For the first five problems, do not use MATLAB to solve the differential equations; in particular, you may not use the dsolve command (except to check your work). You may use MATLAB to compute integrals, solve equations, perform arithmetic, and check your answers. You must show your work to receive any credit.

1. For the following differential equations, determine whether the method of undetermined coefficients can be used to find a particular solution. If it can, determine the form of a particular solution. You do not need to solve the differential equation.

   (a) \( y'' - 5y' + 6y = t^2 e^{-t} + \cos(2t) \)
   (b) \( x'' + 4x' + 13x = t^2 e^{-2t} \cos(3t) \)
   (c) \( y'' + y' + 3xy = \cos 2x + e^{2x} \)
   (d) \( z'' + 4z = xe^{2x} + \cos^2 x \)
   (e) \( y'' + 5y' + 6y = \sqrt{t} + \cos(2t) \)

2. Find all solutions to the following differential equation:

   \( r'' + 4r = 3 \csc(2\theta) + 10e^{-\theta} \)

3. Find all solutions to the following differential equation:

   \( t^2 x'' - 3tx' + 4x = t^2 \ln t \)

4. Use the definition of the Laplace transform to compute the Laplace transform of the following function:

   \[
   f(t) = \begin{cases} 
   2 & 0 \leq t \leq 5 \\
   e^{3t} & t > 5 
   \end{cases}
   \]

5. For what values \( \alpha \) are the following functions of exponential order \( \alpha \)?

   (a) \( f(t) = t^2 e^{3t} + e^{2t} \)
   (b) \( f(t) = \ln(3^t) \)
   (c) \( f(t) = (\ln 3)^t \)
   (d) \( f(t) = e^{3t} \)
   (e) \( f(t) = e^{2t/(3t+1)} \)

For the remaining problem, you may use any MATLAB commands.

6. Consider the following initial value problem:

   \( y' = y^2, \quad y(0) = 1 \)

   (a) Use \texttt{rk4.m} to approximate \( y(0.9) \) and \( y(1.01) \) with stepsize \( h = .01 \). Give your answers to 6 decimal places.

   (b) What happens to the solution to the initial value problem between \( x = 0.9 \) and \( x = 1.01 \)?