



*University of Portland
School of Engineering*

EE 262-Signals & Systems-3 cr. hrs.
Spring 2016

Midterm Exam # 2

(Prepared by Professor A. S. Inan)

(Friday, April 8, 2016)

(Closed Book Exam, formula sheets allowed.)

(Total Time: 55 mins.)

(Any 7 of 10 problems in-class, other 3 take-home!)

Name: _____ 😊

Signature: _____ 😊

(1)(10 points) **Unilateral Laplace transform.** Find the unilateral Laplace transform of the signal given by

$$x(t) = 4e^{3-2t}u(t-1)$$

(2)(10 points) **Unilateral Laplace transform.** Find the unilateral Laplace transform of the signal $x(t)$ given by

$$x(t) = 4r(t+1) - 8r(t) + 4r(t-1)$$

(Hint: Sketch the signal.)

(3)(10 points) **Inverse Laplace transform.** Find the inverse Laplace transform of the signal given by

$$X(s) = \frac{3s^2 + 16s + 81}{s^2 + 6s + 25}$$

(4)(Total: 10 points) **Unilateral Laplace transform.** Given the Laplace transform pair:

$$x(t) \leftrightarrow X(s) = \frac{3s}{s^2 + 4}$$

Find the unilateral Laplace transform of the following signals:

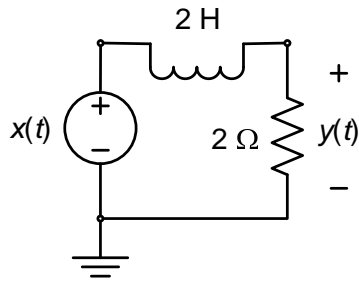
(a) (5 points) $f(t) = x(3t - 6)$

(b) (5 points) $g(t) = x(t) * \frac{dx(t)}{dt}$

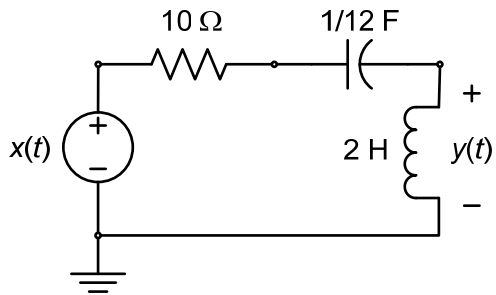
(5)(10 points) **Applications of Laplace transform to solve differential equations.** Find $y(t)$ for $t > 0$ of the differential equation with the specified input signal and the initial condition:

$$\frac{dy(t)}{dt} + 3y(t) = 5x(t), \quad x(t) = 2e^{-t}u(t), \quad y(0^-) = -4$$

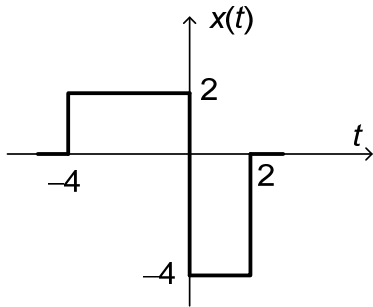
(6)(10 points) (10 points) **Application of Laplace transform to electric circuits.** For the electric circuit shown, the input voltage signal $x(t)$ is given by $x(t) = 4e^{-t}u(t) - 6u(-t)$ V. Use Laplace-domain circuit to find the output voltage signal $y(t)$ for $t \geq 0$.



(7)(10 points) **Transfer function and impulse response.** Find the transfer function $H(s)$ and the impulse response $h(t)$ of the electric circuit shown.



(8) (10 points) **Fourier transform.** Find the Fourier transform of the signal shown.



(9) (10 points) **Fourier transform.** Given the Fourier-transform pair:

$$x(t) \leftrightarrow \hat{X}(\omega) = \begin{cases} 10, & |\omega| < 5 \\ 0, & |\omega| > 5 \end{cases}$$

Sketch the Fourier transform of $y(t) = x(t)\cos(3t)$. (That is, sketch $\hat{Y}(\omega)$ versus ω .)

(10) (10 points) **Fourier transform.** Given the signal $x(t)$ to be

$$x(t) = \left[\frac{6 \sin(3t)}{\pi t} \right] * \left[\frac{\sin(5t)}{2t} \right]$$

Sketch the Fourier transform of $x(t)$. (That is, sketch $\hat{X}(\omega)$ versus ω .)