EE 362: Signals and Systems Name:

Spring 2019

Homework #4 (Due: Thursday, February 19, 2019)

- Circle or box your answer (don't forget units).
- **Show** your steps.
- Use 8.5" x 11" paper, and trim off any ragged edges.
- **Staple** your work together and write your name neatly.

(1) For the RLC circuit shown in Figure 1, find the input/output differential equation when the output is the ~~current through the circuit~~ voltage across the resistor, $v_R(t)$, and the input is the voltage source. [5 points]

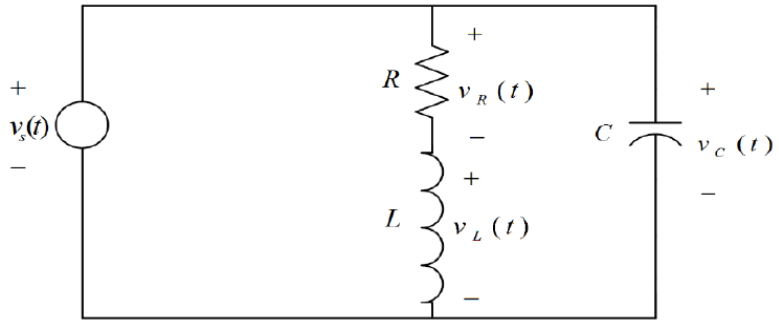


Figure 1. Problem 1

(2) For the continuous-time signals $x(t)$ and $v(t)$ shown in Figure 2, compute the convolution $x(t) * v(t)$ for all $t \geq 0$ and sketch the results. [7 points]

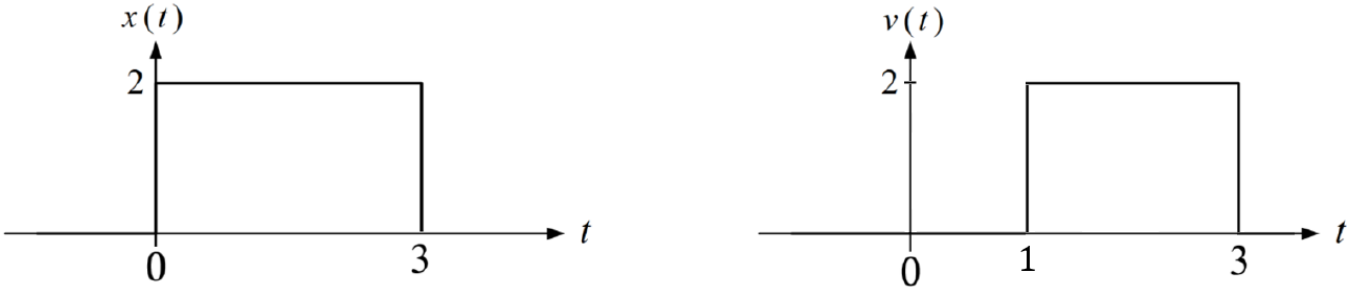


Figure 2. Problem 2

(3) For the continuous-time signal shown in Figure 3, compute the convolution $x(t) * v(t)$ for all $t \geq 0$ using the graphical method and sketch your resulting signal. [10 points]

