# Annihilator Operators

| Functions $f(x)$ | Annihilators $L$ |
|---|---|
| $k$ | $D$ |
| $x^n$ | $D^{n+1}$ |
| $e^{\alpha x}$ | $(D-\alpha)$ |
| $x^n e^{\alpha x}$ | $(D-\alpha)^{n+1}$ |
| $\sin \beta x,\ \cos \beta x$ | $(D^2+\beta^2)$ |
| $x^n \sin \beta x,\ x^n \cos \beta x$ | $(D^2+\beta^2)^{n+1}$ |
| $e^{\alpha x} \sin \beta x,\ e^{\alpha x} \cos \beta x$ | $[D^2-2\alpha D+(\alpha^2+\beta^2)]$ |
| $x^n e^{\alpha x} \sin \beta x,\ x^n e^{\alpha x} \cos \beta x$ | $[D^2-2\alpha D+(\alpha^2+\beta^2)]^{n+1}$ |

Notes:

1. The annihilators $L$ can also annihilate scalar multiples of the functions $f(x)$. For example, $(D-5)^3$ can annihilate $7x^2e^{5x}$.

2. The annihilator $D^{n+1}$ can also annihilate any power of $x$ less than $n$, and more generally any polynomial of degree $n$ (or less). For example, $D^4$ can annihilate $2x^3-4x^2+7x+2$.

3. Any sums of functions of the types listed in the chart can be annihilated using products of the corresponding annihilators. For example, since $D^2$ annihilates $3x+17$ and $(D^2-8D+20)$ annihilates both $-2e^{4x}\sin 2x$ and $5e^{4x}\cos 2x$, then the product $D^2(D^2-8D+20)$ will annihilate $3x+17-2e^{4x}\sin 2x+5e^{4x}\cos 2x$.