UNIVERSITEIT TWENTE.

Invullen in blokletters/To be completed by student

Cursusnaam/*Coursename*		Datum/*Date*	Bladnr./*Page no.*
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Studentnr./*Student no.*	Voorl./*Initials*	Opleiding/*Programme*	Groepnr./*Group no.*
Naam/*Name*			

1. given: $\dot{x}_1 = x_1 x_2 - x_1$
$\dot{x}_2 = -x_1^2 - x_2^3$

a) Compute equilibrium points
b) Analyze stability ⇒ linearization
c) " ⇒ Lyapunov, $V(x_1, x_2) = \frac{1}{2}x_1^2 + \frac{1}{2}x_2^2$
d) Open question: Enunciate Lyapunov theorem for MIMO

2. given: $x(k+1) = \begin{bmatrix} 0 & 1 & 1 \\ 0 & 2 & 0 \\ 0 & 0 & 0.5 \end{bmatrix} x(k) + \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix} u(k)$

$y(k) = [0 \ 1 \ 0]\, x(k)$

a) completely reachable?
b) controllable in k steps?
c) find control sequence $u(0), u(1)$ that brings system from $x_0 = [1 \ 1 \ 0]^T$ to $x_f = [0 \ 0 \ 0]^T$
d) find control sequence that brings system from $x_0 = [0 \ 0 \ 0]^T$ to $x_f = [0 \ 0 \ 1]^T$
e) completely observable?
f) constructable in k steps?
g) kalman decomp ⇒ find T
h) internally stable? explain
i) externally " ?
j) BIBO?
k) stabilizable
l) detectable?
m) compute transfer function

3. Consider system of exercize 2.

a) Design, if possible, an identity observe that stabilizes the system with dominant dynamics given by 0.9^k. Motivate design choises.
b) Design, if possible, an identity observe in closed loop. Motivate
c) Design, if possible, a dead-beat observe. Explain.

4. $L\frac{di(t)}{dt} = v(t) - Ri(t) - V_c(t)$

$C\frac{dV_c(t)}{dt} = i(t)$

V_c is system output

a) Write system in State space form. $R = L = C = 1$
b) Design infinite-time optimal control law that minimizes the control action $V(t)$ and power supplied by the Voltage generator.

Note: ARE given.