College of Engineering and Computer Science
Mechanical Engineering Department

California State University Northridge

Mechanical Engineering 501A
Seminar in Engineering Analysis

Fall 2017 Number: 15966 Instructor: Larry Caretto

November 8 Homework Problems

1. Find the Laplace transform of a plot which is a straight line from (0,1) to (1,0.5). Show the details of your work.
2. Given F(s) = $\mathcal{L}$ [f(t)] = (–s – 10)/(s^2 – s – 2), find f(t). Show the details.
3. Find the Laplace transform of 5e^{2t}sinh 2t. (Show the details.)
4. If $\mathcal{L}$[f(t)] = F(s) and c is any positive constant, show that $\mathcal{L}$[f(ct)} = F(s/c)/c. Use this result to obtain $\mathcal{L}$(cos ωt) from $\mathcal{L}$(cos t).
5. Solve the following differential equation y'' + 9y = 8 sin t if 0 < t < π and 0 if t > π. y(0) = 0, y'(0) = 4. Use Laplace transforms. (Show the details.)
6. Solve the differential equation y'' + ω_0^2y = K sin pt with y(0) = y'(0) = 0 and p^2 ≠ ω_0^2. Find the solution by Laplace transforms. (Show the details of your work.)
7. Solve the initial value problem y'' + 4y = u(t – 3), y(0) = 1, y'(0) = 0, using Laplace transforms. Show the details of your work.
8. Obtain the solution to the coupled spring-mass system governed by the following equations

$$\frac{d^2y_1}{dt^2} = -\frac{k_1 + k_2}{m_1}y_1 + \frac{k_2}{m_1}y_2 \qquad \frac{d^2y_2}{dt^2} = \frac{k_2}{m_2}y_1 - \frac{k_3 + k_2}{m_2}y_2$$

Use the following properties and initial conditions: $m_1 = m_2 = 10$ kg; $k_1 = k_3 = 20$ kg/s^2; $k_2 = 40$ kg/s^2, $y_1(0) = y_2(0) = 0$; $y_1'(0) = 1$ m/s, and $y_2'(0) = -1$ m/s. Solve the problem using Laplace transforms; show your work.