Adaptive Control, CDS 270: Midterm / Quiz

<u>Rules</u>: **Closed book, no notes, no references**

<u>Material</u>: **Lectures 1 through 4**

<u>Duration</u>: **1 hour**

1. State the Initial Value Problem (IVP) and give sufficient conditions for existence and uniqueness (as many as you can) of the IVP solution.

2. Give precise definitions of a locally asymptotically <u>stable</u> and a globally exponentially <u>unstable</u> systems, (in the sense of Lyapunov). Does state convergence imply stability in the sense of Lyapunov (SISL)? Illustrate your answer with a drawing.

3. How does exponential stability of a nonlinear system relate to the eigenvalues of its linearization around an equilibrium?

4. State the Lyapunov 1st and 2nd theorems.

5. State the LaSalle's Invariance Theorem and illustrate it with a sketch of the sets involved.

6. For a non-autonomous dynamical system state precise definitions of: a) Uniformly bounded solution, and b) uniformly ultimately bounded (UBB) solution. How does UUB compares to SISL?

7. State sufficient conditions for a non-autonomous dynamics to have UUB solutions. Sketch related subsets in the state space to illustrate your statements.

8. State the Barbalat's Lemma and the Lyapunov – like Lemma. Illustrate the Barbalat's Lemma with examples. Explain why are the two lemmas so important from the adaptive control design perspective.