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Q2 $\frac{d^2 y(1)}{dt^2} + y(t) = \tan^2(t)$

Roots of CE are

$m = \pm i$

$y_c = c_1 \cos t + c_2 \sin t$

$$W(t) = \begin{vmatrix} \cos(t) & \sin(t) \\ -\sin(t) & \cos(t) \end{vmatrix}$$

$= \cos^2(t) + \sin^2(t)$

$W(t) = 1$

$f(t) = \tan^2(t)$

$$y_p(t) = -y_1(t) \int \frac{y_2(t)\, f(t)}{W(t)}\, dr + y_2(t) \int \frac{y_1(t)\, f(t)}{W(t)}$$

$$y_p(t) = -\cos t \int \frac{\sin t \tan^2 t}{1} + \sin(t) \int \cos t \tan^2 t\, dr$$

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$$= -\cos t \int \frac{\sin 3t}{\cos 2t} dt + \sin t \int \frac{\cos t \sin^2(t)}{\cos^2 t} dt$$

$$= -\cos t \int \frac{\sin 3t}{\cos^2 t} dt + \sin t \int \frac{\sin^2 t}{\cos t} dt$$

$$= -\cos t\,(\cos t + \sec t) + \sin t\,[\ln|\tan t + \sec t| - \sin t]$$

$$y(t) = c_1 \cos t + c_2 \sin t - \cos t\,[\cos t + \sec t] + \sin t\,[\ln|\tan t + \sec t| - \sin t]$$

$$= c_1 \cos t + c_2 \sin t - \cos^2 t - (\cos t)(\sec t) + \sin t\,[\ln|\tan t + \sec t| - \sin 2t]$$

$$= c_1 \cos t + c_2 \sin t - 1 - 1 + \sin [\ln|\tan t + \sec t|]$$

$$y(t) = c_1 \cos t + c_2 \sin t - 2 + \sin [\ln|\tan t + \sec t|]$$