University of California at Berkeley
Department of Electrical Engineering and Computer Sciences
Professor J.M. Kahn

EECS 120
Midterm 1

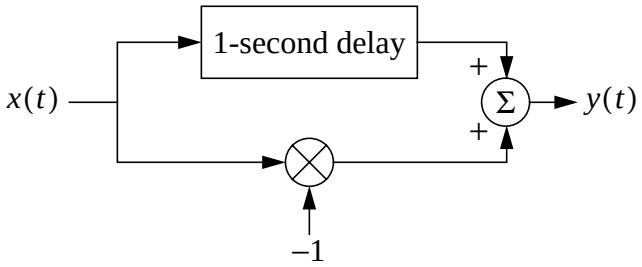
Monday, October 13, 1997, 2:10-3:10 pm

Name: _____

1. Pace yourself. Don't spend too much time on any one problem.
2. Do all work in the space provided. If you need more room, use the back of previous page.
3. Indicate your answer clearly by circling it or drawing a box around it.
4. Think carefully about the problem before you begin to write.

Problem	Points	Score
1	35	
2	50	
3	15	
TOTAL:	100	

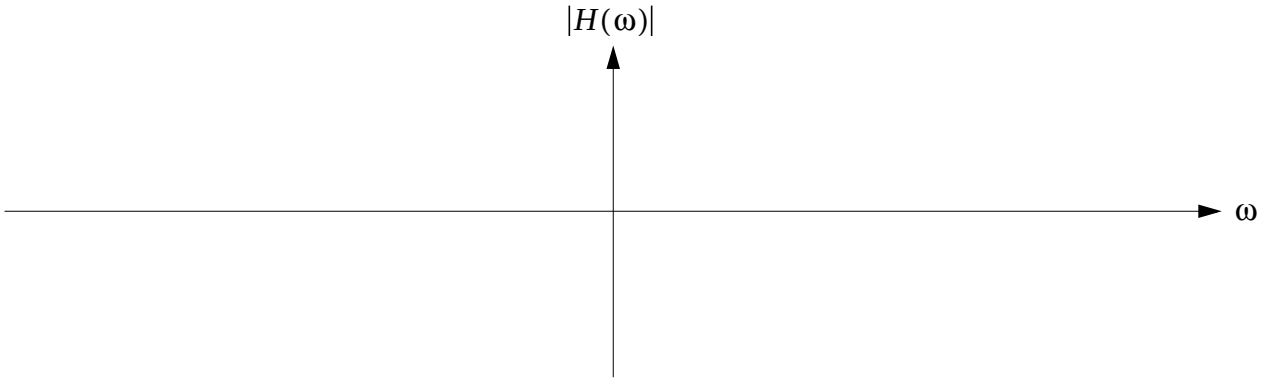
Problem 1 (35 pts.) A LTI system with input $x(t)$ and output $y(t)$ is implemented as shown.



(a) (10 pts.) Give an expression for the impulse response $h(t)$.

(b) (10 pts.) Give an expression for the frequency response $H(\omega)$.

(c) (10 pts.) Find a purely real expression for $|H(\omega)|$. Sketch $|H(\omega)|$, labeling the vertical and horizontal axes of your plot.



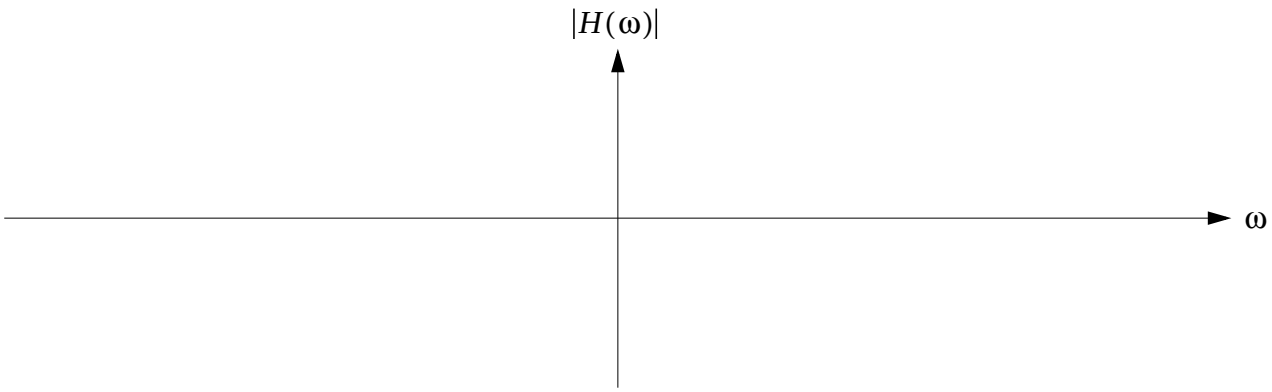
(d) (5 pts.) Suppose the input is $x(t) = \cos\omega_0 t$. For what values of ω_0 is the output zero, i.e., $y(t) = 0$?

