EECS 216 - Winter 2008
PRACTICE PROBLEMS for LAST PART OF COURSE
April 10, 2008

Problem 1

1. Calculate the Transfer Function $H(s)$ of the system described by the following differential equation:

$$\frac{d^3y(t)}{dt^3} + 5\frac{dy(t)}{dt} + y(t) = 2\frac{dx(t)}{dt} + x(t-1)$$

2. Determine if the LTI system with impulse response

$$h(t) = [2t^3e^{-0.5t} + 2\cos(3t) - 2]u(t)$$

is BIBO stable or marginally stable or neither.

Problem 2

Consider the second-order differential equation

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

for $t \geq 0$, and with initial conditions $y(0^-) = 1$ and $y'(0^-) = 0$.
Let the input $x(t)$ be

$$x(t) = \int_0^t \sin(\tau)u(\tau)d\tau$$

for $t \geq 0$.

1. What is the Transfer Function of this system?

2. Calculate $ZSR(s) = \mathcal{L}[ZSR(t)]$, the (unilateral) Laplace transform of the Zero-State Response.

3. Calculate the Zero-Input Response $ZIR(t)$, for $t \geq 0$.

Problem 3

Consider a causal LTI system whose Transfer Function has no zeros and has one pole at -1, i.e.,

$$H(s) = \frac{1}{s+1} \ .$$

1. Calculate the Zero-State Response $ZSR(t)$ of this system, for $-\infty < t < \infty$, if the input is

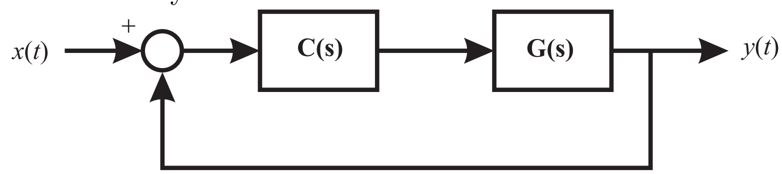
$$x(t) = \cos(5t) + e^{t-2}u(t-2) \quad \text{for } -\infty < t < \infty \ .$$

2. Find an input $x(t)$ such that the Zero-State Response $ZSR(t)$ due to this input satisfies the condition

$$\lim_{t \to \infty} ZSR(t) = 10 \ .$$

Problem 4

Consider the feedback control system



where

$$C(s) = \frac{K_1}{s + K_2} \qquad \text{and} \qquad G(s) = \frac{1}{s-2} \ .$$

Find values of K_1 and K_2 such that the overall system from input $x(t)$ to output $y(t)$ satisfies both of the following conditions:

- It is *marginally stable* but *not BIBO stable*.
- Its Zero-Input Response, $ZIR(t)$, exhibits *oscillations* of frequency 2 radians/sec.