

$$\textcircled{1} \quad \lim_{x \rightarrow 0} \frac{(\cos x - 1)(\cos x - e^x)}{x^n}$$

$$= \lim_{x \rightarrow 0} \frac{\left(-2 \sin^2 \frac{x}{2}\right) \left\{ \left(1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \dots\right) - \left(1 + x + \frac{x^2}{2!} + \dots\right) \right\}}{x^n}$$

$$= \lim_{x \rightarrow 0} \frac{\left(-2 \sin^2 \frac{x}{2}\right) \left(-x - \frac{2x^2}{2!} - \frac{x^3}{3!} - \dots\right)}{4 \cdot \left(\frac{x}{2}\right)^2 \cdot x^{n-2}}$$

$$= \lim_{x \rightarrow 0} \frac{\sin^2 \frac{x}{2} \left(1 + x + \frac{x^2}{3!} + \dots\right)}{2 \left(\frac{x}{2}\right)^2 \cdot x^{n-3}}$$

Above limit is finite if $n-3=0$
n=3