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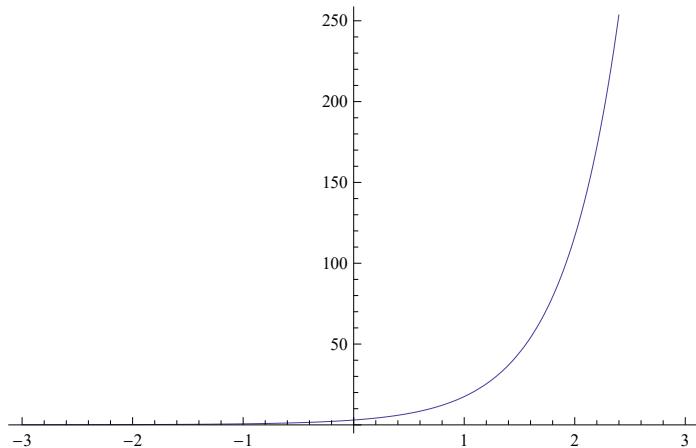
ROLL NO = 2138104

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## PRACTICAL 2 SECOND ORDER DIFFERENTIAL EQUATION

Q1. Plot any one solution of the differential equation  $(d^2y/dx^2) - 3(dy/dx) + 2y = 0$

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sol = DSolve[y''[x] - 3*y'[x] + 2*y[x] == 0, y[x], x]
y[x] /. sol (*/.sol is used to remove the y[x] from the solution or output*)
psol = Evaluate[y[x] /. sol /. {C[1] → 1, C[2] → 2}]
Plot[psol, {x, -3, 3}]
{y[x] → e^x C[1] + e^{2x} C[2]}
{e^x C[1] + e^{2x} C[2]}
{e^x + 2 e^{2x}}
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Q2. Plot family solution of the differential equation  $(d^2y/dx^2) + (dy/dx) - 6y = 0$

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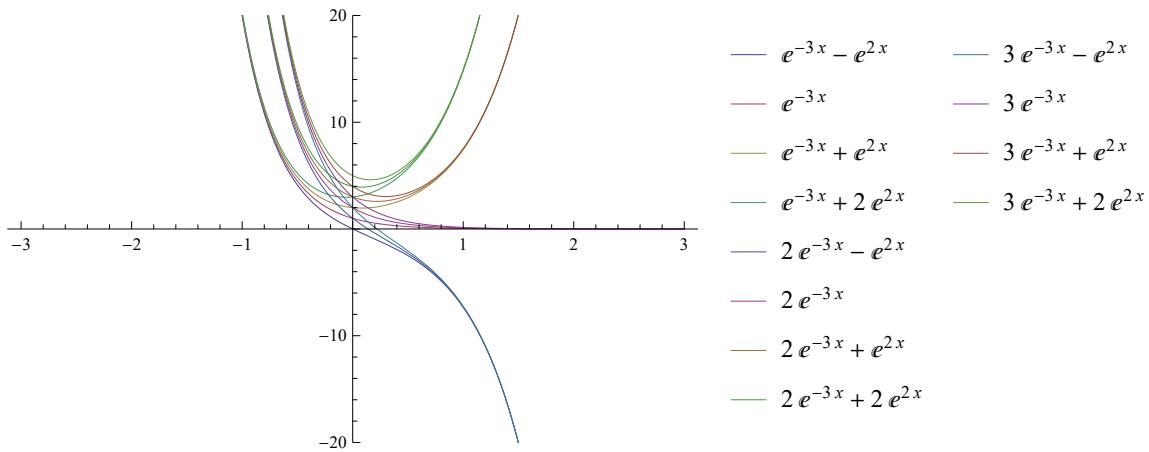
sol = DSolve[y''[x] + y'[x] - 6*y[x] == 0, y[x], x]
qsol = y[x] /. sol
T = Table[qsol /. {{C[1] → i, C[2] → j}}, {i, 1, 3, 1}, {j, -1, 2, 1}]
Plot[T, {x, -3, 3}, PlotRange → 20, PlotLegends → "Expressions"]

```

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

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

$$\begin{aligned} & \{ \{ \{ \{ e^{-3x} - e^{2x} \} \}, \{ \{ e^{-3x} \} \}, \{ \{ e^{-3x} + e^{2x} \} \}, \{ \{ e^{-3x} + 2 e^{2x} \} \} \}, \\ & \{ \{ \{ 2 e^{-3x} - e^{2x} \} \}, \{ \{ 2 e^{-3x} \} \}, \{ \{ 2 e^{-3x} + e^{2x} \} \}, \{ \{ 2 e^{-3x} + 2 e^{2x} \} \} \}, \\ & \{ \{ \{ 3 e^{-3x} - e^{2x} \} \}, \{ \{ 3 e^{-3x} \} \}, \{ \{ 3 e^{-3x} + e^{2x} \} \}, \{ \{ 3 e^{-3x} + 2 e^{2x} \} \} \} \} \end{aligned}$$



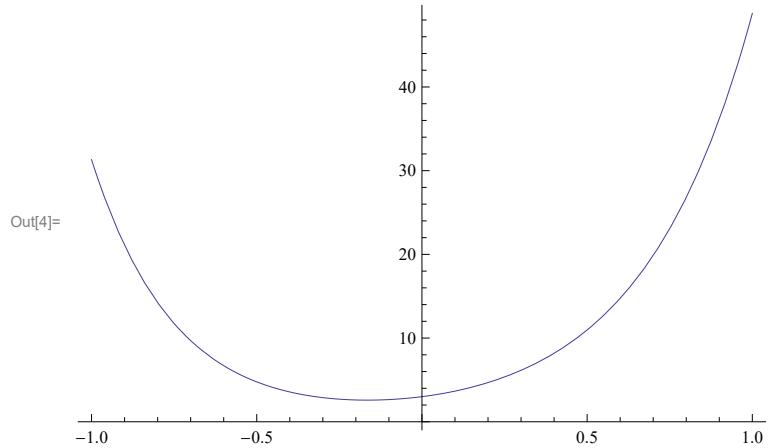
Q3. Plot the solution of the differential equation  $(d^2y/dx^2) + (dy/dx) - 12y = 0; y(0) = 3, y'(0) = 5$

