<h1>Homework Week2: <mark>Due on Monday, January 31st</mark></h1>

2.1 Using the Laplace transform pairs and the Laplace transform theorems, derive the Laplace transforms for the following time functions:

a. $e^{-at} \sin \omega t \, u(t)$

b. $e^{-at} \cos \omega t \, u(t)$

c. $t^3 u(t)$

2.2 Find the inverse Laplace transform of $F(s) = \dfrac{10}{s(s+2)(s+3)^2}$.

2.3 A system is described by the following differential equation:

$$\frac{d^3 y}{dt^3} + 3\frac{d^2 y}{dt^2} + 5\frac{dy}{dt} + y = \frac{d^3 x}{dt^3} + 4\frac{d^2 x}{dt^2} + 6\frac{dx}{dt} + 8x$$

Find the expression for the transfer function of the system, Y(s)/X(s).

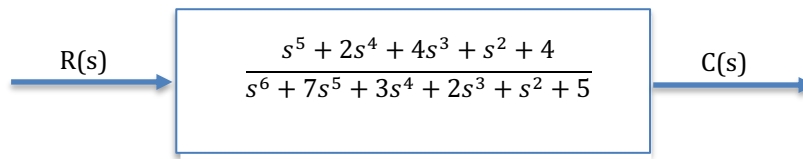2.4 Write the differential equation for the system shown in Figure 2.1.

R(s) → $\dfrac{s^5 + 2s^4 + 4s^3 + s^2 + 4}{s^6 + 7s^5 + 3s^4 + 2s^3 + s^2 + 5}$ → C(s)

Figure 2.1

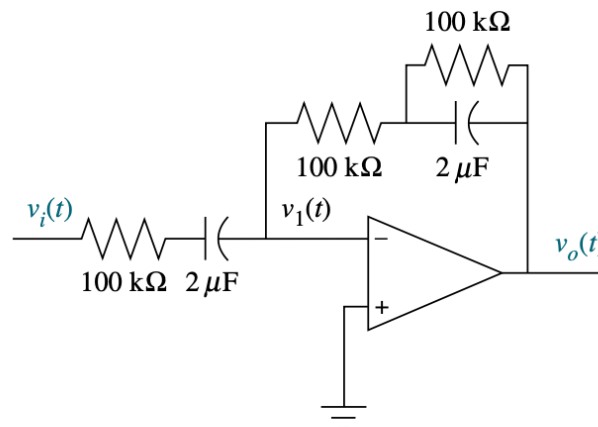2.5 Find the transfer function, $G(s) = V_O(s)/V_O(s)$ for the operational amplifier circuit shown in Figure 2.2.

Figure 2.2