

Problem S4 (Signals and Systems)

Note: This problem is similar to one given a couple years ago. Please try to do this one without looking at bibles — the solution is instructive.

One of the benefits of the approach of using the superposition integral is that you don't have to guess the particular solution — it pops right out of the integral, automatically. In some cases, the particular solution can be hard to guess, but easy to find using the convolution integral. To see this, consider the system described by the differential equation

$$\frac{d^2}{dt^2}y(t) + 5\frac{d}{dt}y(t) + 6y(t) = u(t)$$

1. Find the step response of the system.
2. Take the derivative of the step response to find the impulse response.
3. Now assume that the input is given by

$$u(t) = e^{-2t}\sigma(t)$$

Before doing part (4), try to find the particular solution by the usual method, that is, by intelligent guessing. Be careful — it may not be what you expect!

4. Now find $y(t)$ using the superposition integral. Is the particular solution what you expected?