```
Clear[x, y, sol, qsol, T]
```

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In[1]:= Clear[x, y, sol];
sol = DSolve[{y''[x] + y'[x] - 12*y[x] == 0, y[0] == 3, y'[0] == 5}, y[x], x]
gsol = y[x] /. sol
Plot[gsol, {x, -1, 1}]
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$$\text{Out[2]}= \left\{ \left\{ Y[x] \rightarrow \frac{1}{7} e^{-4x} (4 + 17 e^{7x}) \right\} \right\}$$

$$\text{Out[3]}= \left\{ \frac{1}{7} e^{-4x} (4 + 17 e^{7x}) \right\}$$



Q4. Plot the solution of the differential equation  $(d^2y/dx^2) - 2(dy/dx) - 3y = 2e^x - \sin(x)$ ;  $y(0) = 2$ ,  $y'(0) = 4$

```
In[8]:= sol = DSolve[
  {y''[x] - 2*y'[x] - 3*y[x] == 2*Exp[x] - Sin[x], y[0] == 2, y'[0] == 4}, y[x], x]
ysol = y[x] /. sol
Plot[ysol, {x, -1, 1}]

Out[8]=  $\left\{ \left\{ y[x] \rightarrow \frac{1}{40} e^{-x} (35 - 20 e^{2x} + 69 e^{4x} - 4 e^x \cos[x] + 8 e^x \sin[x]) \right\} \right\}$ 

Out[9]=  $\left\{ \frac{1}{40} e^{-x} (35 - 20 e^{2x} + 69 e^{4x} - 4 e^x \cos[x] + 8 e^x \sin[x]) \right\}$ 

Out[10]=
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Q4. Plot the solution of the differential equation  $(d^2 y / dx^2) + 2(dy/dx) + 10y = 5xe^{-2x}$  taking c1 varying from -1 to 1 and c2 varying from 0 to 2.

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In[11]:= sol = DSolve[y''[x] + 2*y'[x] + 10*y[x] == 5*x*Exp[-2*x], y[x], x]
jsol = y[x] /. sol
K = Table[jsol /. {{C[1] → i, C[2] → j}}, {i, -1, 1, 1}, {j, 0, 2, 1}]
Plot[K, {x, -10, 10}, PlotRange → 20, PlotLegends → "Expressions"]

Out[11]= {y[x] → e-x C[2] Cos[3 x] + e-x C[1] Sin[3 x] +  $\frac{1}{10} e^{-2x} (1+5x) (\cos^2(3x) + \sin^2(3x))$ }

Out[12]= {e-x C[2] Cos[3 x] + e-x C[1] Sin[3 x] +  $\frac{1}{10} e^{-2x} (1+5x) (\cos^2(3x) + \sin^2(3x))$ }

