Name _____ Section _____

**ES205**
Examination II
April 27, 2007

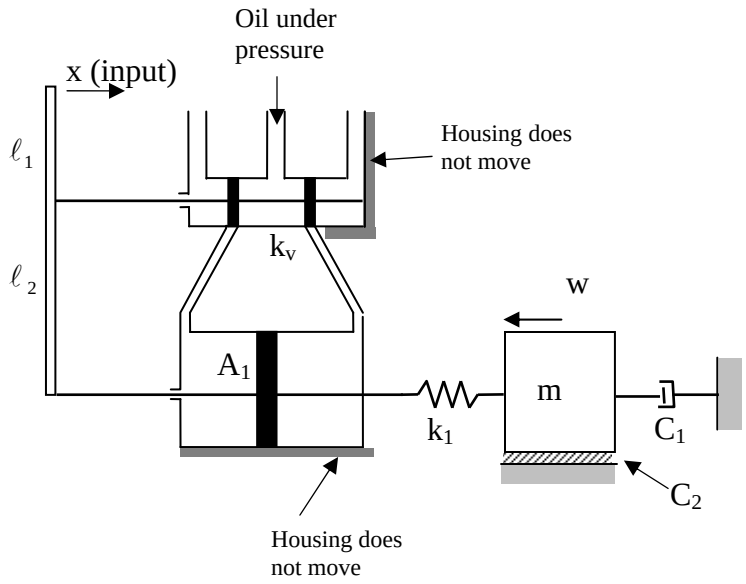
| Problem | Score |
|---|---|
| 1 | /25 |
| 2 | /25 |
| 3 | /35 |
| 4 | /15 |
| Total | /100 |

Show all work for credit
AND
Turn in your signed help sheet
AND
Stay in your seat until the class ends
(Translation: I am not going to let you leave early,
so you might as well check your answers!)

25 pts

ES205 Examination II **Problem 1** April 27, 2007

Determine the equations necessary to determine the equation of motion for the hydraulic amplifier shown below. The input is x and the output is y. **Do not find the EOM but number the equations that you would use and generate a list of the unknown variables**. Assume the force required to move the control valve and the mass of the input lever are negligible.

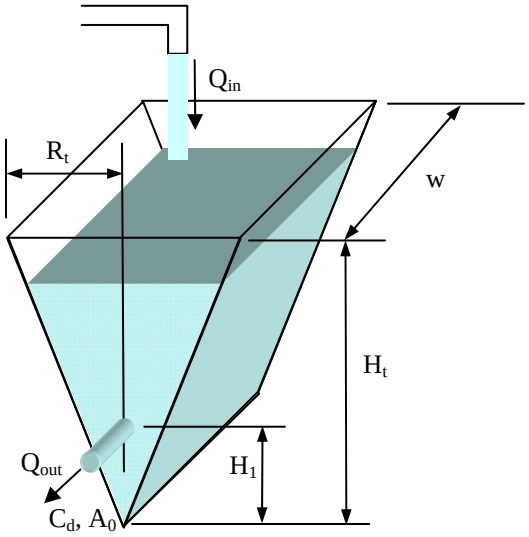



Unknowns

25 pts

ES205 Examination II **Problem 2** April 27, 2007

Determine the non-linear EOM for the height of fluid in the tank as meaured from the bottom of the tank.



