EXAM 1

February 11, 2021

Do All Problems – Show All Work
This exam is open notes and open book.

You have 24 hours to complete all problems.
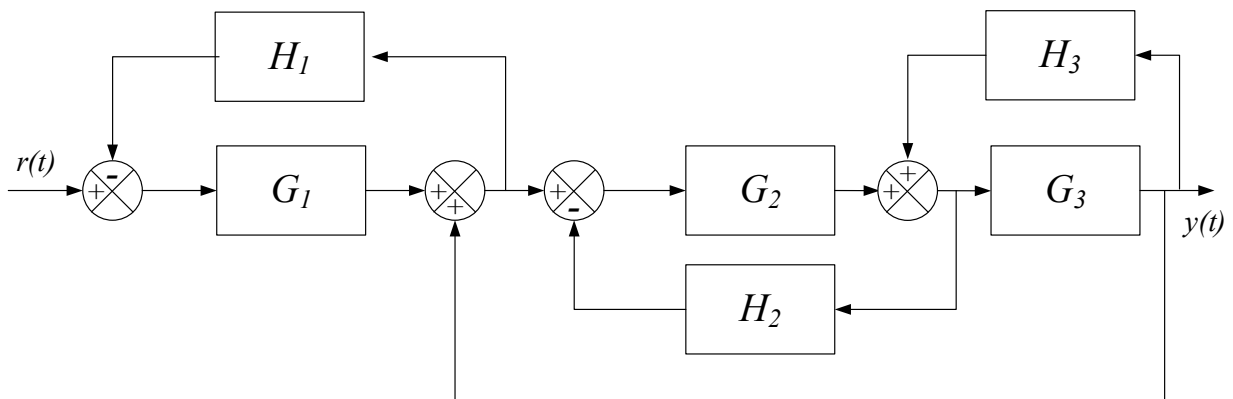
Student ID: _____

Student Printed Name: _____

Student Signature: _____

Name: _____   ID: _____

**1.) (30 pts)** Please simplify the block diagram shown below into a single block from *r* to *y*.

Name: _____   ID: _____

2.) (40 pts) Please consider the mechanical system shown in the figure below.

   a) Find the differential equation(s) that model this system.

   b) Identify state variables, and represent your model in state-space form.

   c) Let's do a thought experiment to try to visualize the motion in steady state (i.e. after enough time has passed for short-term transients to die off). Assuming that the dampers do not have any range limits (for example, they may be representing drag in a liquid), how do you expect this system to move if $F_1 > F_2$?
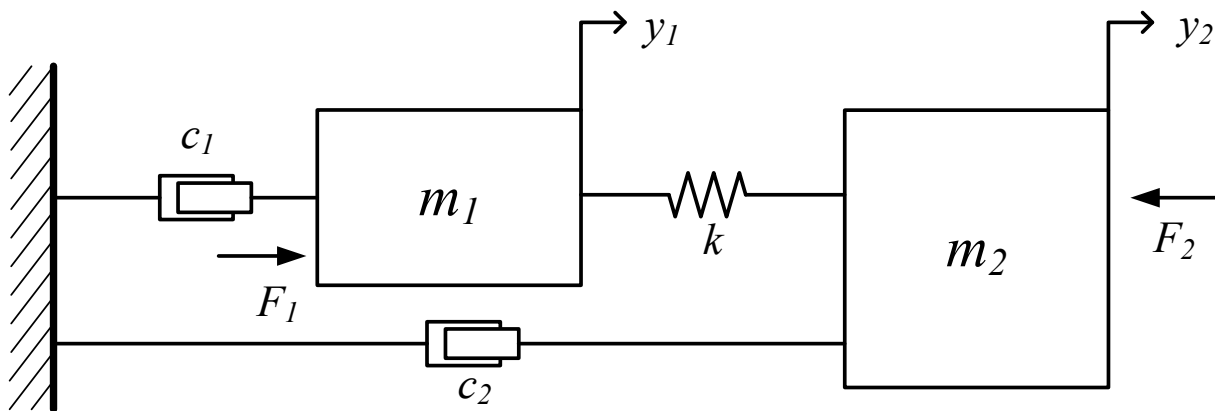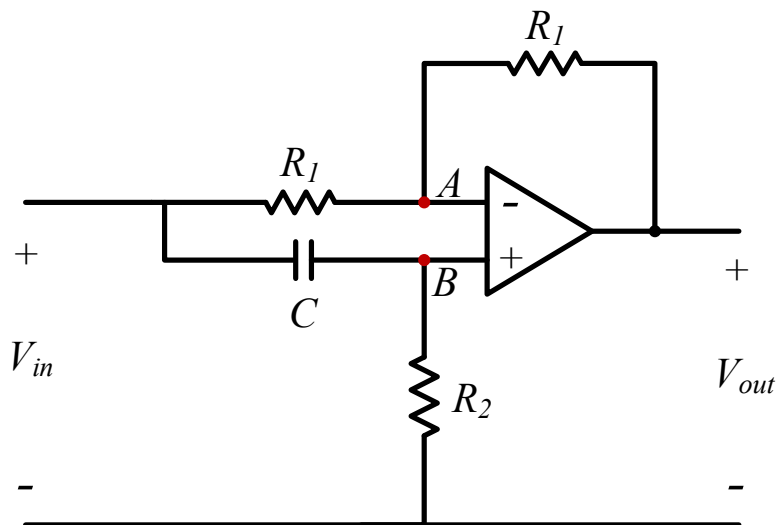
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3.) (30 pts) Please find the differential equation(s) that model the electrical system shown below. Can this system be represented by a single differential equation between V_{in} and V_{out}?

Hint: What is the voltage V_A at node A? How about V_B?

Bonus (5 pts) Notice that both resistors on the top branch have the same value. Please inspect your differential equation(s). Would it be more desirable to pick large or small values for these resistors? How would your selection affect the system function? Please explain your rationale.

Name: _____ ID: _____

Extra Page