Question
In analysing the linear-free vibrations of a uniform clamped-beam, one encounters the eigenvalue problem

$$\cos\lambda\cosh\lambda = -1$$

Show that for n integer,

$$\lambda \sin\left(n-\frac{1}{2}\right)\pi + 2e^{-(n-\frac{1}{2})\pi}\sin\left(n-\frac{1}{2}\right)\pi,\ \ n \to +\infty$$

Answer
$\cosh\lambda \to \infty$ as $\lambda \to \infty$ so

$$\cos\lambda = -\frac{1}{\cosh\lambda} \to 0 \text{ as } \lambda \to \infty$$

Therefore we look for large λ solutions $\lambda \approx \left(n-\frac{1}{2}\right)\pi$ n integer, being the zeros of $\cos\lambda$.
So try $\lambda = \left(n-\frac{1}{2}\right)\pi + \delta,\ \ \delta = o(1)$.
Substitute back into full equation.

$$\cos\left(\left(n-\frac{1}{2}\right)\pi + \delta\right) = -\frac{1}{\cosh((n-\frac{1}{2})\pi + \delta)}$$