Khemis Miliana university
Faculty of Material Sciences and Computer Sciences

Level : L_2
Specialization : fundamental physics
module : Mathematics III
Semester 3

Chapter 03 : Differential Equations

Exercise 1. *Solve the following first-order differential equations using the appropriate method in each case :*

1. *(Separable equation)* $\frac{dy}{dx} = \frac{x^2}{y}, \quad y(0) = 1$
2. *(Linear equation)* $\frac{dy}{dx} + 2y = e^{-x}, \quad y(0) = 0$
3. *(Homogeneous equation)* $\frac{dy}{dx} = \frac{x+y}{x-y}$
4. *(Bernoulli equation)* $\frac{dy}{dx} + y = y^2 e^x, \quad y(0) = 1$
5. *(Linear equation with a non-constant coefficient)* $y' - \frac{2y}{x} = x^2 e^x$

Exercise 2. *Solve the following differential equation :*

1. $u'' - 5u' + 6u = e^{2x}$ *2.* $u'' - 4u' + 4u = x$

3. $u^{''} + u^{'} + u = x^2 + 1, \quad u(0) = 1,\ u^{'}(0) = 0.$

Exercise 3. *Solve the following first-order differential equations. For each part, verify if the differential form is exact, and solve using the method of exact differentials or an integrating factor if necessary.*

1. $(2xy + 3)\,dx + (x^2 + 4y)\,dy = 0,$ *2.* $\frac{dy}{dx} + \frac{2}{x}y = x^2$, *3.* $\frac{dy}{dx} = \frac{x^2}{y+1}$,

4. $\frac{dy}{dx} = \frac{y-x}{y+x}$, *5.* $(y\cos x - 2xy^2)\,dx + (\sin x - 2x^2 y)\,dy = 0$

Use the method of exact differentials to find the general solution $u(x, y) = f($*constant*$)$.

6. $(x^2 + y)\frac{\partial u}{\partial x} + (x + y^2)\frac{\partial u}{\partial y} = 0$

7. $(y\sin x)\frac{\partial u}{\partial x} + (x\cos y)\frac{\partial u}{\partial y} = 0$