Goulette,Spencer J

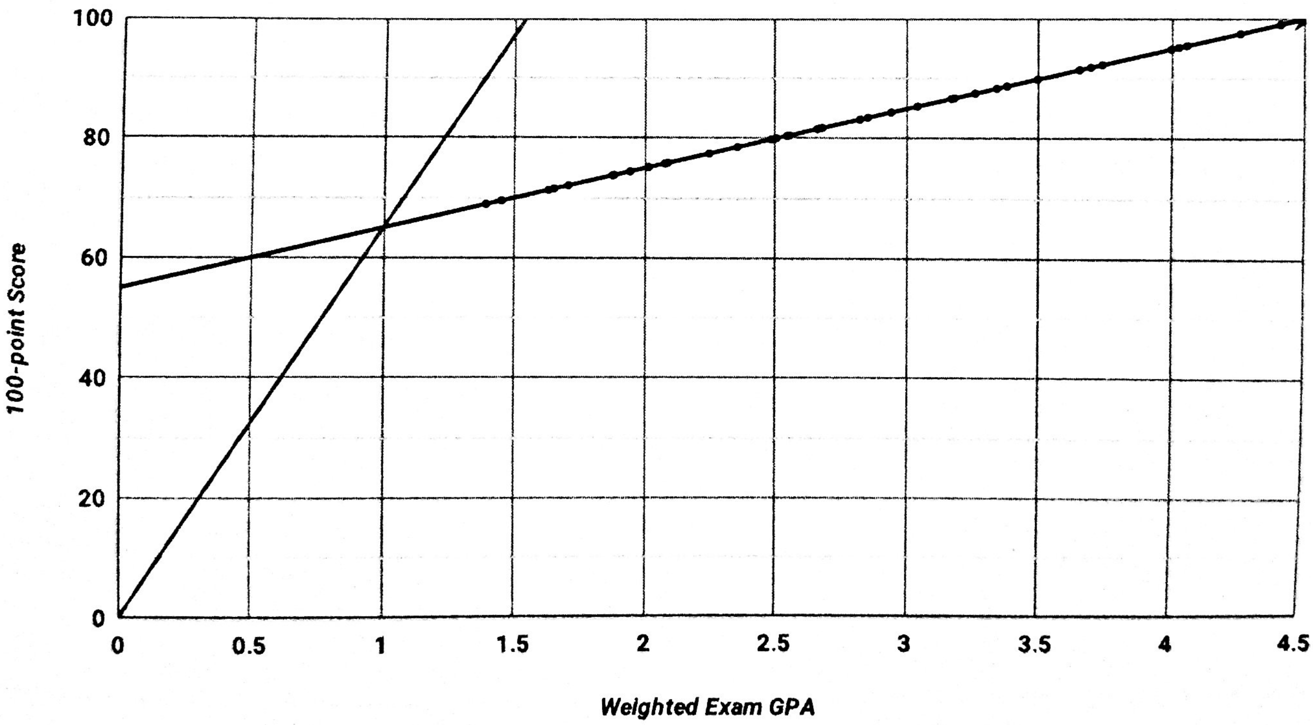
	Problem Grade	Grade Points	Weight
Problem 1	A+	4.50	30%
Problem 2	A+	4.50	13%
Problem 3	A+	4.50	19%
Problem 4	A+	4.50	14%
Problem 5	A+	4.50	10%
Problem 6	A+	4.50	14%

Weighted Exam GPA:	**4.50**	

GPA > 1.0: Recorded 100-pt Score = 65.0+10.0(GPA-1.0)

GPA < 1.0: Recorded 100-pt Score = 65.0(GPA)

GPA to 100-point score mapping



Recorded 100-point max score:	**100.00**	**#N/A**

(90/80/70/60 Scale)

Class Average GPA: 2.83

Class Average 100-pt score: 83.26

ECE-314 Test 1: Oct 2, 2018

2 Hours; Closed book;

Allowed calculator models: (a) Casio fx-115 or fx-991 models (b) HP33s and HP 35s (c) TI-30X and TI-36X models. Calculators not included in this list are not permitted.