Problem 2 (50 pts.) A system with input $x(t)$ and output $y(t)$ is described by the differential equation:

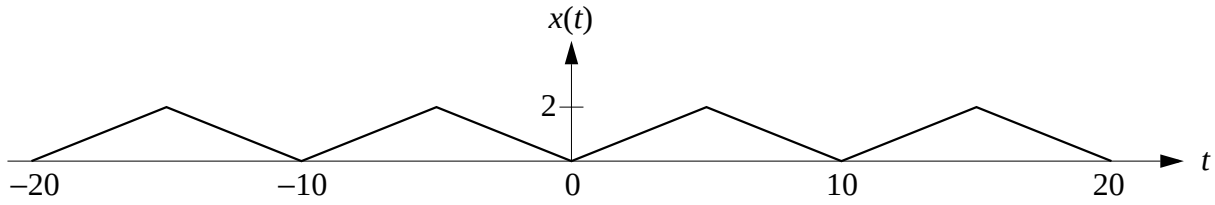
$$\frac{d^2y}{dt^2} + 2\frac{dy}{dt} + y = 2\frac{dx}{dt} + x.$$

(a) (10 pts.) Find an expression for the frequency response $H(\omega)$.

(b) (10 pts.) Find a purely real expression for $|H(\omega)|$, and sketch $|H(\omega)|$, labeling the horizontal and vertical axes of your sketch. *Hint*: just evaluate $|H(\omega)|$ for a few values of ω, e.g., $\omega = 0, 1, 2, \infty$.



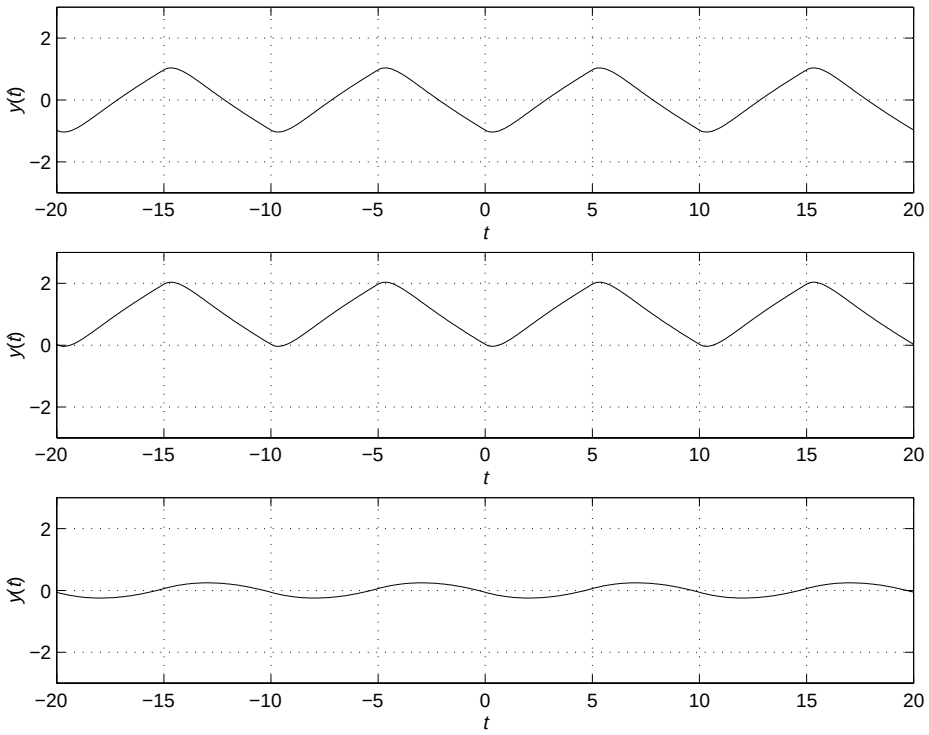
Consider the periodic signal $x(t)$ shown below.



(c) (15 pts.) State the period T_0 and the fundamental frequency ω_0 of the signal $x(t)$. Give an exponential Fourier series representation of $x(t)$.

(d) (10 pts.) The signal $x(t)$ shown above is input to the system. Give an exponential Fourier series representation of the output $y(t)$.

(e) (5 pts.) Circle the drawing that you think best depicts the $y(t)$ obtained in part (d).



Problem 3 (15 pts.) Consider a signal $y(t) = r(t) \otimes \Pi(t)$, where $r(t)$ is the unit ramp function and $\Pi(t)$ is the unit pulse function.

(a) (10 pts.) Find an expression for $y(t)$.

(b) (5 pts.) Sketch $y(t)$, labeling the vertical and horizontal axes of the plot. You may find it helpful to evaluate $y(t)$, $t \geq 1/2$.