsubseteq S_1 \), then which of the following are vector spaces:

- \( S_1 \setminus S_2 \)
- \( S_1 \cup S_2 \)
- \( S_1 \cap S_2 \)

\( \{(v_1, v_2) \mid v_1 \in S_1, v_2 \in S_2 \} \) with \( (u_1, u_2) + (v_1, v_2) = (u_1 + v_1, u_2 + v_2) \)

No, the answer is incorrect.
Score: 0

Accepted Answers:
- \( S_1 \cap S_2 \)

\( \{(v_1, v_2) \mid v_1 \in S_1, v_2 \in S_2 \} \) with \( (u_1, u_2) + (v_1, v_2) = (u_1 + v_1, u_2 + v_2) \)

12. Consider the vector space \( \mathbb{R}^{n \times n} \). Then \( \mathcal{W} = \{ A \in \mathbb{R}^{n \times n} : \text{Trace}(A) = 1 \} \) is a subspace of \( \mathbb{R}^{n \times n} \).

- True
- False

No, the answer is incorrect.
Score: 0

Accepted Answers:
- False
No, the answer is incorrect.
Score: 0
Accepted Answers: False