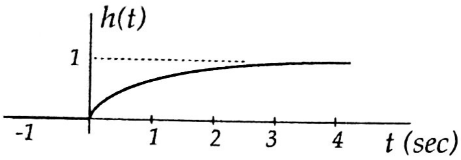
Name : Spencer Goulettes

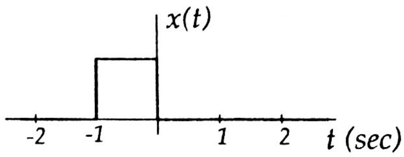
1. (30%) A linear and time invariant system has impulse response $h(t)$ and input signal $x(t)$ given by:

$$h(t) = \begin{cases} 1 - e^{-2t} & t > 0 \\ 0 & \text{elsewhere} \end{cases} \qquad x(t) = \begin{cases} 1 & -1 < t < 0 \\ 0 & \text{elsewhere} \end{cases}$$

S:SO

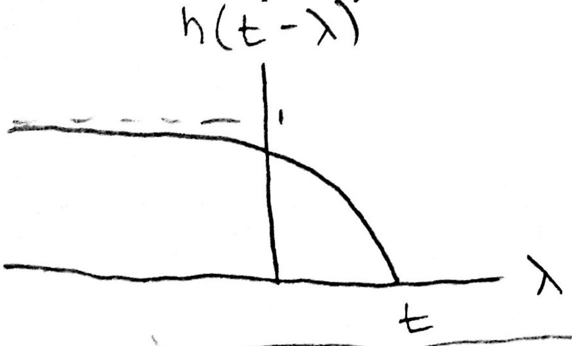
check over answers

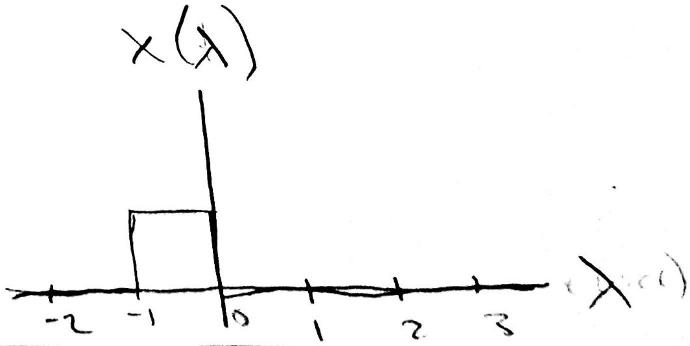




Use convolution to evaluate and plot the system output $y(t)$ for $-\infty < t < \infty$. To receive full credit for this problem, be sure to clearly indicate the following:

- Set up the required convolution integral(s) (without the use of unit steps in the integrand). Be sure that the limits of integration are clear, and clearly specify the range of time values for which each integral expression is valid.
- Evaluate the convolution to give expressions(s) for $y(t)$ (the expressions should not involve integrals). Clearly indicate the range of time values for which each expression holds. Be sure to specify $y(t)$ for the entire range $-\infty < t < \infty$.
- Provide a plot of your result.





$$\boxed{\begin{aligned} y(t) &= 0, && \text{for } t < -1 \\ y(t) &= \int_{-1}^{t} 1 - e^{-2(t-\lambda)}\, d\lambda, && \text{for } -1 \le t \le 0 \\ y(t) &= \int_{-1}^{0} 1 - e^{-2(t-\lambda)}\, d\lambda, && \text{for } t > 0 \end{aligned}}$$

A+

(mostly) blank page for problem 1

$y(t) = 0, \quad \text{for } t < -1$

$y(t) = \int_{-1}^{t} 1 - e^{-2(t-\lambda)} \, d\lambda, \quad \text{for } -1 \le t \le 0$

