Assignment 2

The due date for submitting this assignment has passed. As per our records you have not submitted this assignment. Due on 2018-09-05, 23:59 IST.

(A)

1) Given the following the dynamics

\[ \begin{align*}
    \dot{x}_1 &= -x_1^3 + x_1x_2 \\
    \dot{x}_2 &= -x_2^3
\end{align*} \]

And the following Lyapunov candidate function

\[ V(x_1, x_2) = \frac{1}{2} x_1^2 + \frac{1}{2} x_2^2 \]

Which of the following is true? (Click on all the correct answers)

- The state \( x_1 \to 0 \) as \( t \to \infty \)
- The state \( x_2 \to 0 \) as \( t \to \infty \)
- Origin is asymptotically stable
- Origin is Lyapunov stable

No, the answer is incorrect.

Score: 0

Accepted Answers:

- The state \( x_1 \to 0 \) as \( t \to \infty \)
- Origin is Lyapunov stable

(B) For the following functions write “TRUE” if the function is positive definite and write “FALSE” otherwise

2) \[ V(x) = x^T (A^T A)x, \text{ where } x \in \mathbb{R}^n, A \in \mathbb{R}^{n \times m}, n > m \]
3) \( V(x) = x^T (A^T BA)x \), where \( x \in \mathbb{R}^n, A \in \mathbb{R}^{2 \times 2}, B = \begin{bmatrix} 1 & 4 \\ 0.5 & 2 \end{bmatrix} \)

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: String) FALSE

(C) With reference to the MRAC design method in lectures 3 and 4 answer the following. Given the following

**Plant**: \( \dot{x} = ax + bu \)  
**Reference model**: \( \dot{x}_m = a_m x_m + b_m r \).

Where \( a, b \) are unknown scalars and \( a_m, b_m \) are known scalars. Write "TRUE" or "FALSE" for the following

4) Lower bound of \(|b|\) is required for designing indirect MRAC :

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: String) True

5) Lower bound of \(|b|\) is required for designing direct MRAC :

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: String) False

6) \( \text{sign}(b) \) is required for designing indirect MRAC :

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: String) TRUE

7) \( \text{sign}(b) \) is required for designing direct MRAC :

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: String) TRUE
(D) Consider the Lyapunov equation

\[ A^T P + PA = -Q \]

Where \( A \in \mathbb{R}^{n \times n} \), \( P \in \mathbb{R}^{n \times n} \) and \( P = P^T \). For \( x \in \mathbb{R}^n \), write “TRUE” or “FALSE” for the following

8) \( x^T PAx = -2x^T Qx \):

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: String) FALSE

9) \( 2x^T PAx = -x^T Qx \):

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: String) TRUE

10) \( 1/2 \ x^T PAx = -x^T Qx \):

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: String) FALSE

11) \( 1/2 \ x^T PAx = -x^T Qx \):

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: String) FALSE