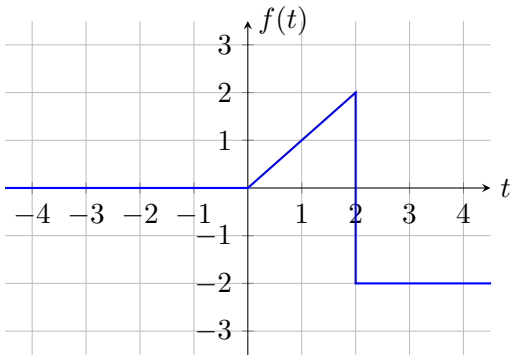
ECE 2260 hw06

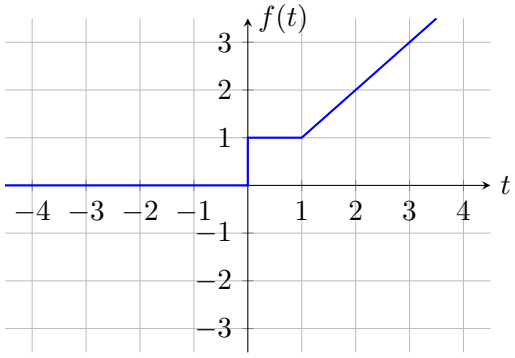
1. Laplace Transforms

Find the Laplace transforms for the following functions. You may use direct integration or tables.

(a) Find $F(s)$.



(b) Find $F(s)$.



(c) Given $F(s) = \frac{5s+2}{s(s+1)}$, find $f(t \to \infty)$.

2. Laplace transforms

Find the Laplace transform of each of the following functions:

a) $f(t) = te^{-at}$;

b) $f(t) = \sin \omega t$;

c) $f(t) = \sin(\omega t + \theta)$;

d) $f(t) = t$;

e) $f(t) = \cosh(t + \theta)$.

3. Parallel RLC Circuit with a Switch

There is no energy stored in the circuit shown in Fig. 1 at the time the switch is opened.

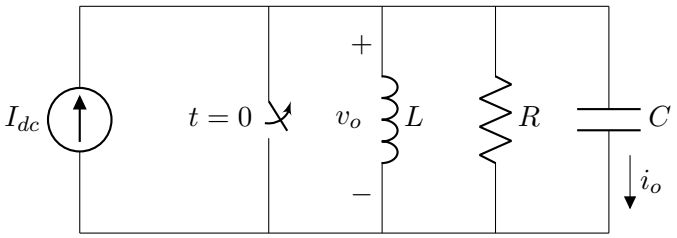


Figure 1: RLC circuit with a switch.

Note: The switch is initially closed and opens at $t = 0$.

a) Derive the integrodifferential equation that governs the behavior of the voltage v_o.

b) Show that

$$V_o(s) = \frac{I_{dc}/C}{s^2 + (1/RC)s + (1/LC)}.$$

c) Show that

$$I_o(s) = \frac{sI_{dc}}{s^2 + (1/RC)s + (1/LC)}.$$

d) Suppose $R = 20\ \Omega$, $L = 50$ mH, $C = 20$ µF, and $I_{dc} = 75$ mA. Find the poles of $V_o(s)$ and $I_o(s)$.

4. Inverse Laplace Transforms

Find $f(t)$ for each of the following functions:

a)

$$F(s) = \frac{6(s+10)}{(s+5)(s+8)}.$$

b)

$$F(s) = \frac{20s^2 + 141s + 315}{s(s^2 + 10s + 21)}.$$

c)

$$F(s) = \frac{15s^2 + 112s + 228}{(s+2)(s+4)(s+6)}.$$

d)

$$F(s) = \frac{2s^3 + 33s^2 + 93s + 54}{s(s+1)(s^2 + 5s + 6)}.$$

5. Inverse Laplace Transforms

Find $f(t)$ for each of the following functions:

a)

$$F(s) = \frac{280}{s^2 + 14s + 245}.$$

b)

$$F(s) = \frac{-s^2 + 52s + 445}{s(s^2 + 10s + 89)}.$$

c)

$$F(s) = \frac{14s^2 + 56s + 152}{(s + 6)(s^2 + 4s + 20)}.$$

6. Inverse Laplace Transforms

Find $f(t)$ for each of the following functions:

a)

$$F(s) = \frac{320}{s^2(s+8)}.$$

b)

$$F(s) = \frac{80(s+3)}{s(s+2)^2}.$$

c)

$$F(s) = \frac{60(s+5)}{(s+1)^2(s^2+6s+25)}.$$

d)

$$F(s) = \frac{25(s+4)^2}{s^2(s+5)^2}.$$