

## KIX 1002: ENGINEERING MATHEMATICS 2

### Tutorial 1 – 2: Differential Equations & 1<sup>st</sup> Order ODE

1. Identify 5 physical laws/ theory that are frequently used in your field of study (i.e. Mechanical/Electrical/Chemical/Civil/Biomedical) and show that they can be transformed into the form of differential equation.
2. Classify each equation according to its order, linearity/non-linearity, and homogeneity/non-homogeneity. Also identify its dependent & independent variables in each case. Hence, find the solutions except 2<sup>nd</sup> order ODE and nonhomogeneous  $\frac{dy}{dx} = \frac{f(x, y)}{g(x, y)}$  cases. Verify that the solution that you find is a true solution.

(i)  $5x \frac{d^2 y}{dx^2} - \frac{4}{x} \frac{dy}{dx} - \sin 2x = 0, y(0) = 0, y'(0) = 0$

(ii)  $x^2 \frac{d^2 y}{dx^2} - 3x \frac{dy}{dx} = 4y, y(0) = 0, y'(0) = 0$

(iii)  $5x^2 y \frac{dy}{dx} + y^3 + x^3 = 0, y(0) = 3$

(iv)  $e^{-t^3} \frac{dx}{dt} - 3t^2 e^{-t^3} x = 0, y(1) = 2$

(v)  $\frac{dv}{dt} - 3t^2 v + 3t^2 = 0, v(0) = 2$

(vi)  $\frac{dy}{dt} - 3ty = \frac{t^2 y^3}{y+1}, y(0) = 0$

(vii)  $x^2 \frac{d^2 y}{dx^2} - 3y \frac{dy}{dx} = 0, y(0) = 1, y(2) = 4$

(viii)  $x \frac{dy}{dx} + y = 8, y(0) = 5$

(ix)  $\frac{dy}{dt} = \frac{y^2 + yt}{t^2}, y(1) = 4$

(x)  $5x \frac{d^3 y}{dx^3} - \frac{4}{x} \frac{dy}{dx} - 5 \tan x = 0, y(0) = 0, y(5) = 4, y(10) = 7$

3. Solve

(i)  $\frac{dy}{dx} + 2xy = 4x$

(ii)  $\frac{dy}{dx} = -\frac{2}{y} - \frac{3y}{2x}$

(iii)  $\frac{dy}{dx} = \frac{y}{x} + \tan\left(\frac{y}{x}\right)$