Quizzes of TTK4225 - Systems Theory, Autumn 2020

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Question 140

Can we have $BA \neq \mathbf{0}$ even if $AB = \mathbf{0}$?

Question 141

Which is more correct to say among these two options?

1. a matrix defines a specific linear transformation
2. a matrix defines a specific linear transformation from a specific basis into another

1. the first
2. the second
3. they are equivalent
4. I don't know

Question 142

Assume that a LTI system admits a rational transfer function with two distinct zeros and three distinct poles. Then the associated minimal state space system realizing that transfer function has its state update matrix . . .

1. diagonalizable
2. diagonalizable if there are no poles-zeros cancellations
3. non-diagonalizable
4. I don't know

Question 143

If the state update matrix of a LTI system is diagonalizable then the system is controllable

1. true
2. false
3. it depends
4. I don't know

Question 144

Consier a generic matrix $A \in \mathbb{R}^{n \times n}$, and its characteristic polynomial, i.e., the scalars $\alpha_0, \alpha_1, \ldots, \alpha_{n-1}$ such that

$$A^n = -\alpha_{n-1} A^{n-1} - \ldots - \alpha_1 A - \alpha_0 I$$

and forming the polynomial

$$s^n + \alpha_{n-1} s^{n-1} + \ldots + \alpha_1 s + \alpha_0 .$$

Then the characteristic polynomial is the lowest order polynomial that is nullified by A. I.e., there are no other scalars $\beta_0, \beta_1, \ldots, \beta_{m-1}$ with $m < n$ such that

$$A^m = -\beta_{m-1} A^{m-1} - \ldots - \beta_1 A - \beta_0 I$$

1. true
2. false
3. it depends
4. I don't know

Question 145

Compute e^{At} with

$$A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 3 \end{bmatrix}$$

Question 146

Compute e^{At} with

$$A = \begin{bmatrix} 1 & 1 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

Question 147

Consider the autonomous system

$$\begin{cases} \dot{\boldsymbol{x}} & = \begin{bmatrix} 1 & 1 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix} \boldsymbol{x} \\ y & = \begin{bmatrix} 1 & 0 & 1 \end{bmatrix} \boldsymbol{x} \end{cases}$$

Compute $y(t)$ assuming that the initial condition for the system is

$$\boldsymbol{x}_0 = \begin{bmatrix} 0 \\ 1 \\ 2 \end{bmatrix}$$

Question 148

Consider the system

$$\begin{cases} \dot{\boldsymbol{x}} & = \begin{bmatrix} 1 & 1 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix} \boldsymbol{x} + \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix} u \\ y & = \begin{bmatrix} 1 & 0 & 1 \end{bmatrix} \boldsymbol{x} \end{cases}$$

1. Compute its step response;
2. say how the step response would change if B was $[0, 0, 1]^T$;
3. say how the step response would change if C was $[1, 0, 0]$.

Question 149

Consider the system

$$\begin{cases} \dot{\boldsymbol{x}} &= \begin{bmatrix} 1 & 3 & 5 \\ 2 & 1 & 0 \\ 0 & 1 & 2 \end{bmatrix} \boldsymbol{x} + \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix} u \\ y &= \begin{bmatrix} 1 & 0 & 1 \end{bmatrix} \boldsymbol{x} \end{cases}$$

How may one do to compute its step response?

Question 150

Compute e^{At} with

$$A = \begin{bmatrix} 0 & 1 \\ -k & -f \end{bmatrix}$$

Question 151

Assume that a system is s.t. its state update matrix A is s.t. $A^m = \mathbf{0}$ for some m. How does this help computing the forced response of the system?