

## Recitation 16, April 11, 2006

### Step and delta functions, and step and delta responses

1. Graph the functions

$$f(t) = 1 + [t] - t$$

(where  $[t]$  denotes the greatest integer less than or equal to  $t$ ) and

$$g(t) = 3(u(t - a) - u(t - b))$$

(where  $a < b$ ). Then find their generalized derivatives and graph them, using harpoons to denote the delta functions that occur.

2. Find the unit step and unit impulse responses to the operator  $mD^2 - kI$ , for  $m > 0$ , and graph them.
3. Suppose  $q(t) = 2u(t+1) + \delta(t) - 2u(t-1)$ . Sketch a graph of this generalized function. Tell stories which might result in each of the equations  $\dot{x} + kx = q(t)$  (your choice of  $k$ , it might be negative) and  $2\ddot{x} + 4\dot{x} + 18x = q(t)$ .
4. Find the unit step and unit impulse responses for  $2D^2 + 4D + 20I$ . Why is one the derivative of the other?