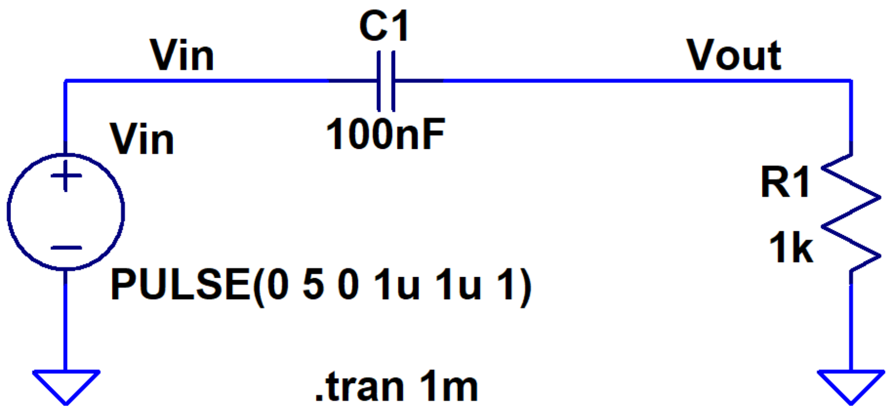
Quiz #21 EE 221 Spring 2023 Name:_______________________________________

Closed book and notes.

Show your work for credit and place a box around each of your answers. Note the information on the back of the quiz!

1. Using the Laplace transform determine, and sketch, the voltage across the resistor from 0 to 1 ms. (5 points)



12-2.1 Definition of the Laplace Transform

The symbol $\mathcal{L}[f(t)]$ is a short-hand notation for "the Laplace transform of function $f(t)$." Usually denoted $\mathbf{F}(\mathbf{s})$, the Laplace transform is defined by

$$\mathbf{F}(\mathbf{s}) = \mathcal{L}[f(t)] = \int_{0^-}^{\infty} f(t)\, e^{-\mathbf{s}t}\, dt, \tag{12.10}$$

Table 12-2: Examples of Laplace transform pairs for $T \geq 0$. Note that multiplication by $u(t)$ guarantees that $f(t) = 0$ for $t < 0^-$.

Laplace Transform Pairs			
	$f(t)$		$\mathbf{F}(\mathbf{s}) = \mathcal{L}[f(t)]$
1	$\delta(t)$	$\leftrightarrow$	1
1a	$\delta(t-T)$	$\leftrightarrow$	$e^{-T\mathbf{s}}$
2	1 or $u(t)$	$\leftrightarrow$	$\dfrac{1}{\mathbf{s}}$
2a	$u(t-T)$	$\leftrightarrow$	$\dfrac{e^{-T\mathbf{s}}}{\mathbf{s}}$
3	$e^{-at}\, u(t)$	$\leftrightarrow$	$\dfrac{1}{\mathbf{s}+a}$
3a	$e^{-a(t-T)}\, u(t-T)$	$\leftrightarrow$	$\dfrac{e^{-T\mathbf{s}}}{\mathbf{s}+a}$
4	$t\, u(t)$	$\leftrightarrow$	$\dfrac{1}{\mathbf{s}^2}$
4a	$(t-T)\, u(t-T)$	$\leftrightarrow$	$\dfrac{e^{-T\mathbf{s}}}{\mathbf{s}^2}$
5	$t^2\, u(t)$	$\leftrightarrow$	$\dfrac{2}{\mathbf{s}^3}$
6	$te^{-at}\, u(t)$	$\leftrightarrow$	$\dfrac{1}{(\mathbf{s}+a)^2}$
7	$t^2e^{-at}\, u(t)$	$\leftrightarrow$	$\dfrac{2}{(\mathbf{s}+a)^3}$
8	$t^{n-1}e^{-at}\, u(t)$	$\leftrightarrow$	$\dfrac{(n-1)!}{(\mathbf{s}+a)^n}$
9	$\sin\omega t\, u(t)$	$\leftrightarrow$	$\dfrac{\omega}{\mathbf{s}^2+\omega^2}$
10	$\sin(\omega t+\theta)\, u(t)$	$\leftrightarrow$	$\dfrac{\mathbf{s}\sin\theta+\omega\cos\theta}{\mathbf{s}^2+\omega^2}$
11	$\cos\omega t\, u(t)$	$\leftrightarrow$	$\dfrac{\mathbf{s}}{\mathbf{s}^2+\omega^2}$
12	$\cos(\omega t+\theta)\, u(t)$	$\leftrightarrow$	$\dfrac{\mathbf{s}\cos\theta-\omega\sin\theta}{\mathbf{s}^2+\omega^2}$
13	$e^{-at}\sin\omega t\, u(t)$	$\leftrightarrow$	$\dfrac{\omega}{(\mathbf{s}+a)^2+\omega^2}$
14	$e^{-at}\cos\omega t\, u(t)$	$\leftrightarrow$	$\dfrac{\mathbf{s}+a}{(\mathbf{s}+a)^2+\omega^2}$
15	$2e^{-at}\cos(bt-\theta)\, u(t)$	$\leftrightarrow$	$\dfrac{e^{j\theta}}{\mathbf{s}+a+jb}+\dfrac{e^{-j\theta}}{\mathbf{s}+a-jb}$
16	$\dfrac{2t^{n-1}}{(n-1)!}e^{-at}\cos(bt-\theta)\, u(t)$	$\leftrightarrow$	$\dfrac{e^{j\theta}}{(\mathbf{s}+a+jb)^n}+\dfrac{e^{-j\theta}}{(\mathbf{s}+a-jb)^n}$

Note: $(n-1)! = (n-1)(n-2)\ldots 1.$