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1. Use the integral definition to find the Laplace Transform of the given functions. Indicate any restrictions on s.

(a). $f(t) = t^2 e^{at}$, for positive constant a.

(b). $f(t) = \begin{cases} 2t, & 0 \le t < 2 \\ 4, & 2 \le t < 6 \\ 2, & 6 \le t < 8 \\ 0, & \text{otherwise} \end{cases}$

2. Find the inverse Laplace Transform.

(a). $F(s) = \dfrac{3s}{s^2 - 16}$

(b). $F(s) = \dfrac{e^{-3s}}{s^2 - s - 6}$

3. For the given initial value problem, find the Laplace Transform $Y(s)$ of the solution $y(t)$.
[Only find $Y(s)$, do not solve for $y(t)^*$.]

(a). $y'' + 4y' + 5y = 0, \qquad y(0) = 1, y'(0) = 0$

(b). $y'' - 3y' - 10y = g(t), \qquad y(0) = 0, y'(0) = 1$ where $g(t) = \begin{cases} 0, & 0 \le t < 3 \\ 2, & 3 \le t < 6 \\ 0, & t \ge 6 \end{cases}$

*Note: The take-home problem could be like one of these problems, but actually solving the full problem. In which case, the solutions would be (on the answer version):

4. Solve the following differential equations and initial value problems using any technique from class.

(a). $y'' - 3y' - 4y = 3e^{2x} + 2\sin x + 4x^2$

(b). $y'' - 3y' - 4y = e^{-x}, \qquad y(0) = 1,\ y'(0) = 4$

(c). $y' = y^2/x, \qquad y(1) = -2$

(d). $x^2y'' - xy' + 4y = 0$

(e). $(x+1)^2y'' - 5(x+1)y' + 9y = 0$

(f). $y' - \dfrac{1}{x}y = xe^x$

(g). $(2x + 4xy)dx + (2x^2 - 2y)dy = 0$

(h). $y'' + 2y' + 2y = 0, \qquad y(\pi/4) = 2,\ y'(\pi/4) = -2$

(i). $4y'' + y = 2\sec\left(\dfrac{t}{2}\right)$

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