**Control Systems Course, Academic Year 2011-2012**

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**Mid Term Exam, November $7^{th}$ 2011**

Available time: 2h

**Ex1** Given a plant characterized by the transfer function

$$G(s) = \frac{1}{s-1},$$

design a control scheme and a controller $G_c(s)$ such that:

1. the closed loop system is astatic with respect to a step additive disturbance applied to the output of the plant $G(s)$;
2. the steady state error with respect to a ramp input is smaller than 0.1;
3. the settling time $T_s$ is smaller or equal to 0.4 s;

Compute the percent overshoot of the obtained system.

**Ex2** Given a plant $P$ characterized by the following state space representation

$$\dot{x}(t) = \begin{bmatrix} 0 & 1 \\ 0 & 0 \end{bmatrix} x(t) + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t), \quad y(t) = \begin{bmatrix} 1 & 0 \end{bmatrix} x(t), \quad t \geq 0,$$

derive the transfer function $G(s)$ of $P$ and design a control scheme and a controller $G_c(s)$ such that:

1. the closed loop system is astatic with respect to a step additive disturbance applied to the input of the plant;
2. the steady state error with respect to a parabola input is smaller than 0.1.

Discuss the steady state behavior of the system with respect to polynomial additive disturbances applied to the output of the plant.

**Ex3** Discuss the type number of a feedback control system and provide one illustrative example.