EENG307: Disturbances and Steady State Error[1]

Lecture 15

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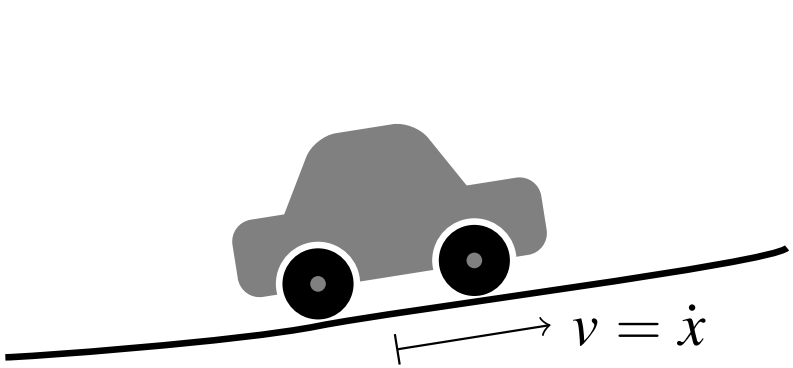
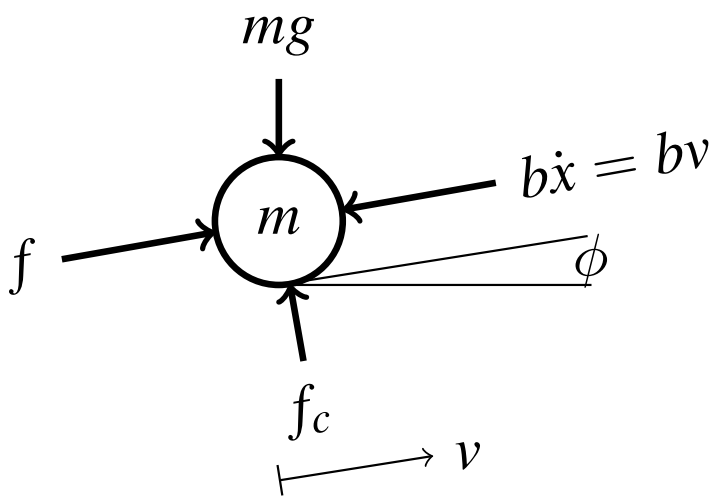
Cruise Control

