JIDHUN PP | BSc(Hons) Computer Science| 20211419|Practical-2

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]
```

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

Question 2:Solve Second order differential Equation y''+y'-6y=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 4y''+12y'-6y=0

Solution:

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

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

Question 4:Solve Second order differential Equation y''-6y'+13y=0

Solution:

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

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

Question 5:Solve Second order differential Equation y''-2y'+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 Equation

Question1:Solve Second order differential Equation y''+y=0 and Plot its three solutions:

Solution:

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

$$\{\{y[x] \to C[1] \cos[x] + C[2] \sin[x]\}\}$$

```
Sol1 = y[x] /. Sol[[1]] /. {C[1] → 1, C[2] → 2}
```

$$\cos[x] + 2 \sin[x]$$

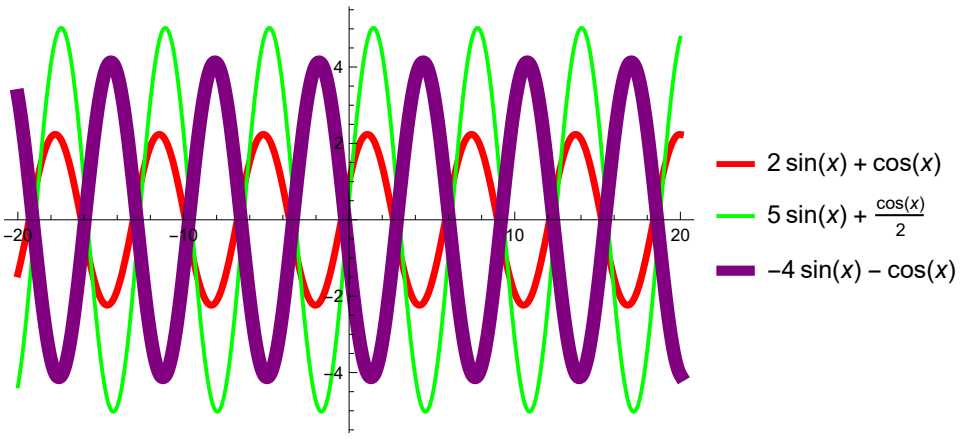
```
Sol2 = y[x] /. Sol[[1]] /. {C[1] → 1 / 2, C[2] → 5}
```

$$\frac{\cos[x]}{2} + 5 \sin[x]$$

```
Sol3 = y[x] /. Sol[[1]] /. {C[1] → -1, C[2] → -4}
```

$$-\cos[x] - 4 \sin[x]$$

```
Plot[{Sol1, Sol2, Sol3}, {x, -20, 20},
 PlotStyle → {{Red, Thickness[0.01]}, {Green, Thick}, {Purple, Thickness[0.02]}},
 PlotLegends → {Sol1, Sol2, Sol3}]
```



Question 2:Solve Second order differential Equation y''+y'-6y=0 and Plot its three solutions:

Solution:

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

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

```
Sol1 = y[x] /. Sol[[1]] /. {C[1] → 0, C[2] → 2.5}
```

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

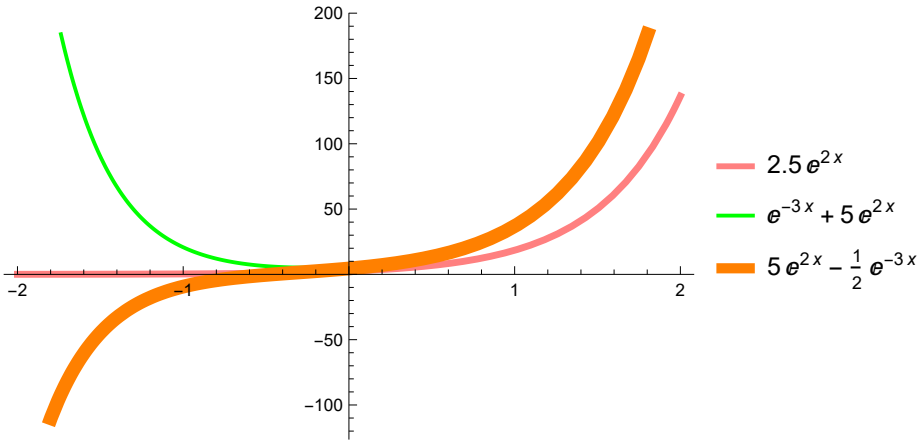
```
Sol2 = y[x] /. Sol[[1]] /. {C[1] → 1, C[2] → 5}
```

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

