Mohamed Khider University of Biskra   Academic Year: 2025/2026
Department of Material Sciences   The date :   22/10/2025
Module: Applied Mathematics

1

Guided Work Series Number **2**   Differential Equations

Exercse 2.1   (Separation of Variables)

Solve the differential equation:

$$\frac{dy}{dx} = \frac{x^2}{y} \quad \text{with initial condition } y(0) = 2$$

Exercse 2.2   (Homogeneous Differential Equation)

Solve the homogeneous differential equation:

$$\frac{dy}{dx} = \frac{x^2 + y^2}{xy}$$

Exercse 2.3   (First Order Linear Differential Equation)

Solve the linear differential equation:

$$\frac{dy}{dx} + 2xy = x$$

Exercse 2.4   (Bernoulli Differential Equation)

Solve the Bernoulli differential equation:

$$\frac{dy}{dx} - \frac{2y}{x} = x^2 y^3$$

Exercse 2.5   (Riccati Differential Equation)

Solve the Riccati differential equation:

$$\frac{dy}{dx} = 1 + x - y - xy + y^2$$

given that $y_1 = x$ is a particular solution.

Exercse 2.6 (Another Bernoulli Equation)

Solve the Bernoulli differential equation:

$$\frac{dy}{dx} + \frac{y}{x} = y^2 \ln x$$

Exercse 2.7 (Bernoulli Differential Equation)

Solve the Bernoulli differential equation:

$$\frac{dy}{dx} + y = xy^2$$

Exercse 2.8 (Second Order Linear Differential Equation with Constant Coefficients)

Solve the initial value problem:

$$y'' - 3y' + 2y = 0, \quad y(0) = 1, \quad y'(0) = 0$$

Exercse 2.9

Find in the domain I of $\mathbb{R}$ the solutions of the following differential equations:

$$
\begin{array}{lll}
1) & x \ln x y' + y = x, & I =]1, +\infty[\\
2) & x(xy' + y - x) = 1, & I =]-\infty, 0[\\
3) & 2xy' + y = x^4, & I =]-\infty, 0[
\end{array}
$$

Exercse 2.10

Find on the set $]-\infty, 0[$ and the set $]0, +\infty[$ the solutions of the differential equation:

$$|x|y' + (x - 1)y = x^3$$