

# Alexander Hiller

## *Non-Homogeneous Differential Equations* Practice

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**Undetermined Coefficients** Problems, Ch3 of '*Differential Equations...*' by Boyce (10 Ed.)  
Section 3.5

### Problem 2:

`In[ ]:= DSolve[{y'[t] + 2 y'[t] + 5 y[t] == 3 Sin[2 t]}, y[t], t]`

`Out[ ]:=`  $\left\{ \left\{ y[t] \rightarrow e^{-t} C[2] \cos[2 t] + e^{-t} C[1] \sin[2 t] - \frac{3}{68} \left( 17 \cos[2 t] - \cos[2 t] \cos[4 t] + 4 \cos[4 t] \sin[2 t] - 4 \cos[2 t] \sin[4 t] - \sin[2 t] \sin[4 t] \right) \right\} \right\}$

Taking only that which is from the particular solution:

`In[ ]:= Expand[Simplify[- $\frac{3}{68}$  (17 Cos[2 t] - Cos[2 t] Cos[4 t] + 4 Cos[4 t] Sin[2 t] - 4 Cos[2 t] Sin[4 t] - Sin[2 t] Sin[4 t])]]]`

`Out[ ]:=`  $-\frac{12}{17} \cos[2 t] + \frac{3}{17} \sin[2 t]$

### Problem 5:

`In[ ]:= DSolve[{y'[t] - 2 y'[t] - 3 y[t] == -3 t * Exp[-t]}, y[t], t]`

`{ {y[t] →  $\frac{3}{64} e^{-t} (1 + 4 t + 8 t^2) + e^{-t} C[1] + e^{3 t} C[2]$  } }`

**Problem 10:**

```
In[ ]:= DSolve[{y''[t] + y[t] == 3 Sin[2 t] + t * Cos[2 t]}, y[t], t]
```

```
Out[ ]:= {{y[t] -> C[1] Cos[t] + C[2] Sin[t] + 1/18 (-9 t Cos[t]^2 + 3 t Cos[t] Cos[3 t] - 36 Cos[t] Sin[t] - 8 Cos[3 t] Sin[t] + 9 t Sin[t]^2 + 8 Cos[t] Sin[3 t] + 3 t Sin[t] Sin[3 t])}}
```

Taking only that which is from the particular solution:

```
In[ ]:= Expand[
  Simplify[1/18 (-9 t Cos[t]^2 + 3 t Cos[t] Cos[3 t] - 36 Cos[t] Sin[t] - 8 Cos[3 t] Sin[t] +
    9 t Sin[t]^2 + 8 Cos[t] Sin[3 t] + 3 t Sin[t] Sin[3 t])]
Out[ ]:= -1/3 t Cos[2 t] - 5/9 Sin[2 t]
```

## Variation of Parameters Problems, Ch3 of 'Differential Equations...' by Boyce (10 Ed.)

### Section 3.6

**Problem 1:**

```
In[ ]:= DSolve[{y''[t] - 5 y'[t] + 6 y[t] == 2 E^t}, y[t], t]
```

```
Out[ ]:= {{y[t] -> e^t + e^{2 t} C[1] + e^{3 t} C[2]}}
```

**Problem 2:**

```
In[ ]:= DSolve[{y''[t] - y'[t] - 2 y[t] == 2 E^{-t}}, y[t], t]
```

```
Out[ ]:= {{y[t] -> -2/9 e^{-t} (1 + 3 t) + e^{-t} C[1] + e^{2 t} C[2]}}
```

**Problem 3:**

```
In[ ]:= DSolve[{y''[t] + 2 y'[t] + y[t] == 3 E^{-t}}, y[t], t]
```

```
Out[ ]:= {{y[t] -> 3/2 e^{-t} t^2 + e^{-t} C[1] + e^{-t} t C[2]}}
```

### Problem 4:

```
In[ ]:= f = DSolve[{4 y''[t] - 4 y'[t] + y[t] == 16 E^t/2}, y[t], t]
Out[ ]:= {{y[t] -> 2 e^{t/2} t^2 + e^{t/2} C[1] + e^{t/2} t C[2]}}
```