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P1 (1p). Consider a system with the input signal $u(t)$ and the output $y(t)$ described by the transfer function:

$$G(s) = \frac{4}{s^2 + s - 2}$$

A. *(0.6p)* Determine a state-space model for this system in the standard matrix form: ($\dot{\boldsymbol{x}} = \boldsymbol{Ax} + \boldsymbol{B}u$, $y = \boldsymbol{Cx} + \boldsymbol{D}u$)

B. *(0.4p)* Is this system stable? Why?

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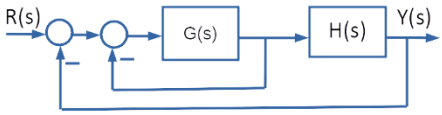

A. *(0.5p)* Determine the overall closed-loop transfer function.

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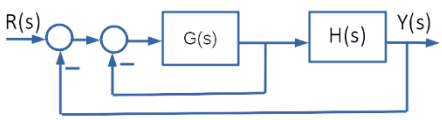

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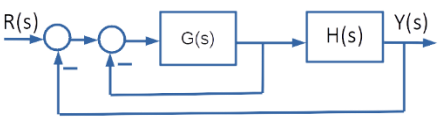

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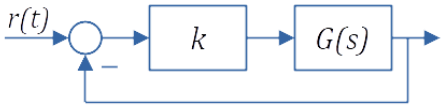

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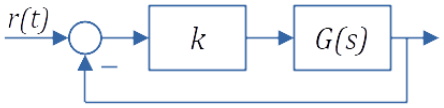

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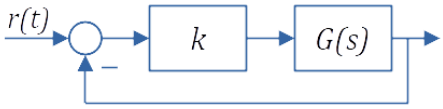

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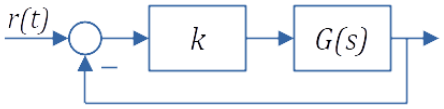

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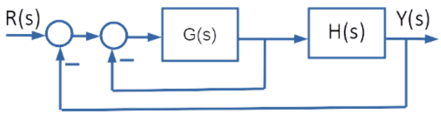

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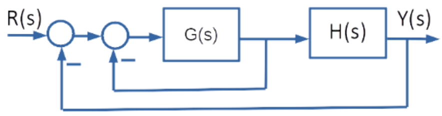

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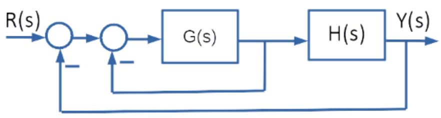

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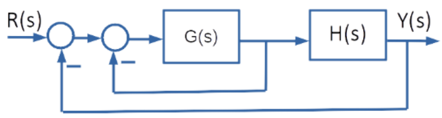

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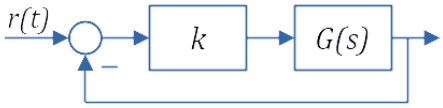

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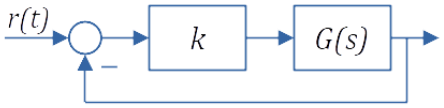

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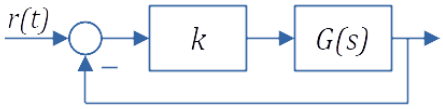

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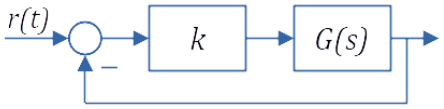

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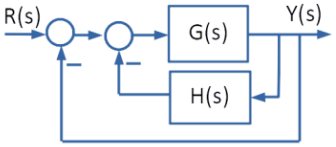

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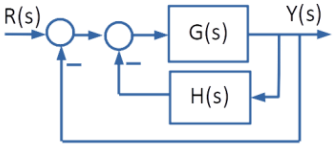

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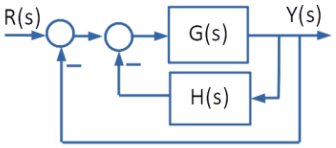

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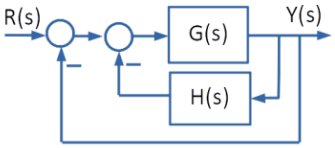

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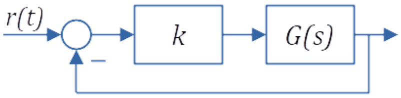

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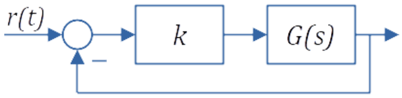

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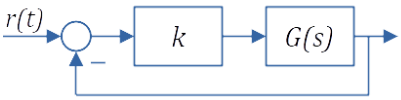

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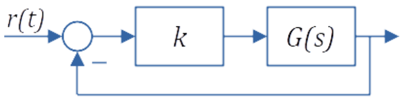

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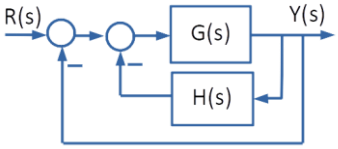
B. *(0.4p)* Is this system stable? Why?

P2 (1p). Consider the closed-loop system in the figure, where $k > 0$ and:



$$G(s) = \frac{4}{s^2}, \quad H(s) = ks$$

A. *(0.5p)* Determine the overall closed-loop transfer function.

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Systems Theory - Midterm exam April 13, 2022

Name and group: _____

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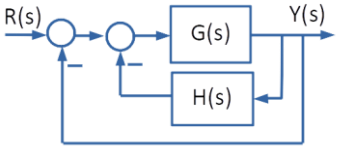

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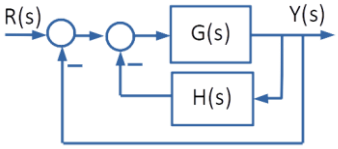

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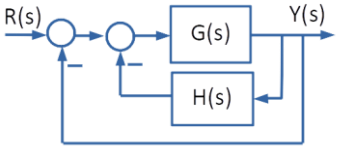

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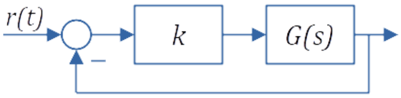

$$G(s) = \frac{s+2}{(s+4)(s^2+4)},$$

A. *(1p)* Sketch the root locus for $k \in [0, \infty)$ (there are no breakaway or breakin points).
B. *(1p)* Choose a value for k so that the closed-loop system underdamped and explain your choice using the root locus. For this value of k, determine the steady-state error for a step input $r(t) = 4, t \geq 0$.

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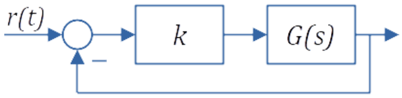

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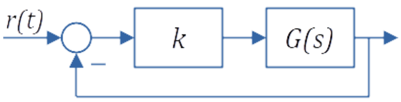

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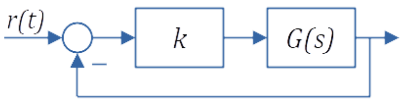

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