1. Solve the IVP: \[ y' = \frac{3y}{t^2 + 1}, \quad y(0) = 5 \]
2. Find the general solution of \( \frac{dy}{dt} + 3y = \frac{1}{(1+e^{3t})^2} \)
3. Find the general solution of $y'' + 2y' - 15y = 0$
4. Using the method of undetermined coefficients, find a particular solution of 
\( y'' + 2y' + 2y = \sin(t) \). Then, given the fact that the corresponding homogeneous 
differential equation has solutions \( y_h(t) = e^{-t}(c_1 \sin(2t) + c_2 \cos(2t)) \) write the 
general solution of the non-homogeneous equation and find a particular solution of the 
non-homogeneous equation which satisfies \( y(0) = 0 \) and \( y'(0) = 1 \).
5. Solve the system \[
\begin{bmatrix}
  x'(t) \\
  y'(t)
\end{bmatrix} = \begin{bmatrix}
  -3 & 2 \\
  1 & -2
\end{bmatrix} \begin{bmatrix}
  x(t) \\
  y(t)
\end{bmatrix}.
\]
Sketch the straight line solutions and typical solutions showing the direction of the motion. Identify the “fast” and “slow” eigenvectors and characterize the equilibrium solution \[
\begin{bmatrix}
  x(t) \\
  y(t)
\end{bmatrix} = \begin{bmatrix}
  0 \\
  0
\end{bmatrix}
\]
as attracting nearby solutions, repelling them or neither.
6. Use Laplace transforms to solve the IVP \( y'' + 2y' = 4, \ y(0) = 1, \ y'(0) = -4 \).