

**The homogeneous linear differential equation of second order with constant coefficients**

$$y'' + a_1 y' + a_0 y = 0$$

The resulting characteristic equation to be solved is given by:

$$\lambda^2 + a_1 \lambda + a_0 = 0$$

Case I: for  $\lambda_1 \neq \lambda_2$  real:  $y = c_1 e^{\lambda_1 x} + c_2 e^{\lambda_2 x}$

Case II: for  $\lambda_{1,2} = \alpha \pm \beta i$  :  $y = e^{\alpha x} (A \cos \beta x + B \sin \beta x) = C e^{\alpha x} \sin(\beta x + \gamma)$

Case III: for  $\lambda_1 = \lambda_2 = \lambda$  real:  $y = e^{\lambda x} (c_1 + c_2 x)$