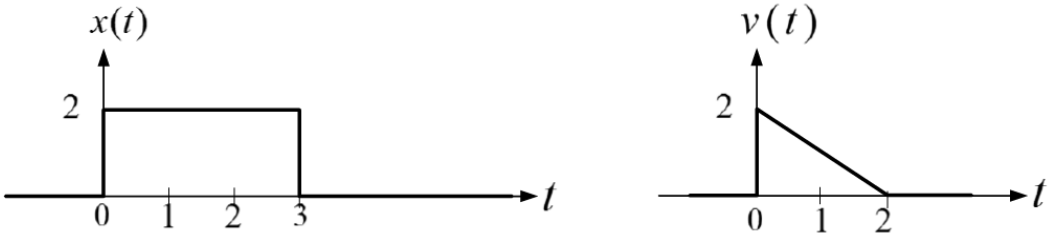
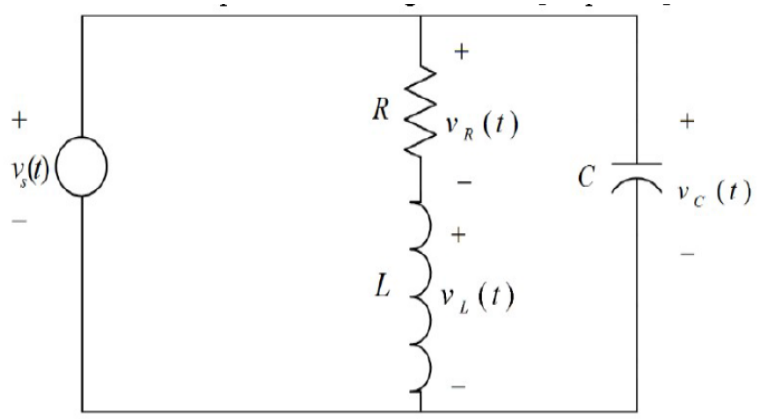


Figure 3. Problem 3

(1)



$$-x(t) + y(t) + v_L(t) = 0$$

$$v_L(t) = L\frac{di_L(t)}{dt} \quad \text{and} \quad i_L(t) = \frac{v_R(t)}{R} = \frac{y(t)}{R}$$

$$\therefore v_L(t) = \frac{L}{R}\frac{dy(t)}{dt}$$

$$\therefore -x(t) + y(t) + \frac{L}{R}\frac{dy(t)}{dt} = 0$$

OR

$$\frac{dy(t)}{dt} + \frac{R}{L}y(t) = \frac{R}{L}x(t)$$

(2)