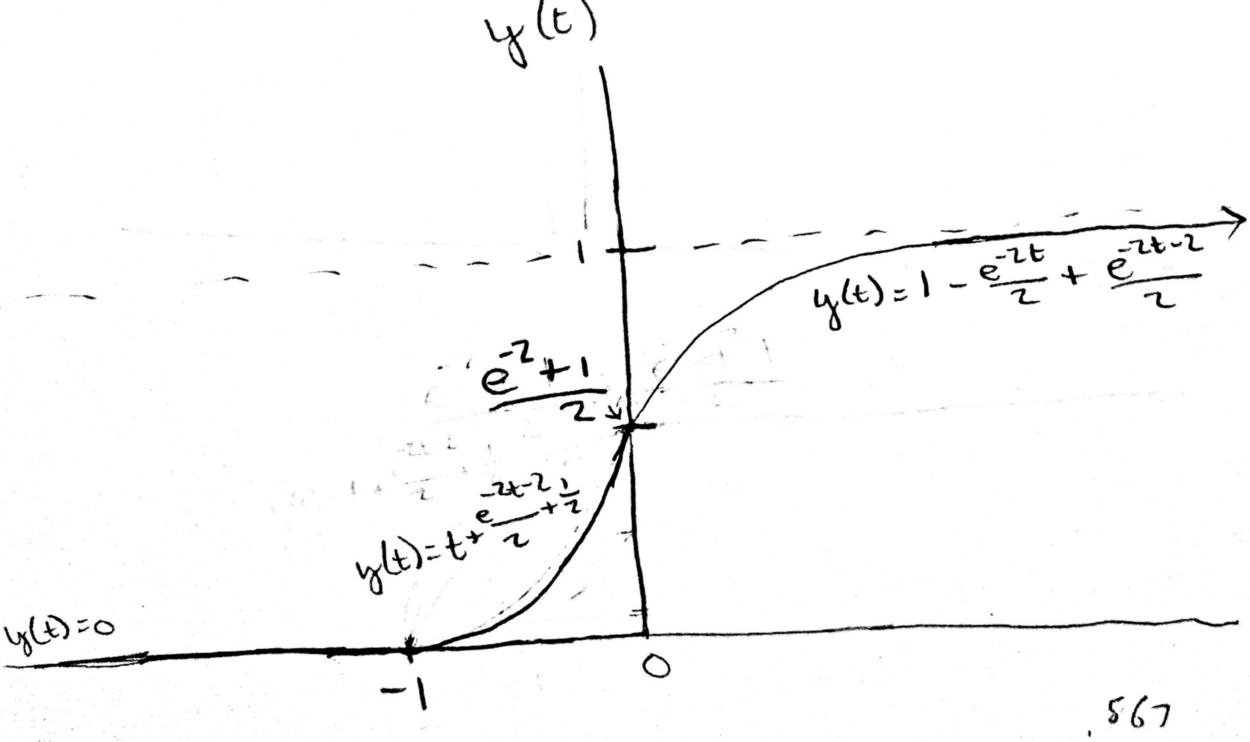
$y(t) = \int_{-1}^{0} 1 - e^{-2(t-\lambda)} \, d\lambda, \quad \text{for } t \ge 0$

$$\int 1 - e^{-2(t-\lambda)} \, d\lambda = \int 1 - e^{-2t} e^{2\lambda} \, d\lambda = \lambda - \frac{e^{-2t} e^{2\lambda}}{2}$$

$$\left[\lambda - \frac{e^{-2t} e^{2\lambda}}{2} \right]_{-1}^{t} = t - \frac{e^{-2t+2t}}{2} + 1 + \frac{e^{-2t-2}}{2}$$

$$\left[\lambda - \frac{e^{-2t} e^{2\lambda}}{2} \right]_{-1}^{0} = 0 - \frac{e^{-2t}}{2} + 1 + \frac{e^{-2t-2}}{2}$$

$$\boxed{y(t) = \begin{cases} 0, & t < -1 \\ t + \frac{e^{-2t-2}}{2} + \frac{1}{2}, & -1 \le t \le 0 \\ 1 - \frac{e^{-2t}}{2} + \frac{e^{-2t-2}}{2}, & t > 0 \end{cases}}$$



