SFWR ENG 3DX4 – Lab 1 Prelab solutions

1. (a) As $\omega(t) = \frac{d}{dt}\theta(t)$, we have $\omega(s) = s\theta(s)$. So,

$$G_\theta(s) = \frac{\omega(s)}{U(s)}\frac{\theta(s)}{\omega(s)} = \frac{A}{s(\tau s + 1)}$$

(b) First, $U(s) = U_0/s$. The output in the Laplace domain, $\omega(s)$, is thus

$$\omega(s) = G_\omega(s)U(s) = \frac{A}{\tau s + 1}\frac{U_0}{s}$$

Taking the partial fraction expansion, we have

$$\omega(s) = \frac{AU_0}{s} - \frac{AU_0\tau}{\tau s + 1}.$$

Taking inverse Laplace transforms,

$$\omega(t) = (AU_0 - AU_0 e^{-t/\tau})u(t).$$

As $t \to \infty$, $\omega(t) \longrightarrow AU_0$.