# Lesson 30
# By Inspection
# Non-Homogeneous Equation

## *4. Inspection*

It is easy to obtain a particular solution of a non–homogeneous linear differential equation by inspection if R(x) is a constant, $R_0$.

Standard Form:

$$\left(a_0D^n + a_1D^{n-1} + a_2D^{n-2} + \ldots + a_{n-1}D + a_n\right)y = R\left(x\right)$$

Case I. if $\boldsymbol{a_n \neq 0, then \quad y_p = \frac{R_o}{a_n}}$

Case II. if $\boldsymbol{a_n = 0, then \quad y_p = \frac{R_o x^k}{k!\,a_{n-k}}}$

Where: $R_0$ = constant found on the right side of the equation
$a_n$ = constant term
$a_{n-k}$ = coefficient of the lowest–ordered derivative
$k$ = lowest–ordered derivative

Example: Find the particular solution of the differential equation.

$1.(D^2 + 4)y_p = 12$

$a_n = 4, R_o = 12$

$y_p = \frac{12}{4}$

$\underline{\underline{y_p = 3}}$

$2.(D^2 - D - 2)y_p = 5$

$a_n = -2, R_o = 5$

$\underline{\underline{y_p = \frac{5}{-2}}}$

$$3.(D^5 - 9D^3)y_p = 81$$
$$a_n = 0, R_o = 81, K = 3, a_{n-k} = -9$$
$$y_p = \frac{81x^3}{3!(-9)}$$
$$y_p = \frac{81x^3}{(1)(2)(3)(-9)}$$
$$y_p = -\frac{81x^3}{54}$$
$$y_p = \frac{-3}{2}x^3$$

$$4.(D^3 + D^2 - 2D)y_p = 20$$
$$a_n = 0, R_o = 20, K = 1, a_{n-k} = -2$$
$$y_p = \frac{20x^1}{1!(-2)}$$
$$y_p = \frac{20x}{1(-2)}$$
$$\underline{\underline{y_p = -10x}}$$

Seatwork: Find the particular solution of the differential equation.

1. $(D^2 - 2D + 8)\, y_p = 16$
2. $(D^3 + D^2 - 2D)\, y_p = 20$

Homework: Find the particular solution of the differential equation.

1. $(D^2 - 9D - 3)\, y_p = 27$
2. $(D^4 - 2D^3 - 5D^2 + 6D)\, y_p = 15$