Carleton University
Dept. of Systems and Computer Engineering

Systems and Simulations—SYSC 3600
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Homework #3

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1. Use the direct time-domain approach to compute the following convolution integrals for $t \geq 0$:

   (a) $e^{-t} * e^{-t}$.

   (b) $t * (1 - e^{-t})$.

   (c) $e^{-t} * \sin(t)$.

   (d) $f_1(t) * e^{-t}$, where $f_1(t)$ is as shown in Figure 1.

   (e) $f_1(t) * f_2(t)$, where $f_1(t)$ and $f_2(t)$ are as shown in Figures 1 and 2, respectively.

2. Use the Laplace transform method to evaluate the above convolution integrals.

3. The input-output relationship of a system is given by:

$$\ddot{y} + 4\dot{y} + 3y = 5\ddot{x} + 3x.$$

   Obtain an expression for the system output when it is excited with

   (a) $x(t) = u(t)$;

   (b) $x(t) = \sin(t)u(t)$; and

   (c) $x(t) = f_1(t)$, where $f_1(t)$ is as shown in Figure 1.
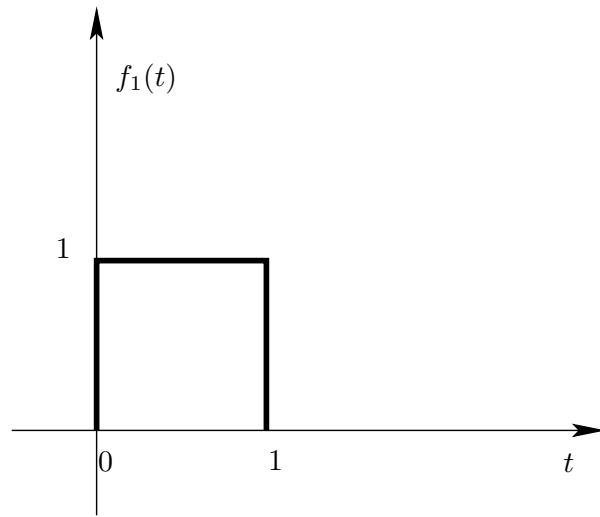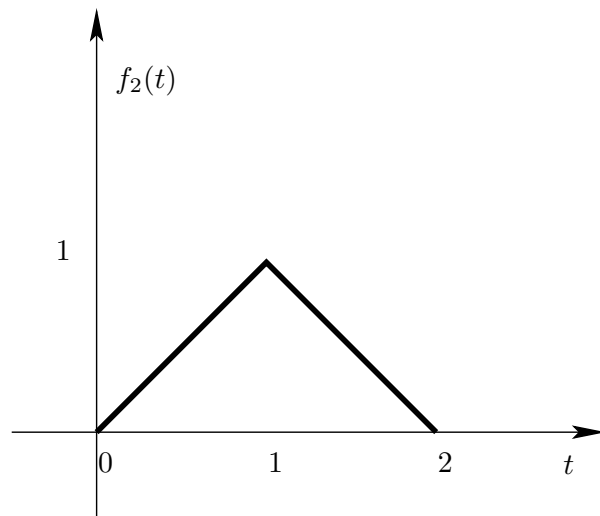
   What is the output at $t = 0$ and what is the output at $t = \infty$?

Figure 1: Unit pulse

Figure 2: Triangular input