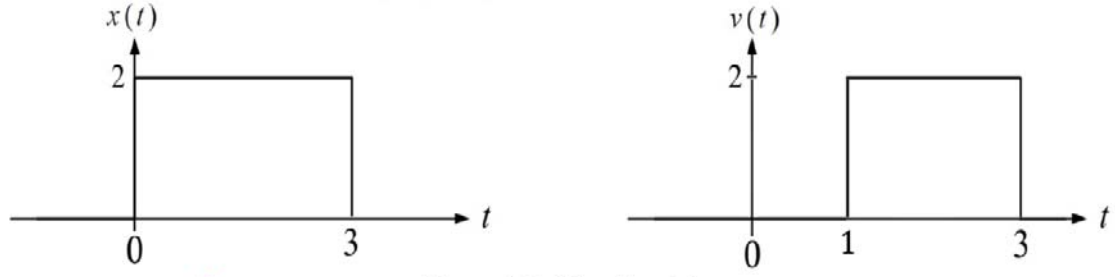
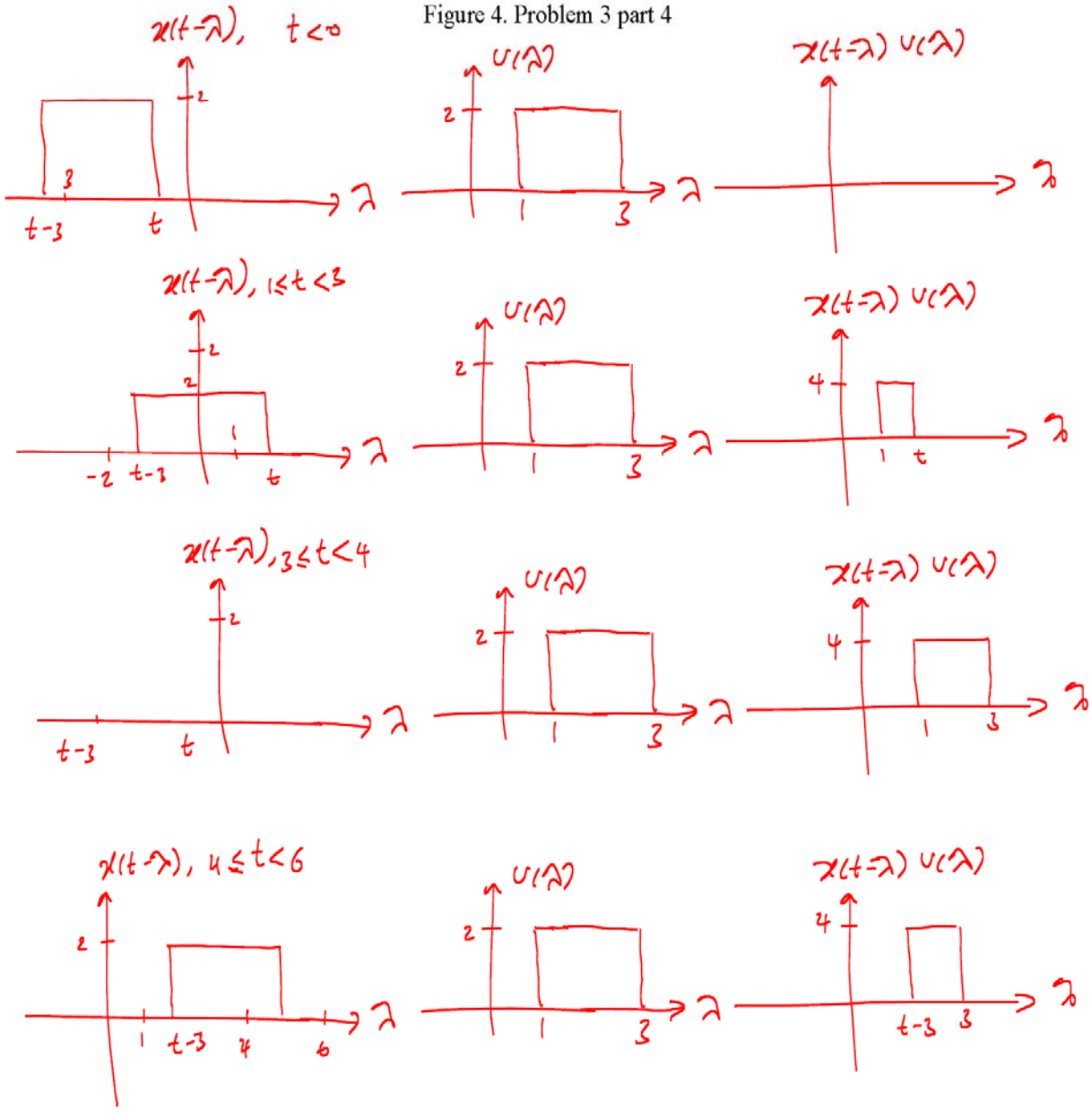
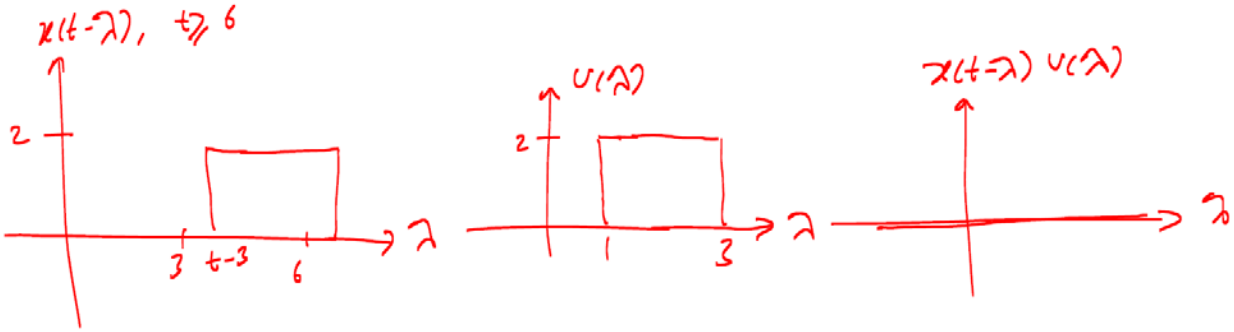