```
Sol3 = y[x] /. Sol[[1]] /. {C[1] → -1 / 2, C[2] → 5}
```

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

```
Plot[{Sol1, Sol2, Sol3}, {x, -2, 2},
 PlotStyle → {{Pink, Thickness[0.01]}, {Green, Thick}, {Orange, Thickness[0.02]}},
 PlotLegends → {Sol1, Sol2, Sol3}]
```



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]
```

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

```
Sol1 = y[x] /. Sol[[1]] /. {C[1] → -1, C[2] → 4}
```

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

```
Sol2 = y[x] /. Sol[[1]] /. {C[1] → 3, C[2] → 6}
```

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

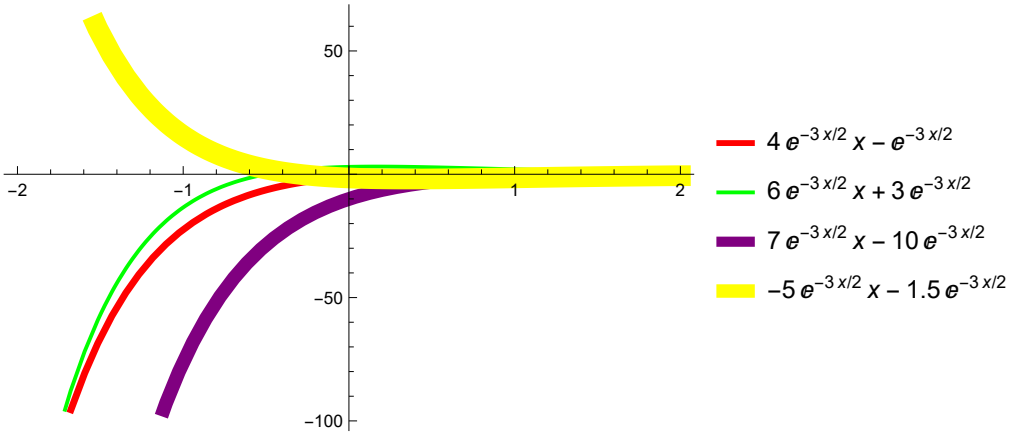
```
Sol3 = y[x] /. Sol[[1]] /. {C[1] → -10, C[2] → 7}
```

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

```
Sol4 = y[x] /. Sol[[1]] /. {C[1] → -1.5, C[2] → -5}
```

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

```
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, Sol4}]
```



Question 4:Solve Second order differential Equation 4y''-6y'+13y=0 and Plot its any three solutions

Solution:

```
Sol = DSolve[4 y''[x] - 6 y'[x] + 13 y[x] == 0, y[x], x]
```

$$\left\{\left\{y[x] \to e^{3x/4}\, C[2]\, \text{Cos}\left[\frac{\sqrt{43}\, x}{4}\right] + e^{3x/4}\, C[1]\, \text{Sin}\left[\frac{\sqrt{43}\, x}{4}\right]\right\}\right\}$$

```
Sol1 = y[x] /. Sol[[1]] /. {C[1] → -1, C[2] → 4}
```

$$4\, e^{3x/4}\, \text{Cos}\left[\frac{\sqrt{43}\, x}{4}\right] - e^{3x/4}\, \text{Sin}\left[\frac{\sqrt{43}\, x}{4}\right]$$