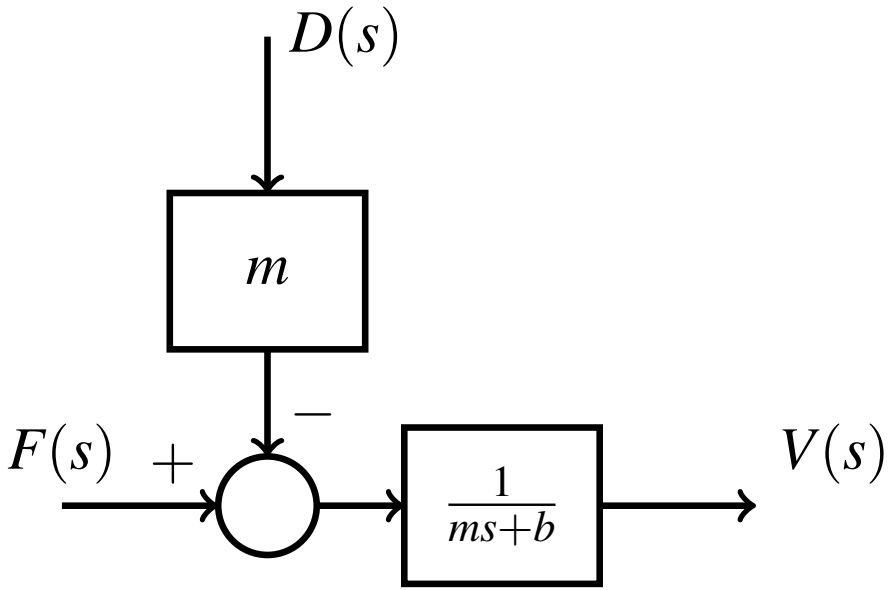




$$m\ddot{x} = f - b\dot{x} - mg\sin(\phi)$$

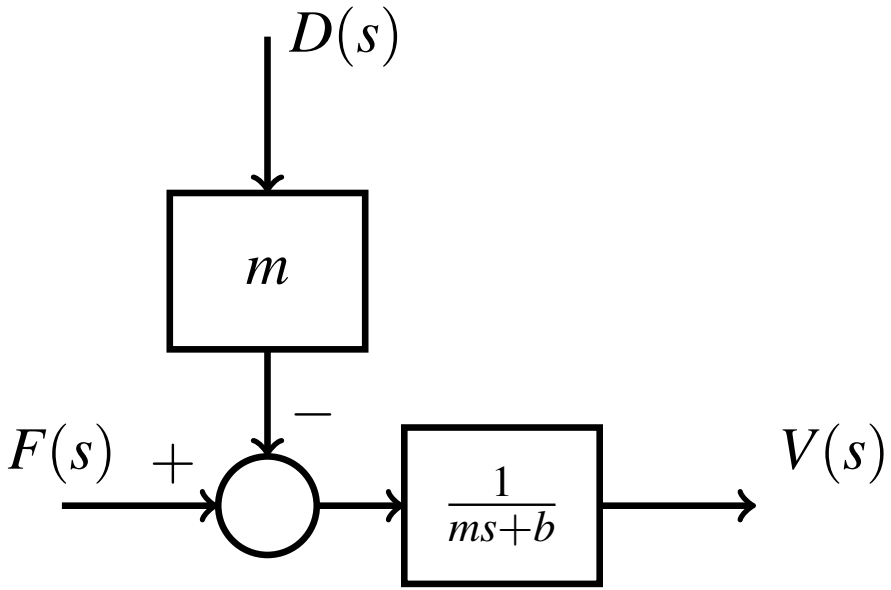
$$m\dot{v} + bv = f - f_d$$

System block diagram



1. Suppose the motor supplies a constant force f_m on a flat road. At steady state, what will the car's speed be?
2. Suppose the car is at steady state on a flat road, but then drives on an incline with slope ϕ. By how much will the car slow down?

System block diagram



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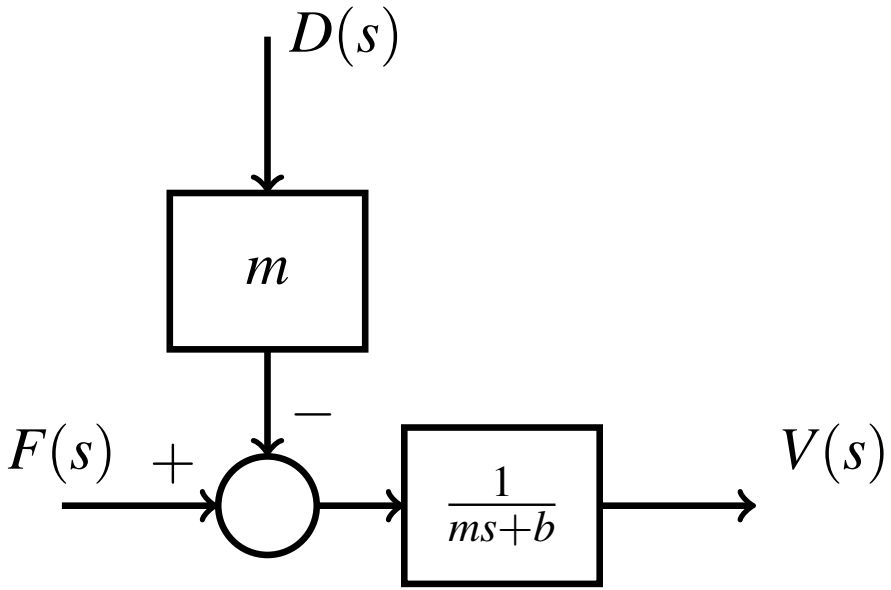

