**Problem 21 in Section 7.2.** Find the inverse Laplace transform of

$$F(s) = \frac{1}{s^2(s^2+1)}$$

**Solution.** We use $\mathcal{L}^{-1}(\frac{F(s)}{s}) = \int_0^t \mathcal{L}^{-1}(F(s))|_\tau d\tau$ twice. We compute

$$\begin{aligned}
\mathcal{L}^{-1}\left(\frac{1}{s^2(s^2+1)}\right) &= \int_0^t \mathcal{L}^{-1}\left(\frac{1}{s(s^2+1)}\right)\Big|_\tau d\tau \\
&= \int_0^t \int_0^\tau \mathcal{L}^{-1}\left(\frac{1}{s^2+1}\right)\Big|_\theta d\theta d\tau \\
&= \int_0^t \int_0^\tau \sin(\theta) d\theta d\tau \\
&= \int_0^t -\cos(\theta)\Big|_0^\tau d\tau \\
&= \int_0^t (-\cos(\tau)+1) d\tau \\
&= (-\sin\tau + \tau)\Big|_0^t \\
&= \boxed{-\sin t + t}.
\end{aligned}$$