Step-1

Suppose that $CD = -DC$ then taking determinant gives

$$(\det C)(\det D) = -(\det D)(\det C)$$

Which is wrong.

The correct one is

$$(\det C)(\det D) = (-1)^n (\det D)(\det C)$$

Step-2

For n even the reasoning fails because $\left((-1)^n = +1\right)$

Where C, D are $n \times n$ matrices.

Hence the given conclusion is wrong.