

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 $y'' + y' - 6y = 0$ Solution :

```
DSolve[y''[x] + y'[x] - 6 y[x] == 0, y[x], x]  
{ {y[x] -> e-3x C[1] + e2x 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]
```

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

**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]
```

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

**Question 5 : Solve Second order
Differential Equation $y'' - 2y' + y = 0$
Solution :**

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

$$\left\{ \left\{ y[x] \rightarrow e^x C[1] + e^x x C[2] \right\} \right\}$$

Plotting Of Solution Of Second order Differential Equations

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

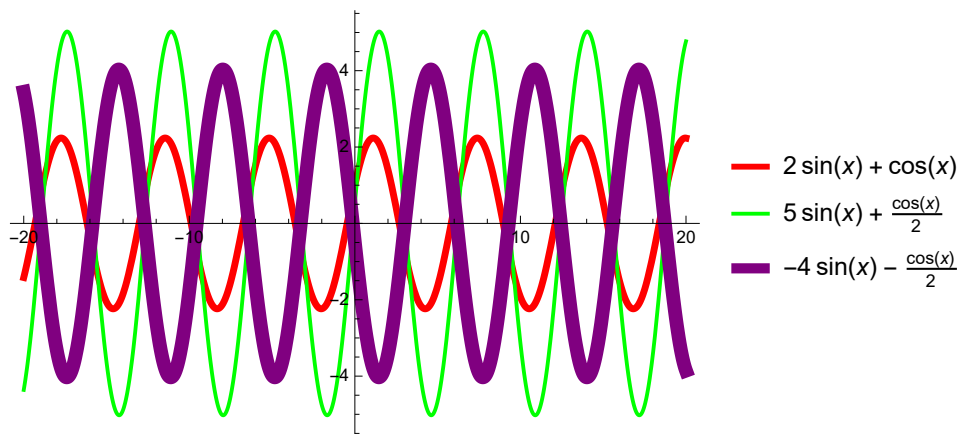
```

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] -> C[1] Cos[x] + C[2] Sin[x]} }
Cos[x] + 2 Sin[x]

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


$$-\frac{\cos[x]}{2} - 4 \sin[x]$$


```



Question 2 :

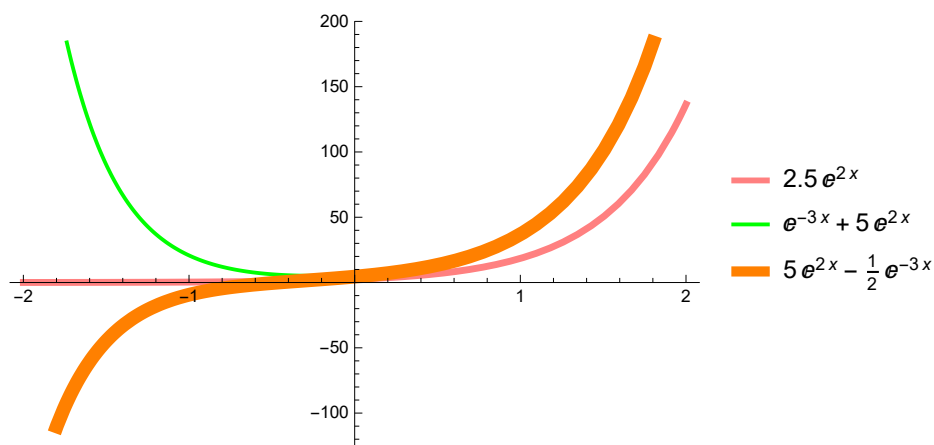
Solve Second order Differential Equation $y'' + y' - 6y = 0$ and Plot its three Solutions.

Solution :

```

Sol = DSolve[y''[x] + y'[x] - 6 y[x] == 0, y[x], x]
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] -> e^{-3 x} C[1] + e^{2 x} C[2]}
2.5 e^{2 x}
e^{-3 x} + 5 e^{2 x}
-\frac{1}{2} e^{-3 x} + 5 e^{2 x}

```



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] -> e^{-3 x/2} C[1] + e^{-3 x/2} x C[2] } }

```

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

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

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

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

