EE 341 - Exam 1

February 25, 2005

Name: _____

Closed book. One page of notes and a calculator are allowed. Show all work. Partial credit will be given. No credit will be given if an answer appears with no supporting work.

1. For the following functions, find the inverse Laplace transform:

   (a)

$$F(s) = \frac{s+8}{(s+6)(s+4)^2}$$

   (b)

$$F(s) = \frac{2s+14}{s^2+6s+25}$$

2. Consider the system described by the differential equation:

$$\frac{d^2y(t)}{dt^2} + y(t) = \frac{dx(t)}{dt} + x(t)$$

The system has initial conditions $\dot{y}(0^-) = 1$ and $y(0^-) = 0$. The input to the system is the step function $u(t)$.

(a) Find the transfer function $H(s)$ for the system.

(b) Find the output $y(t)$ for $t \geq 0$.

(c) Identify the zero-state and zero-input parts of $y(t)$.

3. A system is described by the transfer function:

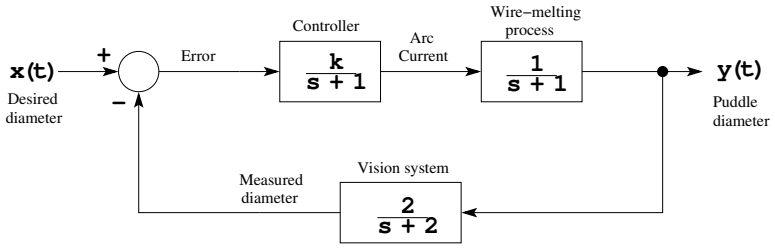
$$H(s) = \frac{s+3}{(s+2)(s^2+4s+20)}$$

(a) Sketch the pole-zero diagram for the system.

(b) Without computing the actual response, give the general form of the step response of the system.

(c) Determine the steady-state value of the step response of the system.

4. The figure below shows the control system for an arc welder:

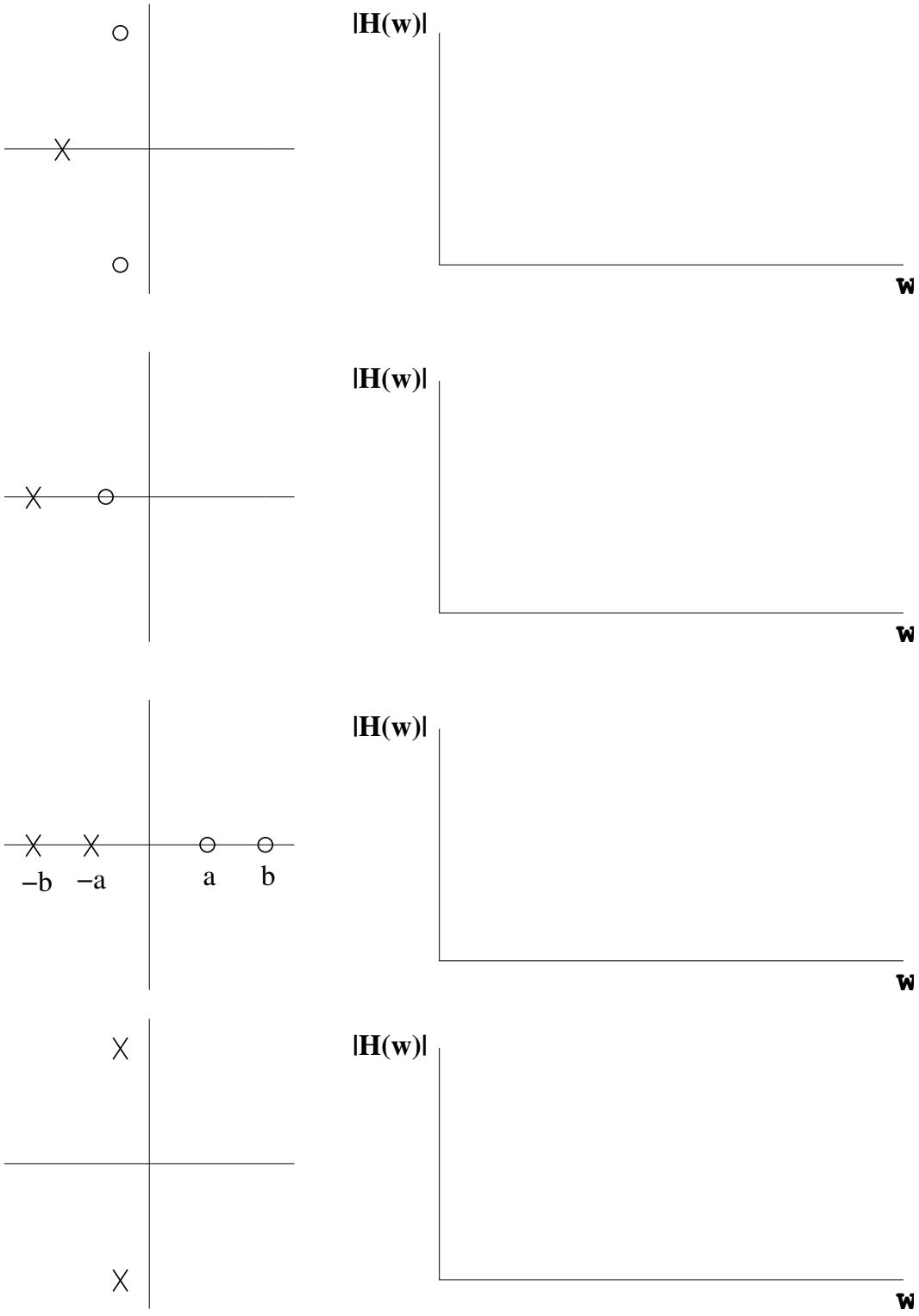


(a) Find the transfer function for the system.

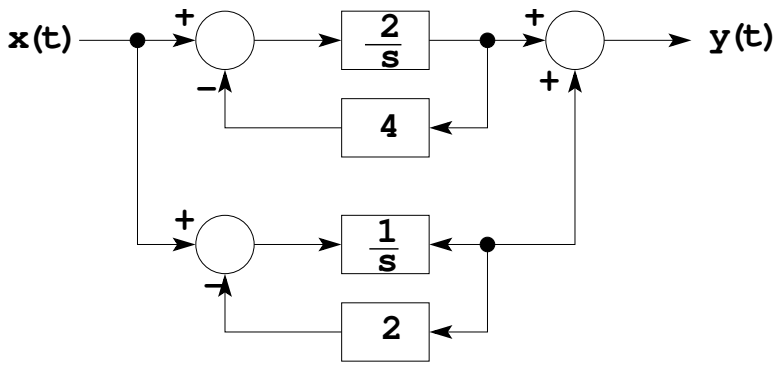
(b) For what values of k is the control system stable? (Note: If you cannot find the transfer function for (a), use the following:

$$H(s) = \frac{3k}{s^4 + s^3 + 2s^2 + 2s + k}$$

5. Roughly sketch the magnitude of the frequency response of the systems represented by the pole-zero diagrams below. Assume the $k = 1$ for all four systems.



6. A linear time-invariant system has the block diagram representation shown below:



(a) Find the transfer function for the system.

(b) Determine a differential equation relating the input $x(t)$ to the output $y(t)$ of this system.