System Dynamics Exam 2 — Spring 2007

The FE reference book, a one-sided formula sheet, and matlab/simulink may be used during this exam. 11-12:05, 152 B Russ. Matlab/Simulink must be available to the student.

When time is up, print all Simulink and Matlab results and turn them in with your exam.

1. Water (of volume 425 ml) in a glass measuring cup was allowed to cool after being heated to 207F. The ambient air temperature was 70F. The measured water temperature at various times is given by the following table. Obtain a functional description of the relative water temperature ($\Delta T = T - 70$) versus time.

Time (m)	0	5	10	15	20	25	30	35	40	45	50
temp (C)	207	182	167	155	143	135	128	123	118	114	109

2. Find $x(t)$ analytically by any method for $x(0) = 1$, $\dot{x}(0) = 0$, if $\ddot{x} + 10\dot{x} + 100x = 20$. Sketch the solution and label points and quantities of interest.

3. Find $x(t)$ analytically by any method for $x(0) = 1$, $\dot{x}(0) = 0$, if $\ddot{x} + 10\dot{x} + 100x = 20t$. Sketch the solution and label points and quantities of interest.

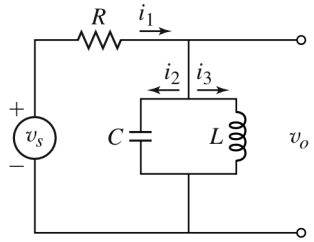
4. Create a Simulink model to solve for $\theta(t)$ and plot the solution for $\theta < \pi/2$ for the system defined by

$$25,400\ddot{\theta} = -17,500\cos(\theta) + \frac{626,000}{Q}\sin(1.33 + \theta)$$

where

$$Q = \sqrt{2020 + 1650\cos(1.33 + \theta)}$$

5. Use the impedance method to obtain the transfer function $\frac{V_o(s)}{V_s(s)}$ for the following circuit.



6. Create the Simulink block diagram for the following system of equations.

$$\dot{T}_1 + \alpha T_1^4 - \beta T_2^4 = Q_1$$
$$\dot{T}_2 + \alpha T_2^4 - \beta T_1^4 = Q_2$$

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