Concordia University

ELEC372 Fundamentals of Control Systems

Homework #1

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1. Problem P1.11 from the 8th, 9th, 10th, 11th, 12th, 13th or 14th edition of the main textbook.
2. (Farid Golnaraghi and Benjamin C. Kuo, *Automatic Control Systems*, 9h Edition, John Wiley & Sons, Inc., 2010) Find the Laplace transforms of the following functions. Check if the initial value theorem and the final value theorem are applicable in each case. The function $u(t)$ is the unit step function.

   (a) $x(t) = 5te^{-5t}u(t)$

   (b) $x(t) = (t\sin(2t) + e^{-2t})u(t)$
3. (Farid Golnaraghi and Benjamin C. Kuo, *Automatic Control Systems*, 9h Edition, John Wiley & Sons, Inc., 2010) Find the Laplace transform of the following one-sided signal.

$$x(t) = \begin{cases} t+1 & 0 \le t < 1 \\ 0 & 1 \le t < 2 \\ 2-t & 2 \le t < 3 \\ 0 & t \ge 3 \end{cases}$$

4. (Farid Golnaraghi and Benjamin C. Kuo, *Automatic Control Systems*, 9h Edition, John Wiley & Sons, Inc., 2010) Solve the following differential equation by means of the Laplace transform, assuming zero initial conditions.

$$\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 4y(t) = e^{-2t}u(t)$$

5. (Farid Golnaraghi and Benjamin C. Kuo, *Automatic Control Systems*, 9h Edition, John Wiley & Sons, Inc., 2010) Find the inverse Laplace transforms of the following functions by expanding the fractional part into partial fractions.

   (a) $X(s) = \dfrac{1}{s(s+2)(s+3)}$

   (b) $X(s) = \dfrac{10}{(s+1)^2(s+3)}$

   (c) $X(s) = \dfrac{100(s+2)}{s(s^2+4)(s+1)}e^{-s}$