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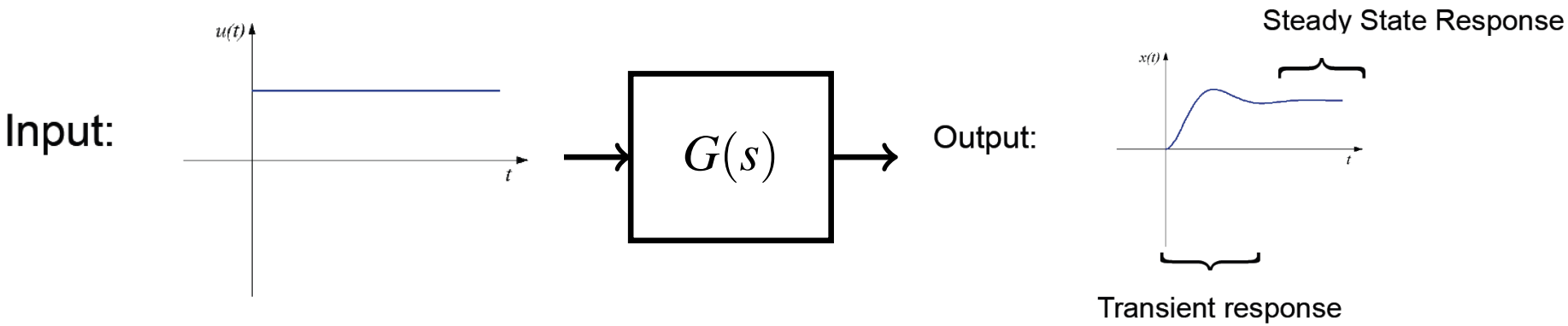
Steady State