Figure 4. Problem 3 part 4





$x(t) * v(t) = 0$ for $t < 1$ & $t \geq 6$

for $1 \leq t < 3$

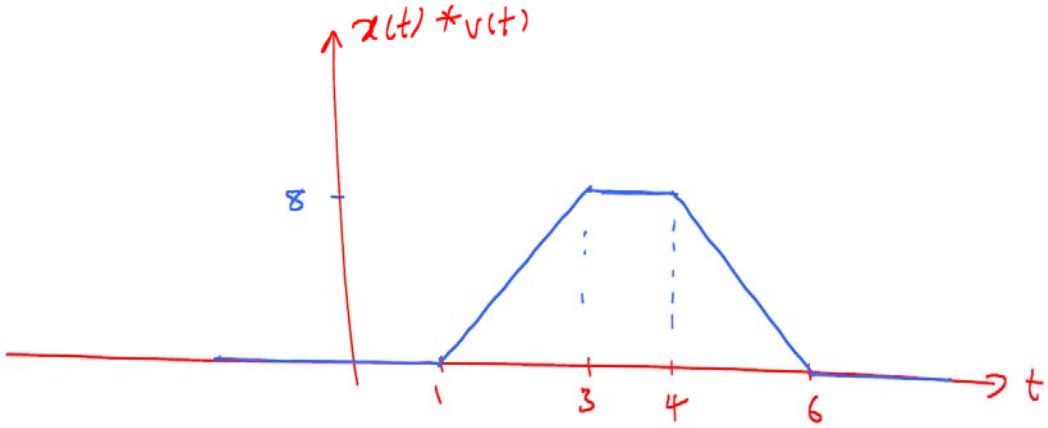
$$x(t) * v(t) = \int_1^t 4 \, d\lambda = 4t - 4$$

for $3 \leq t < 4$

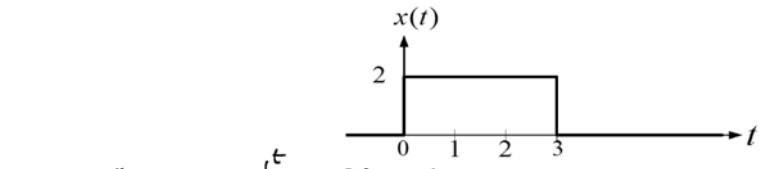
$$x(t) * v(t) = \int_1^3 4 \, d\lambda = 8$$