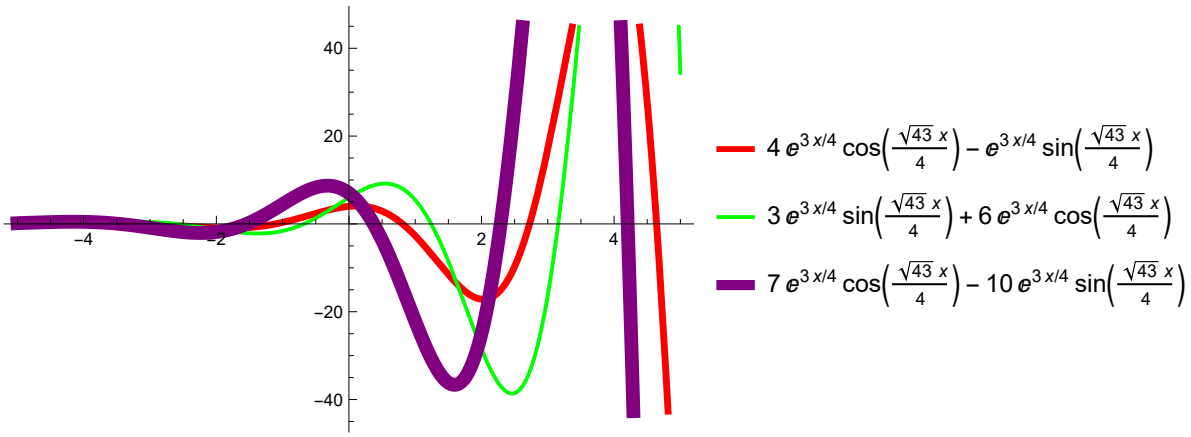
```
Sol2 = y[x] /. Sol[[1]] /. {C[1] → 3, C[2] → 6}
```

$$6\, e^{3x/4}\, \text{Cos}\left[\frac{\sqrt{43}\, x}{4}\right] + 3\, e^{3x/4}\, \text{Sin}\left[\frac{\sqrt{43}\, x}{4}\right]$$

```
Sol3 = y[x] /. Sol[[1]] /. {C[1] → -10, C[2] → 7}
```

$$7\, e^{3x/4}\, \text{Cos}\left[\frac{\sqrt{43}\, x}{4}\right] - 10\, e^{3x/4}\, \text{Sin}\left[\frac{\sqrt{43}\, x}{4}\right]$$

```
Plot[{Sol1, Sol2, Sol3}, {x, -5, 5},
 PlotStyle → {{Red, Thickness[0.01]}, {Green, Thick}, {Purple, Thickness[0.02]}},
 PlotLegends → {Sol1, Sol2, Sol3}]
```



Question 5:Solve Second order differential Equation y''-2y'+y=0 and Plot its any five solutions

Solution:

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

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

```
Sol1 = y[x] /. Sol[[1]] /. {C[1] → 0.5, C[2] → 3}
```

$0.5\,e^x + 3\,e^x x$

```
Sol2 = y[x] /. Sol[[1]] /. {C[1] → -3, C[2] → -2}
```

$-3\,e^x - 2\,e^x x$

```
Sol3 = y[x] /. Sol[[1]] /. {C[1] → -1, C[2] → 7}
```

$-e^x + 7\,e^x x$

```
Sol4 = y[x] /. Sol[[1]] /. {C[1] → -6, C[2] → 1}
```

$-6\,e^x + e^x x$

```
Sol5 = y[x] /. Sol[[1]] /. {C[1] → 1, C[2] → 2 / 3}
```

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

```
Plot[{Sol1, Sol2, Sol3, Sol4, Sol5}, {x, -2, 2},
 PlotStyle → {{Red, Thickness[0.01]}, {Green, Thick}, {Purple, Thickness[0.02]},
   {Yellow, Thickness[0.03]}, {Orange, Thickness[0.04]}},
 PlotLegends → {Sol1, Sol2, Sol3, Sol4, Sol5}]
```