Practical – 2
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Plotting of second order solution family of differential equation

Question 1 : Solve Second order Differential Equation y'' + y = 0

Solution :

```
DSolve[y''[x] + y[x] == 0, y[x], x]
```

```
{{y[x] → C[1] Cos[x] + C[2] Sin[x]}}
```

Question 2 : Solve Second order Differential Equation y'' + y' – 6 y = 0

Solution :

```
DSolve[y''[x] + y'[x] - 6 y[x] == 0, y[x], x]
```

$$\{\{y[x] \to e^{-3x} C[1] + e^{2x} C[2]\}\}$$

Question 3 : Solve Second order Differential Equation 4 y'' + 12 y' – 6 y = 0

Solution :

```
DSolve[4 y''[x] + 12 y'[x] - 6 y[x] == 0, y[x], x]
```

$$\{\{y[x] \to e^{\left(-\frac{3}{2}-\frac{\sqrt{15}}{2}\right)x} C[1] + e^{\left(-\frac{3}{2}+\frac{\sqrt{15}}{2}\right)x} C[2]\}\}$$

Question 4 : Solve Second order Differential Equation y'' – 6 y' + 13 y = 0

Solution :

```
DSolve[y''[x] - 6 y'[x] + 13 y[x] == 0, y[x], x]
```

$$\{\{y[x] \to e^{3x} C[2] \text{Cos}[2x] + e^{3x} C[1] \text{Sin}[2x]\}\}$$

Question 5 : Solve Second order Differential Equation y'' – 2 y' + y = 0

Solution :

```
DSolve[y''[x] - 2 y'[x] + y[x] == 0, y[x], x]
```

$$\{\{y[x] \to e^{x} C[1] + e^{x} x C[2]\}\}$$

Plotting Of Solution Of Second order Differential Equations

Question 1 : Solve Second order Differential Equation y'' + y = 0 and Plot its three Solutions.

Solution :

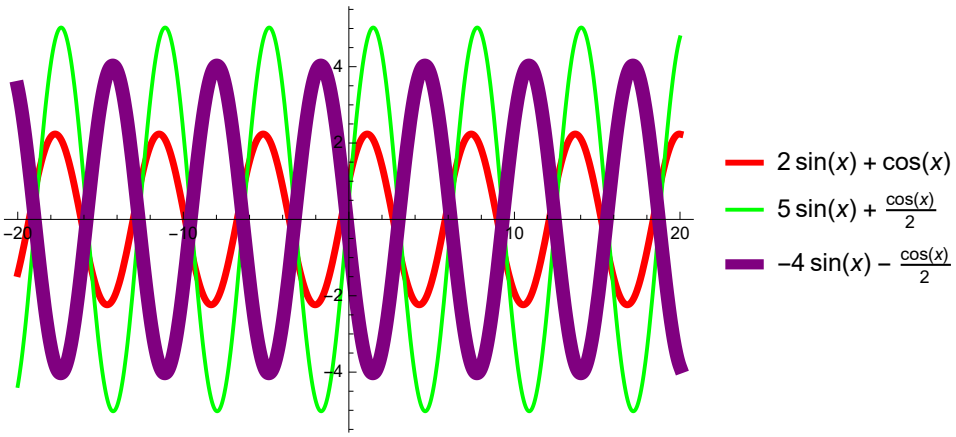
```
Sol = DSolve[y''[x] + y[x] == 0, y[x], x]
Sol1 = y[x] /. Sol[[1]] /. {C[1] → 1, C[2] → 2}
Sol2 = y[x] /. Sol[[1]] /. {C[1] → 1/2, C[2] → 5}
Sol3 = y[x] /. Sol[[1]] /. {C[1] → -1/2, C[2] → -4}
Plot[{Sol1, Sol2, Sol3}, {x, -20, 20},
 PlotStyle → {{Red, Thickness[0.01]}, {Green, Thick}, {Purple, Thickness[0.02]}},
 PlotLegends → {Sol1, Sol2, Sol3}]
```

$$\{\{y[x] \to C[1]\,\text{Cos}[x] + C[2]\,\text{Sin}[x]\}\}$$

$$\text{Cos}[x] + 2\,\text{Sin}[x]$$

$$\frac{\text{Cos}[x]}{2} + 5\,\text{Sin}[x]$$

$$-\frac{\text{Cos}[x]}{2} - 4\,\text{Sin}[x]$$



Question 2 :

Solve Second order Differential Equation y'' + y' – 6 y = 0 and Plot its three Solutions.

