

Instructions: This is an open-book, open-notes exam. Laptops may be used for access to reference material only. You have exactly 50 minutes to complete the exam.

1. Given the following differential equation

$$y'(t) + 3y(t) = \sin(t)u(t)$$

with initial condition  $y(0^-) = -2$ , solve for the total response  $y(t)$  (in the time domain) **using the Laplace Transform.**

2. Suppose a linear time-invariant system has a transfer function

$$H(s) = \frac{s + 1}{s^2 + 6s + 10}$$

- (a) Is the system stable or unstable? and in what sense?  
(b) What is the zero-state response in the Laplace domain to an input  $x(t) = e^{-2t} \cos(5t)u(t)$ .
3. Realize the system from problem 2 using Direct Form II.
4. Suppose a linear time-invariant system has a transfer function

$$H(s) = \frac{10}{s + 2}$$

What is the **steady-state response** due to the input  $x(t) = u(t) + \sin(t)u(t)$ .

5. Given the following circuit, assuming all initial conditions are zero and ideal op-amps, what is the transfer function for the system?

