

3450:335 Ordinary Differential Equations, Kreider
Skills Review for Exam 3

These are some of the algebraic skills that you need for Laplace Transform problems. You should be able to do these calculations in the recommended times. You can make up your own problems to practice.

- 30 second transform the left hand side

$$y'' + 3y' - 7y \quad \text{with} \quad y(0) = 6, y'(0) = -2$$

$$y'' - 4y' + 2y \quad \text{with} \quad y(0) = 0, y'(0) = 1$$

$$y'' - 4y' + 2y \quad \text{with} \quad y(0) = 1, y'(0) = 0$$

- 30 second partial fraction expansions

$$\frac{1}{s(s+4)} =$$

$$\frac{2s-3}{s(s+4)} =$$

- 60 second partial fraction expansions

$$\frac{s+2}{(s+1)(s+3)} =$$

$$\frac{1}{s(s+2)(s+3)} =$$

- 20 seconds: write in shifted form

$$\frac{5s+2}{(s+1)^2+16} =$$

$$\frac{2s-13}{(s+4)^2+1} =$$

- 20 seconds: complete the square

$$s^2 + 4s + 13 =$$

$$s^2 + 6s + 13 =$$

$$s^2 + 6s - 2 =$$

- 10 seconds: match to $\frac{2k^3}{(s^2+k^2)^2}$

$$\frac{3}{(s^2+4)^2} =$$

$$\frac{18}{(s^2+9)^2} =$$

- 30 seconds: solve for $Y(s)$

$$\begin{aligned}(sY - 4) + 2Y &= \frac{1}{s(s+1)} \\(s^2Y + 2s - 3) + 5(sY - 2) + 4Y &= 0 \\(s^2Y + s + 1) + 6Y &= \frac{1}{s} + \frac{2}{s}e^{-5s}\end{aligned}$$

- 30 seconds: find the determinant and factor or complete the square

$$\begin{bmatrix} s-3 & 5 \\ -2 & s-1 \end{bmatrix}$$

$$\begin{bmatrix} s-2 & -1 \\ 4 & s+2 \end{bmatrix}$$

- 60 seconds: multiply and separate into components ($X(s)$ on top, $Y(s)$ on bottom)

$$\frac{1}{(s+2)(s+3)} \begin{bmatrix} s-3 & 4 \\ -2 & s+7 \end{bmatrix} \begin{bmatrix} 2 \\ -3 \end{bmatrix}$$

$$\frac{1}{(s-1)^2 + 4} \begin{bmatrix} s-2 & 1 \\ -2 & s-3 \end{bmatrix} \begin{bmatrix} 1 \\ 2 \end{bmatrix}$$