Solution :

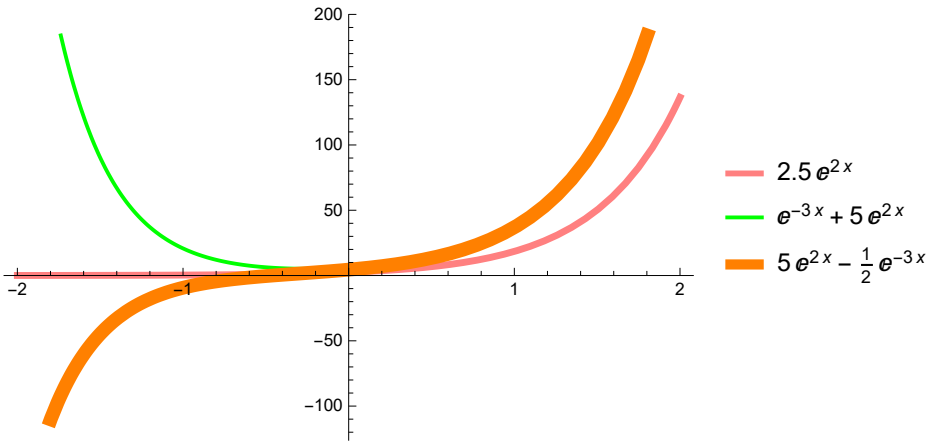
```
Sol = DSolve[y''[x] + y'[x] - 6 y[x] == 0, y[x], x]
Sol1 = y[x] /. Sol[[1]] /. {C[1] → 0, C[2] → 2.5}
Sol2 = y[x] /. Sol[[1]] /. {C[1] → 1, C[2] → 5}
Sol3 = y[x] /. Sol[[1]] /. {C[1] → -1/2, C[2] → 5}
Plot[{Sol1, Sol2, Sol3}, {x, -2, 2},
 PlotStyle → {{Pink, Thickness[0.01]}, {Green, Thick}, {Orange, Thickness[0.02]}},
 PlotLegends → {Sol1, Sol2, Sol3}]
```

$$\{\{y[x] \to e^{-3x} C[1] + e^{2x} C[2]\}\}$$

$$2.5\, e^{2x}$$

$$e^{-3x} + 5\, e^{2x}$$

$$-\frac{1}{2} e^{-3x} + 5\, e^{2x}$$



Question 3 :

Solve Second order Differential Equation 4 y'' + 12 y' + 9 y = 0 and Plot its four Solutions for

(i) C[1] = −1, C[2] = 4
(ii) C[1] = −3, C[2] = 6
(iii) C[1] = −10, C[2] = 7
(iv) C[1] = −1.5, C[2] = −5

Solution :

```
Sol = DSolve[4 y''[x] + 12 y'[x] + 9 y[x] == 0, y[x], x]
Sol1 = y[x] /. Sol[[1]] /. {C[1] → 1, C[2] → 4}
Sol2 = y[x] /. Sol[[1]] /. {C[1] → 3, C[2] → 6}
Sol3 = y[x] /. Sol[[1]] /. {C[1] → -10, C[2] → 7}
Sol4 = y[x] /. Sol[[1]] /. {C[1] → -1.5, C[2] → -5}
Plot[{Sol1, Sol2, Sol3, Sol4}, {x, -2, 2},
 PlotStyle → {{Red, Thickness[0.01]}, {Green, Thick},
   {Purple, Thickness[0.02]}, {Yellow, Thickness[0.03]}},
 PlotLegends → {Sol1, Sol2, Sol3}]
```

$$\{\{y[x] \to e^{-3x/2} C[1] + e^{-3x/2} x C[2]\}\}$$

$$e^{-3x/2} + 4 e^{-3x/2} x$$

$$3 e^{-3x/2} + 6 e^{-3x/2} x$$

$$-10 e^{-3x/2} + 7 e^{-3x/2} x$$

$$-1.5 e^{-3x/2} - 5 e^{-3x/2} x$$