.567

.184

2. (13%) The L.T.I. system/input from problem 1 is repeated here for use in this problem:

$$h(t) = \begin{cases} 1 - e^{-2t} & t > 0 \\ 0 & \text{elsewhere} \end{cases} \qquad x(t) = \begin{cases} 1 & -1 < t < 0 \\ 0 & \text{elsewhere} \end{cases}$$

(a) Is this system causal? (Justify your response for *this* system)

This system is causal since $h(t) = 0$, for $t < 0$.

(b) Is this system B.I.B.O. stable (Justify your response for *this* system)

This system isn't B.I.B.O stable

$$\int_0^\infty 1 - e^{-2t}\, dt = \left[t + \frac{e^{-2t}}{2}\right]\Bigg|_0^\infty$$

$$= \infty$$

3. (19%) The L.T.I. system/input from problem 1 is repeated here for use in this problem:

$$h(t) = \begin{cases} 1 - e^{-2t} & t > 0 \\ 0 & \text{elsewhere} \end{cases} \qquad x(t) = \begin{cases} 1 & -1 < t < 0 \\ 0 & \text{elsewhere} \end{cases}$$

(a) Evaluate the system gain $H(s)$ for this system (be sure to specify any restrictions on the complex variable s that are required).

eq on sheet $\longrightarrow H(s) = \int_{-\infty}^{\infty} h(t) e^{-st}\, dt$

$H(s) = \int_0^{\infty} (1 - e^{-2t}) e^{-st}\, dt$ restriction

$H(s) = \int_0^{\infty} e^{-st} - e^{(-2-s)t}\, dt$ $\downarrow$

$H(s) = \left[\frac{e^{-st}}{-s} - \frac{e^{(-2-s)t}}{-2-s} \right]_0^{\infty}$, $Re(s) > 0$

$H(s) = 0 - 0 + \frac{1}{s} + \frac{1}{-2-s}$

$$\boxed{H(s) = \frac{1}{s} + \frac{-1}{s+2}}$$

(b) Use the system gain to write down the system output $y(t)$ when the input signal is $x(t) = e^{3t}$. $x(t) = e^{st} \rightarrow s = 3$

$y(t) = H(s) x(t)$

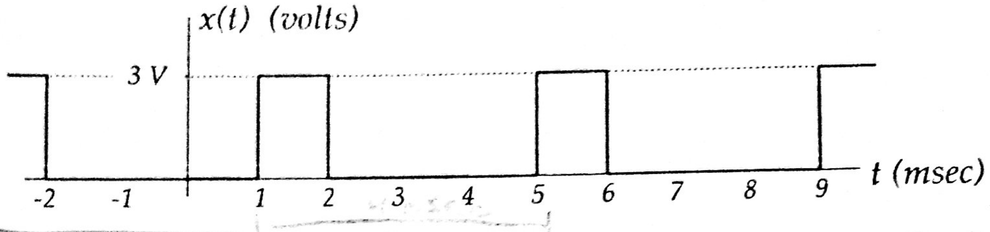
$H(s) = \frac{1}{3} + \frac{-1}{3+2} = \frac{2}{15}$

$$\boxed{y(t) = \frac{2}{15} e^{3t}}$$

A+

4. (14%) A periodic pulse train is shown in the plot below. Evaluate the following (please provide units for your results)

- The signal period
- The fundamental frequency
- The RMS value



$\boxed{\text{Signal period: 4 msec}}$

$\boxed{\text{fundamental frequency: } \overline{4msec} = 250\text{ Hz}}$

The RMS value:

$$RMS = \sqrt{\frac{1}{4}\int_1^5 |x(t)|^2 dt}$$

$$RMS = \sqrt{\frac{9}{4}}$$

$$\boxed{RMS = \frac{3}{2}\text{ Volts}}$$

At

5. (10%) Let $x(t) = Ae^{st} + A^*e^{s^*t}$ where

$$A = 1 + j1 = \sqrt{2}e^{j\pi/4} \qquad s = -3 + 4j = 5e^{j(2.214)}$$

Simplify $x(t)$ to be a purely real function (no imaginary or complex expressions).

