1) (15 pts) Find the equation of the orthogonal trajectories to the family of curves 

\[ y^2 = 3x + c. \]
2) (a) (10 pts) Find the general solution to the equation $y' \cos x + y \sin x = \sin x$.

(b) (10 pts) Solve the IVP $xy' - 2y = 2x^2 \ln x$, $y(1) = 3$. 
3) Find the general solution for each of the equations:

(a) (6 pts) $y'' - y' + 6y = 0$

(b) (13 pts) $y'' + 10y' + 25y = e^{-5x}$

(c) (14 pts) $y'' + 2y = 17e^{-x} \sin 2x$
4) Consider the equation \( x^2y'' - 3xy' + 4y = 0 \).

(a) (6 pts) Find a solution of the form \( y_1(x) = x^r \).

(b) (11 pts) Use the method of reduction of order to find another solution \( y_2(x) \).

(c) (5 pts) Show that \( y_1 \) and \( y_2 \) are linearly independent by calculating their Wronskian, and write the general solution to the equation.
5) (20 pts) Recall that the differential equation governing an RL circuit is \( \frac{di}{dt} + ai = \frac{1}{L} E(t) \), where \( i(t) \) is the current in the circuit at time \( t \) and \( a = \frac{R}{L} \). Consider an RL circuit with zero initial current and electromotive force \( E(t) = E_0 e^{bt} \). Find the current in the circuit for \( t > 0 \). (Caution: At some point you will need to treat the cases \( b \neq -a \) and \( b = -a \) separately.)