

1. Find and plot the orthogonal trajectories to the family of curves  $x^2 + y^2 = 2cx$ .
2. Solve the following differential equations:  
(a)  $dy/dx = (x + y - 1)/(x + 4y + 2)$   
(b)  $dy/dx = (x + y + 4)/(x + y - 6)$
3. Derive the condition under which the differential equation  $Mdx + Ndy = 0$  has an integrating factor that is a function of the sum  $z = x + y$  starting from the concept of integrating factor.
4. Write the equation  $dy/dx + P(x)y = Q(x)$  in the form  $Mdx + Ndy = 0$  and show that it has integrating factor  $\mu$  that is a function of  $x$  alone. Find  $\mu$  and solve  $\mu Mdx + \mu Ndy = 0$  as an exact equation.
5. Solve the first order nonlinear differential equation:  $xy' + y = y^{-2}$ .