Problem 9.11 of text

(a) (i) \[ H(s) = \frac{32}{s^{2}+4s+16} = \frac{32}{(s+2)^{2}+(3.46)^{2}} \]

The poles are at \(-2 \pm 3.46\), therefore, the response is *underdamped*

(ii) \[ H(s) = \frac{32}{s^{2}+8s+16} = \frac{32}{(s+4)^{2}} \]

Two poles at \(s=-4\), therefore the response is *critically damped*

(iii) \[ H(s) = \frac{32}{s^{2}+10s+16} = \frac{32}{(s+2)(s+8)} \]

The poles are at \(s=-2\) and \(s=-8\), therefore, the response is *overdamped*

(b) (i) \[ Y(s) = \frac{32}{s[(s+2)^{2}+(3.46)^{2}]} \]

\[ y(t) = \left(2 - 2e^{-2t} \left[ \cos 3.46t + 0.578 \sin 3.46t \right] \right)u(t) \]

(ii) \[ Y(s) = \frac{32}{s(s+4)^{2}} \]

\[ y(t) = \left(2 - 2(t+4t)e^{-4t} \right)u(t) \]

(iii) \[ Y(s) = \frac{32}{s(s+2)(s+8)} \]

\[ y(t) = \left(\frac{2}{3}e^{-8t} - \frac{8}{3}e^{-2t} + 2 \right)u(t) \]
(c)

(i) Step Response

(ii) Step Response

(iii) Step Response