Homework #3

(1)(a)

$$x(t) = e^{-2t}\,u(t-1)$$

$$= e^{-2}\underbrace{e^{-2(t-1)}\,u(t-1)}_{e^{-2t}u(t)\ +\ \text{delay by 1}} \xrightarrow{\mathcal{L}} e^{-2}\,\frac{e^{-s}}{s+2}$$

(1)(c) Directly from Laplace table (line 6)

$$\sin(100t)\,u(t) \xrightarrow{\mathcal{L}} \frac{100}{s^2+10000}$$

---

(2)(a)

$$X(s) = \frac{1}{s^2+5s+6} = \frac{1}{(s+3)(s+2)} = \frac{A_1}{s+3} + \frac{A_2}{s+2}$$

$$\xrightarrow{\mathcal{L}^{-1}} \quad x(t) = \left(A_1 e^{-3t} + A_2 e^{-2t}\right) u(t)$$

(no need to compute A_1 & A_2)

---

(3)(a) Since the system is represented by a linear differential equation with non-zero initial conditions, then it is a nonlinear system

$\Longrightarrow$ no transfer function

Hard Way: take Laplace transform

$$Y(s)\left[s^2+s-2\right] = sX(s) - \underbrace{x(0)}_{=1} + X(s)$$

$$= X(s)\left[s+1\right] - 1$$

Not possible to obtain $\frac{Y(s)}{X(s)} = H(s)$!