$x(t) = \sqrt{2}\, e^{j\pi/4} e^{-3t} e^{j4t} + \sqrt{2}\, e^{-j\pi/4} e^{-3t} e^{-j4t}$

$x(t) = \sqrt{2}\, e^{-3t}\left(e^{j(\pi/4+4t)} + e^{-j(\pi/4+4t)}\right)$

$x(t) = \sqrt{2}\, e^{-3t}\left(\cos(\pi/4+4t) + \cancel{j\sin(\pi/4+4t)} + \cos(\pi/4+4t) - \cancel{j\sin(\pi/4+4t)}\right)$

$$\boxed{x(t) = 2\sqrt{2}\, e^{-3t}\cos(\pi/4+4t)}$$

✓

/ 1

6. (14%)

(a) Evaluate $\int_{-2}^{2}(3+t+6t^2)\delta(t-0.5)dt$

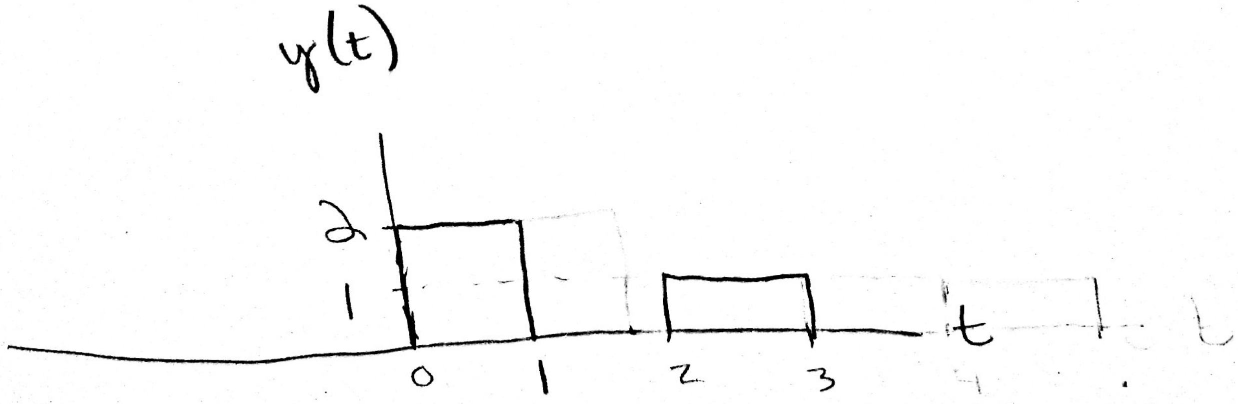
$$\int_{-2}^{2}(3+t+6t^2)\delta(t-0.5)\,dt$$
$$=(3+t+6t^2)\Big|_{t=0.5}$$
$$=(3+(0.5)+6\cdot(0.5)^2)=\boxed{5}$$

(b) Find and plot $y(t)=x(t)*(2\delta(t-1)+\delta(t-3))$, where $x(t)$ is as given in problem 1 (reproduced here)

$$x(t)=\begin{cases}1 & -1<t<0\\ 0 & \text{elsewhere}\end{cases}$$

$$y(t)=\int_{-\infty}^{\infty}x(t-\lambda)\left(2\delta(\lambda-1)+\delta(\lambda-3)\right)d\lambda$$

$$\boxed{y(t)=2x(t-1)+x(t-3)}$$



A+