

ECE332 Quiz 3
(10 minutes)

Name: _____

1. [100 pts] **Given:** The following 1st order differential equation with initial conditions.

$$\frac{di_L(t)}{dt} + 1000i_L(t) = 0.25e^{-500t} u(t) \text{ A}$$

$$i_L(0) = 0.5 \text{ A}$$

- a. [30 pts] **Find:** The Laplace transformation of the above 1st order differential equation.

$$s I_L(s) - i_L(0) + 1000 I_L(s) = \frac{0.25}{s+500}$$

$$s I_L(s) - 0.5 + 1000 I_L(s) = \frac{0.25}{s+500}$$

- b. [20 pts] **Find:** Solve Part a for the transform $I_L(s)$.

$$I_L(s)(s+1000) = \frac{0.25}{s+500} + 0.5$$

$$I_L(s) = \frac{0.25}{(s+500)(s+1000)} + \frac{0.5}{s+1000}$$

- c. [30 pts] **Find:** Assume you found the transform $I_L(s)$ from Part b to be that below. Use inverse Laplace techniques to find the waveform $i_L(t)$.

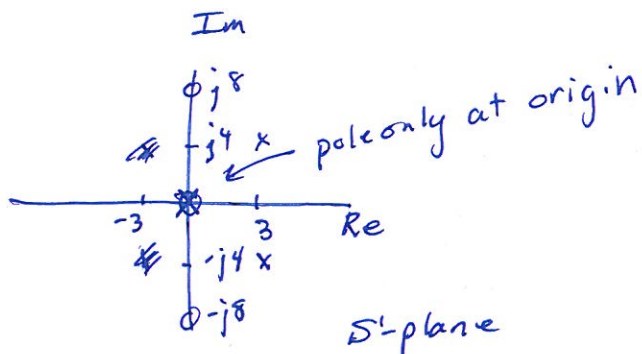
$$I_L(s) = \frac{3(s^2 + 64)}{s(s - 3 - j4)(s - 3 + j4)}$$

$$I_L(s) = \frac{K_1}{s} + \frac{K_2}{s - 3 - j4} + \frac{K_2^*}{s - 3 + j4}$$

$$K_1 = \frac{3 \cdot 64}{(-3 + j4)(-3 - j4)} = \frac{192}{25} = 7.68 \quad K_2 = \frac{3((3 + j4)^2 + 64)}{(3 + j4)(j8)} = 4.64 \angle -120^\circ$$

$$i_L(t) = 7.68 \mu(t) + 9.2 e^{3t} \cos(4t - 120.3^\circ)$$

- d. [10 pts] **Find:** Draw the s-plane below and plot the poles and zeroes of $I_L(s)$. Properly label the axes.



- e. [10 pts] **Find:** Is the response stable or unstable? How do you know?

unstable; real part of poles is positive