ECE 6550 Exam 1
Fall 2022

Name ______________________________

General Instructions instructions:

- Exam is closed book / closed notes other than the one-page of handwritten notes.
- Choose the best possible answer available in all cases.
- Blank scratch paper is allowed

_______ Part I: Objective Questions

_______ Part II: Open Response Questions

_______ Final Score

Part I: Objective Questions

These questions have straight-forward answers. Make sure to put your answer in the line required as that is the part that will be graded for the answer given. Only the final answers, as indicated by the question, will be considered correct for each question. Each question is worth 4 points (total of 72 points)

Matching

_______ 1. Unstable

_______ 2. Marginally Stable

_______ 3. Asymptotically stable

_______ 4. Exponentially stable

a. . $||y(t)||$ bounded throughout $0 < t < \infty$

b. $||y(t)|| < Ce^{\lambda t}$, positive C, negative λ

c. $||y(t)||$ unbounded somewhere $0 < t < \infty$

d. $||y(t)|| \to 0$ as $t \to \infty$

_______ 5. Unstable

_______ 6. Marginally Stable

_______ 7. Asymptotically stable

_______ 8. Exponentially stable

a. All $\lambda_1, \lambda_2, ..., \lambda_n < 0$

b. All $\lambda_1, \lambda_2, ..., \lambda_n \leq 0$

c. One $\lambda_1, \lambda_2, ..., \lambda_n > 0$

Match the following dynamical situations

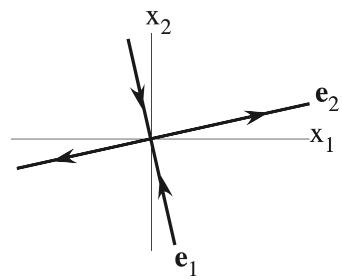
_______ 9. λ_1, λ_2 Real and positive

_______ 10. λ_1, λ_2 Complex, $\mathrm{Re}(\lambda_1, \lambda_2) > 0$

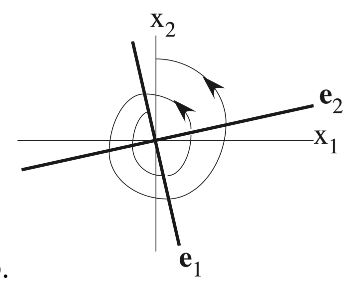
_______ 11. λ_1, λ_2 Real, $\lambda_1 > 0$, $\lambda_2 < 0$

_______ 12. λ_1, λ_2 Real and negative

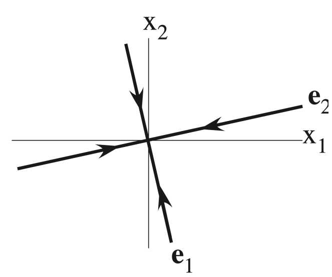
_______ 13. λ_1, λ_2 Complex, $\mathrm{Re}(\lambda_1, \lambda_2) < 0$



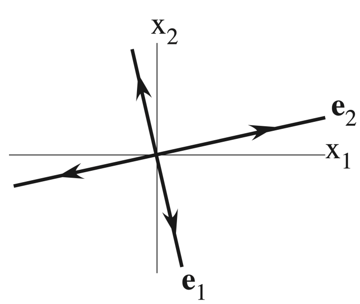
a.



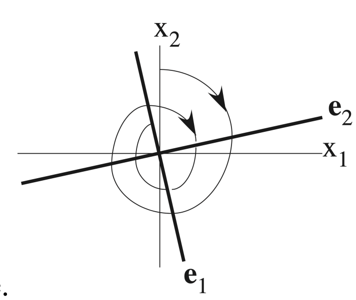
b.



c.



d.



e.

For the following matrix

$$\begin{pmatrix} 0 & 1 \\ -1 & -1 \end{pmatrix}$$

_______________ 14. What are λ_1, λ_2?

_______________ 15. What is the stability given this **A** matrix?

For the following matrix

$$\begin{pmatrix} 0 & 1 \\ 1 & -1 \end{pmatrix}$$

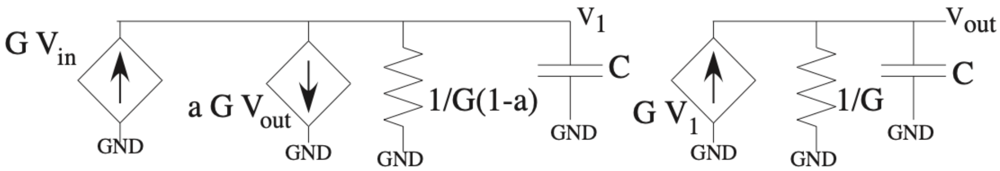
_______________ 16. What are λ_1, λ_2?

_______________ 17. What is the stability given this **A** matrix?

18. (True / False). The exponential of a square mxm matrix **A** can be expressed in a series of m matrix polynomial terms.

Part II: Open Response Question (28 points)

Consider the following linear circuit that is a linearized model for a transconductance amplifier component.



1: Write the state equations. You might benefit from renormalizing in time. Is this a MIMO or SISO system?

2: What is the eigenvalues and stability for a=1 and a=3?

3: for the a=3 case, could one stabilize the system with a proportional control scheme (as below)?