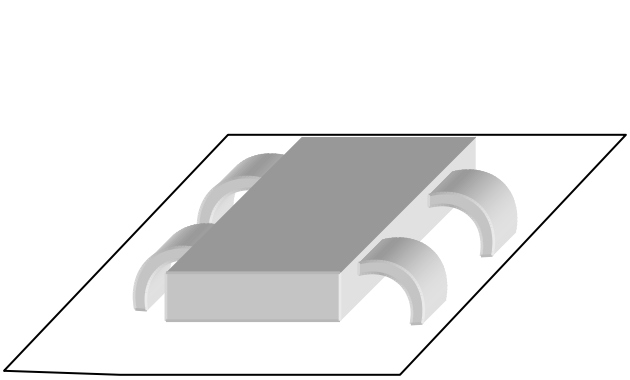
35 pts

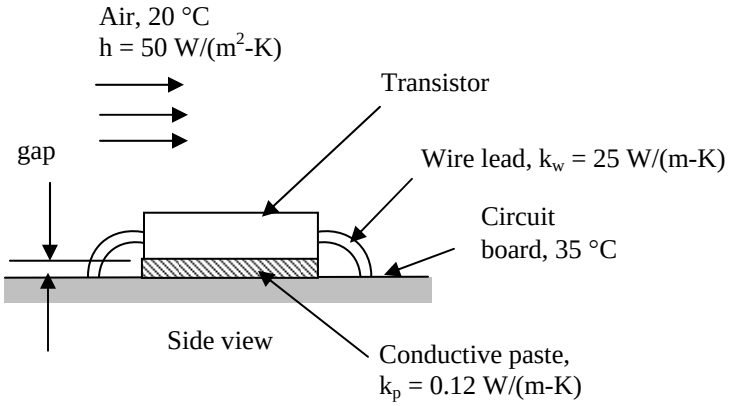
ES205 Examination II **Problem 3** April 27, 2007

Consider a surface-mount type transistor on a circuit board whose temperature is maintained at 35°C. Air at 20°C flows over the upper surface of dimensions 4 mm by 8 mm with a convection coefficient of 50 W/($m^2$-K). Four wire leads, each of cross section 1 mm by 0.25 mm and length 4 mm, conduct heat from the case to the circuit board. The gap between the case and the board is 0.2 mm and is filled with a conducting paste. The thermal conductivities of the wire leads and conducting paste are shown in the figure. When turned on the transistor uses 150 mW of power.

**Do not actually solve for numerical answers for a) and b) shown below - simply set up the equations. Be sure the numerical values of any parameters in your equation are defined (but don't waste time plugging the numerical values into the equation).**

a) Assuming the case is isothermal and neglecting radiation, determine the steady-state case temperature of the transistor.
b) If it takes the transistor 2 seconds to reach its 98% of its steady-state temperature, estimate its thermal capacity.

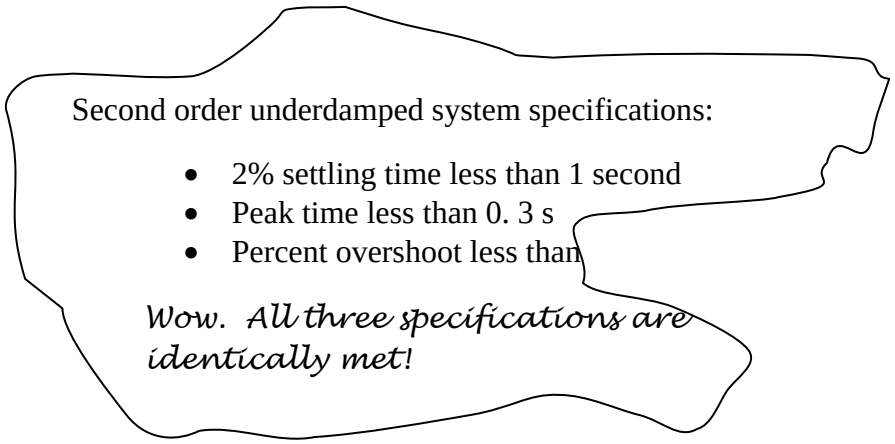




15 pts

ES205 Examination II **Problem 4** April 27, 2007

While cleaning out the lab of a famous engineer, Alex Bell, you found a scrap of paper with the following information:




Knowing that all three specifications are identically satisfied, as indicated on the scrap of paper, determine percent overshoot specification.

Sketch these constraints in the design space on the axis provided.