EE 341 – Homework Chapter 3

3.2 For each of the following diff. eqns. Modeling an LTIC system, determine (a) the zero-input response, (b) the zero-state response, (c) the overall response and (d) the steady-state response of the system for the specified input x(t) and initial conditions.
(i) $\ddot{y}(t) + 4\dot{y}(t) + 8y(t) = \dot{x}(t) + x(t) \ \ with\ x(t) = e^{-4t}u(t),\ \ y(0) = 0, \dot{y}(0) = 0.$

(ii) $\ddot{y}(t) + 6\dot{y}(t) + 4y(t) = \dot{x}(t) + x(t) \ \ with\ x(t) = \cos(6t)\, ut(t),\ \ y(0) = 2, \dot{y}(0) = 0.$

3.4 The input signal $x(t)=e^{-\alpha t}u(t)$ is applied to an LTC system with impulse response $h(t)=e^{-\beta t}u(t)$.
(i) Calculate the output y(t) when $\alpha \neq \beta$.

(ii) Calculate the output y(t) when $\alpha = \beta$.

(iii) Intuitively explain why the output signals are different in parts (i) and (ii).

3.12 Determine whether the LTIC systems characterized by the following impulse responses are memoryless, causal, and stable. Justify your answer. For the unstable systems, demonstrate with an example that a bounded input signal produces an unbounded output signal.
(i) $h1(t) = \delta(t) + e^{-5}u(t)$;

(ii) $h4(t) = e^{-2|t|} + u(t+1) - u(t-1)$;

(viii) $h8(t) = 0.95^{|t|}$

3.15 Consider the feedback configuration of the two LTIC shown in Fig. P3.15. System 1 is characterized by its impulse response, h1(t)=u(t). Similarly, system 2 is characterized by its impulse response, h2(t)=u(t). Determine the expression specifying the relationship between the input x(t) and the output y(t).

3.18 Given that the LTIC system produces the output $y(t) = 5\cos(2\pi t)$ when the signal $x(t) = -3\sin(2\pi t+\pi/4)$ is applied at its input, derive the value of the transfer function $H(\omega)$ at $\omega = 2\pi$. Hint: Use the result derived in Problem 3.17.

3.19 (a) Compute the solutions of the differential equations given in P3.2 (i and ii) for duration $0 \leq t \leq 20$ using MATLAB. (b) Compare the computed solution with the analytical solution obtained in P3.2 (i and ii).