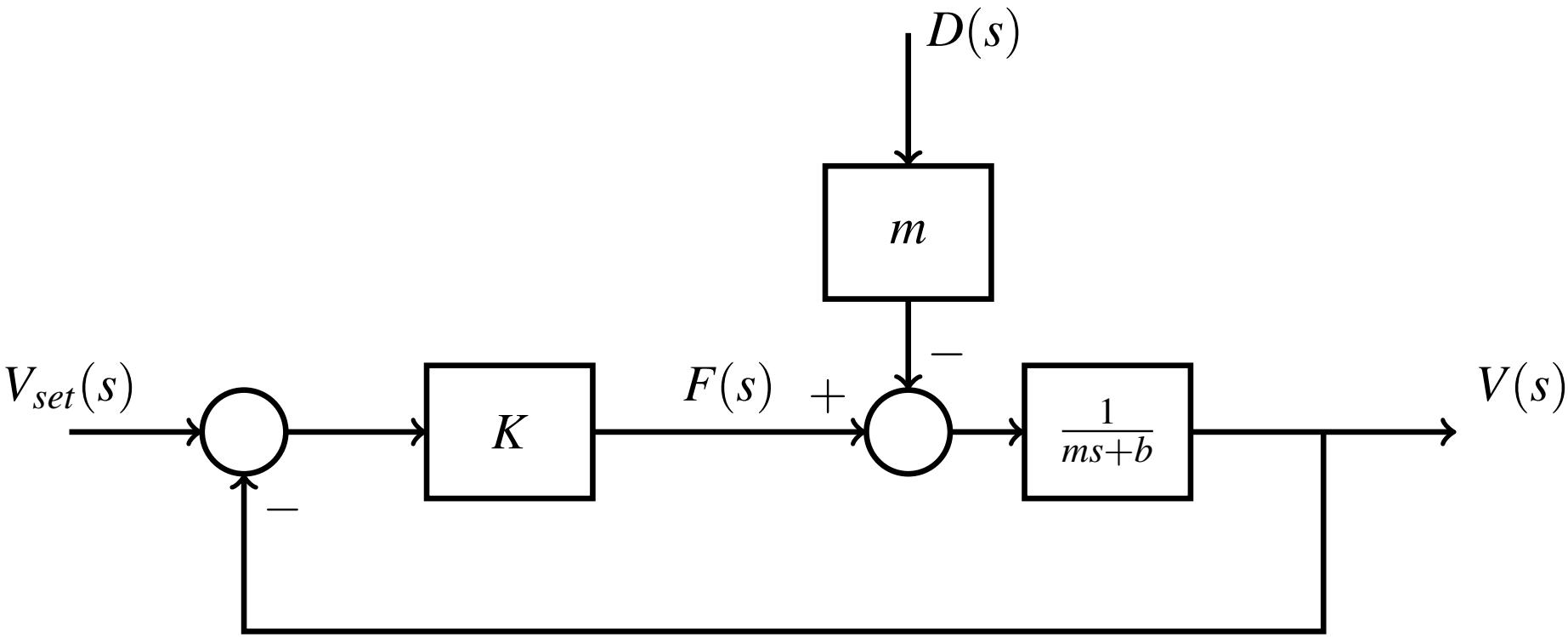


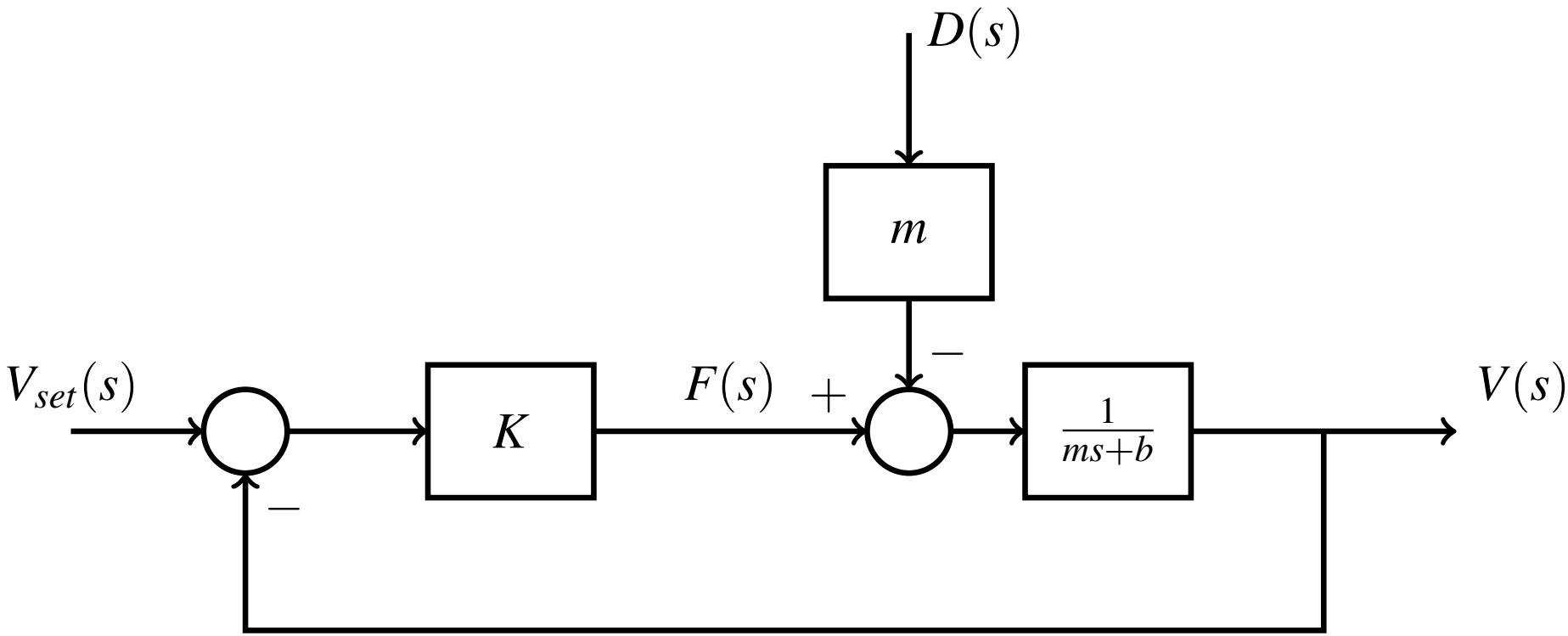
Theorem

Given the signal $Y(s)$ such that $sY(s)$ has all poles with negative real part. Then the inverse Laplace transform $y(t)$ satisfies

$$\boxed{\lim_{t\to\infty} y(t) = \lim_{s\to 0} sY(s)}$$

$$V(s) = \frac{1}{ms+b}F(s) - \frac{m}{ms+b}D(s)$$


$D(s)$
m
$V_{set}(s)$
K
$F(s)$
$+$
$-$
$-$
$\frac{1}{ms+b}$
$V(s)$



$$V(s) = \frac{K}{ms + b + K} V_{set}(s) - \frac{m}{ms + b + K} D(s)$$