Out[13]= {{{{{-e-x Sin[3 x] +  $\frac{1}{10} e^{-2x} (1+5x) (\cos^2(3x) + \sin^2(3x))$ }}, {{{e-x Cos[3 x] - e-x Sin[3 x] +  $\frac{1}{10} e^{-2x} (1+5x) (\cos^2(3x) + \sin^2(3x))$ }}, {{{2 e-x Cos[3 x] - e-x Sin[3 x] +  $\frac{1}{10} e^{-2x} (1+5x) (\cos^2(3x) + \sin^2(3x))$ }}, {{{ $\frac{1}{10} e^{-2x} (1+5x) (\cos^2(3x) + \sin^2(3x))$ }}, {{{e-x Cos[3 x] +  $\frac{1}{10} e^{-2x} (1+5x) (\cos^2(3x) + \sin^2(3x))$ }}, {{{2 e-x Cos[3 x] +  $\frac{1}{10} e^{-2x} (1+5x) (\cos^2(3x) + \sin^2(3x))$ }}, {{{e-x Sin[3 x] +  $\frac{1}{10} e^{-2x} (1+5x) (\cos^2(3x) + \sin^2(3x))$ }}, {{{e-x Cos[3 x] + e-x Sin[3 x] +  $\frac{1}{10} e^{-2x} (1+5x) (\cos^2(3x) + \sin^2(3x))$ }}, {{{2 e-x Cos[3 x] + e-x Sin[3 x] +  $\frac{1}{10} e^{-2x} (1+5x) (\cos^2(3x) + \sin^2(3x))$ }}, {{{e-x sin(3 x) +  $\frac{1}{10} e^{-2x} (1+5x) (\cos^2(3 x) + \sin^2(3 x))$ }}, {{{e-x cos(3 x) - e-x sin(3 x) +  $\frac{1}{10} e^{-2x} (1+5x) (\cos^2(3 x) + \sin^2(3 x))$ }}, {{{2 e-x cos(3 x) - e-x sin(3 x) +  $\frac{1}{10} e^{-2x} (1+5x) (\cos^2(3 x) + \sin^2(3 x))$ }}, {{{ $\frac{1}{10} e^{-2x} (1+5x) (\cos^2(3 x) + \sin^2(3 x))$ }}, {{{e-x cos(3 x) +  $\frac{1}{10} e^{-2x} (1+5x) (\cos^2(3 x) + \sin^2(3 x))$ }}, {{{2 e-x cos(3 x) +  $\frac{1}{10} e^{-2x} (1+5x) (\cos^2(3 x) + \sin^2(3 x))$ }}, {{{e-x sin(3 x) +  $\frac{1}{10} e^{-2x} (1+5x) (\cos^2(3 x) + \sin^2(3 x))$ }}, {{{e-x cos(3 x) + e-x sin(3 x) +  $\frac{1}{10} e^{-2x} (1+5x) (\cos^2(3 x) + \sin^2(3 x))$ }}, {{{2 e-x cos(3 x) + e-x sin(3 x) +  $\frac{1}{10} e^{-2x} (1+5x) (\cos^2(3 x) + \sin^2(3 x))$ }}}}
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Out[14]=

- $-e^{-x} \sin(3x) + \frac{1}{10} e^{-2x} (1+5x) (\cos^2(3x) + \sin^2(3x))$
- $e^{-x} \cos(3x) - e^{-x} \sin(3x) + \frac{1}{10} e^{-2x} (1+5x) (\cos^2(3x) + \sin^2(3x))$
- $2e^{-x} \cos(3x) - e^{-x} \sin(3x) + \frac{1}{10} e^{-2x} (1+5x) (\cos^2(3x) + \sin^2(3x))$
- $\frac{1}{10} e^{-2x} (1+5x) (\cos^2(3x) + \sin^2(3x))$
- $e^{-x} \cos(3x) + \frac{1}{10} e^{-2x} (1+5x) (\cos^2(3x) + \sin^2(3x))$
- $2e^{-x} \cos(3x) + \frac{1}{10} e^{-2x} (1+5x) (\cos^2(3x) + \sin^2(3x))$
- $e^{-x} \sin(3x) + \frac{1}{10} e^{-2x} (1+5x) (\cos^2(3x) + \sin^2(3x))$
- $e^{-x} \cos(3x) + e^{-x} \sin(3x) + \frac{1}{10} e^{-2x} (1+5x) (\cos^2(3x) + \sin^2(3x))$
- $2e^{-x} \cos(3x) + e^{-x} \sin(3x) + \frac{1}{10} e^{-2x} (1+5x) (\cos^2(3x) + \sin^2(3x))$