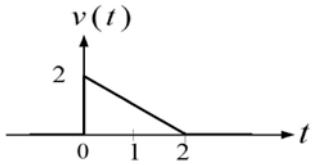
for $5 \leq t < 6$

$$x(t) * v(t) = \int_{t-3}^3 4 \, d\lambda = -4t + 24$$

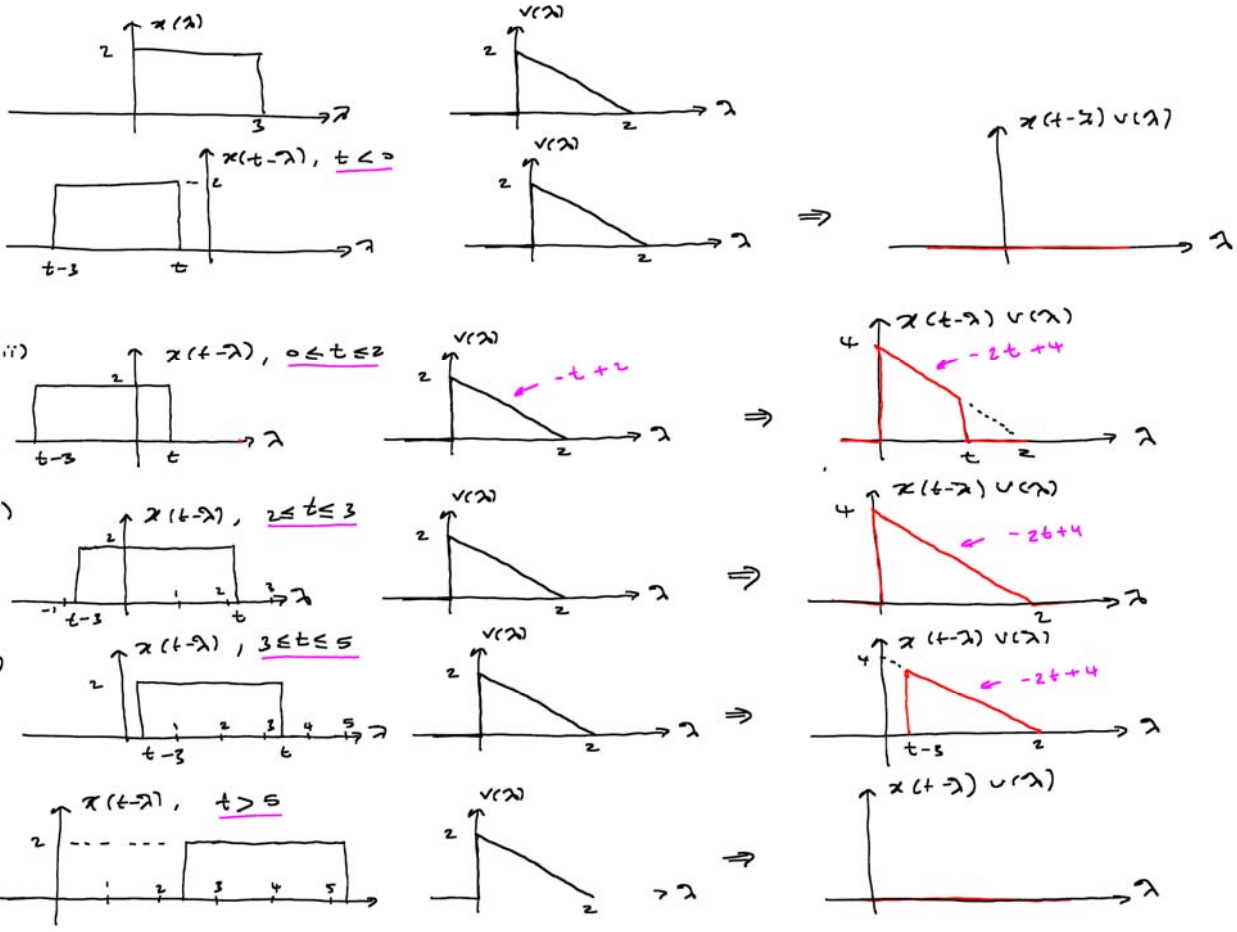


(3)





$$x(t) * v(t) = \int_0^t x(t-\lambda)\, v(\lambda)\, d\lambda$$



for $t<0$ & $t>5$, $x(t)*v(t)=0$

for $0\le t\le 2$

$$x(t)*v(t)=\int_0^t (-2\lambda+4)\,d\lambda=(-\lambda^2+4\lambda)\Big|_0^t=-t^2+4t$$

for $2\le t\le 3$

$$x(t)*v(t)=\int_0^2 (-2\lambda+4)\,d\lambda=(-\lambda^2+4\lambda)\Big|_0^2=4$$

for $3\le t\le 5$

$$x(t)*v(t)=\int_{t-3}^2 (-2\lambda+4)\,d\lambda=(-\lambda^2+4\lambda)\Big|_{t-3}^2=\left(-4+8+(t-3)^2-4(t-3)\right)$$

$$=4+t^2+9-6t-4t+12=t^2-10t+25$$

