### Series 01: (**Differential Equations**)

**First exercise:**

Find the order and degree of the following differential equations:

- $y'+2y=0$
- $y'(1+y'^3)=5y''+\cos x$
- $xy''^2=2y\,y'$
- $y'''+2y'=8x^2+\cos^2 x$
- $(x+y)dx+(2x+\&)dy=0$
- $x''^2+t^2\,x'=2$
- $y'''^2+2y'^3-3y=\sin x$
- $y'+xy=x$
- $y'''+y'^3+\sin x=x$
- $y''^3+y'''^3+y'=0$
- $\sqrt{1+\dfrac{d^2x}{dt^2}}=t^2x$
- $\left(\dfrac{d^2u}{dx^2}\right)^2-2\left(\dfrac{du}{dx}\right)^4$

**Second exercise:**

Find the appropriate differential equation whose general solution is:

- $y = c\sin x$
- $y = \dfrac{c}{2}x + c^2 + c^3 + 1$
- $c(y+1)^2 = x$

Find a solution to the following differential equations:

$y'=2x$ Which fulfills the condition $y(2)=3$

**Third exercise:**

Solve the following differential equations:

- $(1+x)y\,dx + (1-y)x\,dy = 0$
- $\dfrac{dy}{dx} = \dfrac{x+xy}{1+y}$
- $\dfrac{dy}{dx} = 2xy$
- $yy' + x^3(y^2-1) = 0$
- $(1+x^2)y' = 1 + y^2$
- $y' = e^{\frac{y}{x}} + \dfrac{y}{x}$

**Fourth exercise**:

Find the general solution and the specific solution of the following differential equations:

- $e^x \cos y \, dx + (1 + e^x) \sin y \, dy = 0$ ، Find your solution given that y(0) = 0

- $xy \, dy - \frac{1+y^2}{1+x^2} dx = 0$ ، Find :y(1)= –3

- $x \, dx + y \, dy = 0$ ، Find: $y(\sqrt{2}) = \sqrt{2}$

**Fifth exercise**:

Find the solution of the following second–order differential equations:

- $y'' + 3y' - 10y = 0$
- $y'' - 6y + 9 = 0$
- $\frac{d^2y}{dx^2} + 4y = 0$
- $y'' + y = 0$
- $y'' - y = x^2$
- $y'' + 4y = 3 \sin x$

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