Exercise 1 – Determine the type of the following differential equations

1. $y^{(3)} + xy' + e^x y = 0$
2. $\sin(y' - x) + y^2 = 0$
3. $(x - y)dy + 4xdx = 0$
4. $y' = y^2 - 2ye^x$
5. $(x + 1)e^{-x} - y + xy' = 0$

Exercise 2 – Solve the differential equations

$$xyy' = y^2 + 1; y' + y = y^3, y(0) = 1; 2yy' = \frac{e^x}{1 + e^x}$$

Exercise 3 – Consider the differential equation

$$xy' + 5y = (2x + 5)e^{2x} \tag{D1}$$

1. Verify that $y = e^{2x}$ is a particular solution of (D1).
2. Solve equation (D1).

Exercise 4 – Solve the following differential equations

$$x^2y' = xy - y^2; xyy' = x^2 - y^2$$

$$(2x - y + 1)dx - (4x + 2y - 3)dy = 0; y' = \frac{4}{x}y + x\sqrt{y};$$

$$y' + y^2 + \frac{1}{x^2} = \frac{1}{x}y(y_p = \frac{1}{x}).$$

Exercise 5 – Solve the following homogeneous second order differential equations with constant coefficients

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

$$y'' + y = 0.$$
