Problems:

- **Problem 1:** 8.10

- **Problem 2:** You are given a general constant-parameter ODE that can be described by the Laplace Transform of the solution $f(t)$:

  \[ F(s) = \frac{\beta_n s^n + \ldots + \beta_0}{s^m (\alpha_{n+1}s^{n+1} + \ldots + \alpha_0)} \]

  where the values of $s \in \mathbb{C}$ such that $\alpha_{n+1}s^{n+1} + \ldots + \alpha_0 = 0$ all have a real-part less than zero.

  1) Calculate $\lim_{t \to \infty} f(t)$ for $m = 0$, 1, and 2 (if calculable).

  2) Write some general rules describing the long-time solution to a linear constant-parameter ODE as a function of System Type.

- **Problem 3:** 8.20

- **Problem 4:** Consider the interconnected systems given by the block diagram given in Fig. 1.

  1) Assuming the system is initially at rest, calculate $y(t) = \mathcal{L}^{-1}(Y(s))$, when:
Fig. 1. Block diagram for Problem 4.

\[ A(s) = 10 \]

\[ B(s) = s \]

\[ C(s) = \frac{1}{s + 5} \quad (1) \]

\[ D(s) = 3 \]

\[ R(s) = \mathcal{L} (\cos 2t) \, . \]

2) Verify that your answer is correct by building the system in Simulink and computing a numerical solution. Plot your Transfer Function derived answer and Simulink derived answer on the same plot.