Higer order

$D = \frac{d}{dx}$, $D^2 = \frac{d^2}{dx^2}$, $D^3 = \frac{d^3}{dx^3}$, ...

$Dy = \frac{dy}{dx}$, $D^2y = \frac{d^2y}{dx^2}$

$y' = \frac{dy}{dx}$, $y'' = \frac{d^2y}{dx^2}$

Case:-1 $R(x) = 0$ $R(x)$ is Right hand side

$y = y_c + y_p$

when $R(x) = 0$ then $y_p = 0$

$y = y_c$

Case:-2 when $R(x) \neq 0$ then $y_p \neq 0$ so

$y = y_c + y_p$

① If Roots are real & distinct then

$y_c = c_1 e^{m_1 x} + c_2 e^{m_2 x} + \dots + c_n e^{m_n x}$

(2) If two roots are real & equal & $n-2$ roots are distinct then

$$y_c = (c_1 + c_2 x)e^{m_1 x} + c_3 e^{m_3 x} + \cdots + c_n e^{m_n x}$$

(3) If three roots are real & equal

$$y_c = (c_1 + c_2 x + c_3 x^2)e^{m_1 x} + c_4 e^{m_4 x} + \cdots + c_n e^{m_n x}$$

(4) If roots are complex then

$$y_c = e^{ax}[c_1 \cos bx + c_2 \sin bx] + c_3 e^{m_3 x} + \cdots$$

(5) If two complex conjugate then

$$y_c = e^{ax}[(c_1 + c_2 x)\cos bx + (c_3 + c_4 x)\sin bx] + c_4 e^{m_4 x} + c_5 e^{m_5 x} + \cdots + c_n e^{m_n x}$$