PRACTICAL 1

In[ ]:=
```
pde = x * D[u[x, y], x] + y * D[u[x, y], y] == 0;
sol = DSolve[pde, u[x, y], {x, y}]
```

Out[ ]= $\{\{u[x, y] \to C[1][\frac{y}{x}]\}\}$

In[ ]:=
```
pde = D[u[x, t], {t, 2}] == 9 * D[u[x, t], {x, 2}];
sol = DSolve[pde, u[x, t], {x, t}]
```

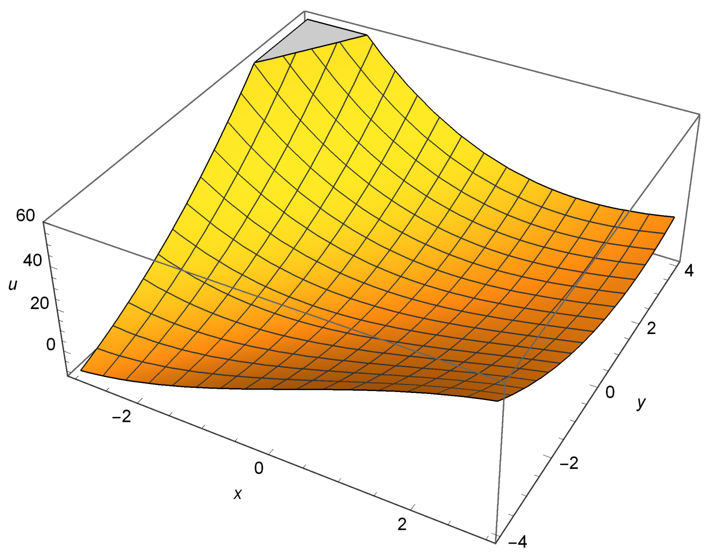
Out[ ]= $\{\{u[x, t] \to C[1][t - \frac{x}{3}] + C[2][t + \frac{x}{3}]\}\}$

PRACTICAL 2

In[ ]:=
```
pde = 2 * D[u[x, y], x] + 3 * D[u[x, y], y] == 2 * x * y;
sol = DSolve[{pde, u[0, y] == y^2}, u[x, y], {x, y}]
Plot3D[u[x, y] /. sol, {x, -3, 3}, {y, -4, 4}, AxesLabel → {x, y, u}]
```

Out[ ]= $\{\{u[x, y] \to \frac{1}{4} (9 x^2 - x^3 - 12 x y + 2 x^2 y + 4 y^2)\}\}$

Out[ ]=

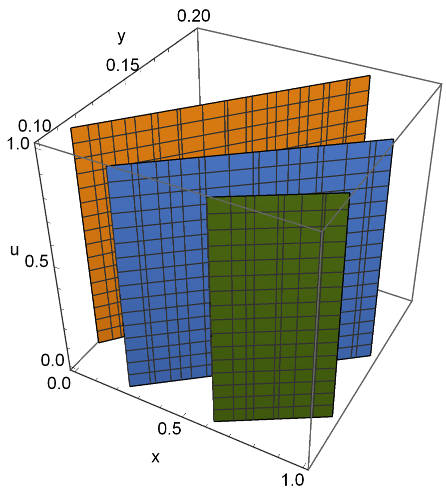


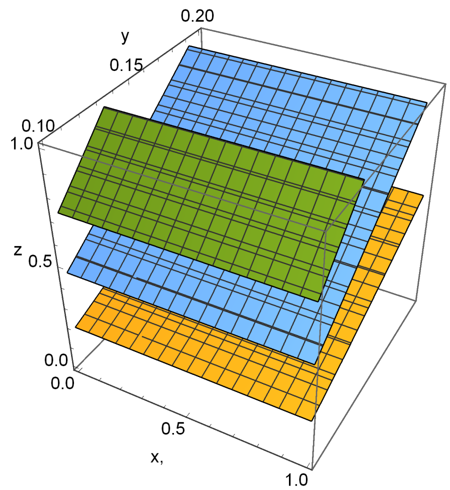
PRACTICAL 3

In[ ]:=
```
pde = x * D[u[x, y], x] + (x + y) * D[u[x, y], y] == u[x, y] + 1;
sol = DSolve[pde, u[x, y], {x, y}]
```

Out[ ]= $\{\{u[x, y] \to -1 + x C[1][\frac{y - x Log[x]}{x}]\}\}$

In[∘]:=
```
f0 = ContourPlot3D[(u + 1) / x, {u, 0, 1}, {x, 0.1, 0.2},
   {y, 0, 1}, ImageSize → {250, 250}, AxesLabel → {"x", "y", "u"}];
f1 = ContourPlot3D[(y - x * Log[x]) / x, {u, 0, 1}, {x, 0.1, 0.2}, {y, 0, 1},
   ImageSize → {250, 250}, AxesLabel → {"x,", "y", "z"}];
Print[
 f0,
 f1]
```





PRACTICAL 4

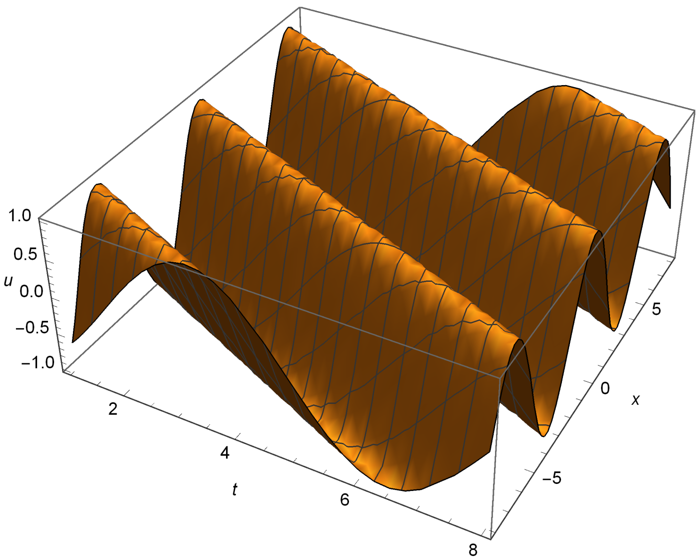
In[∘]:=
```
DSolve[D[u[x, t], {t, 2}] == D[u[x, t], {x, 2}], u[x, t], {x, t}]
```

Out[∘]=
```
{{u[x, t] → C[1][t - x] + C[2][t + x]}}
```

In[∘]:=
```
da[c_, f_, g_, x_, t_] :=
 1/2 ((f /. x → x + c * t) + (f /. x → x - c * t)) +
  1/(2 * c) * Integrate[g, {x, x - c * t, x + c * t}]
da[1, Sin[x], Cos[x], x, t]
Plot3D[%, {t, 1, 8}, {x, -8, 8}, AxesLabel → {t, x, u}]
```

Out[∘]= $\text{Cos}[x]\,\text{Sin}[t] + \frac{1}{2}\left(-\text{Sin}[t - x] + \text{Sin}[t + x]\right)$

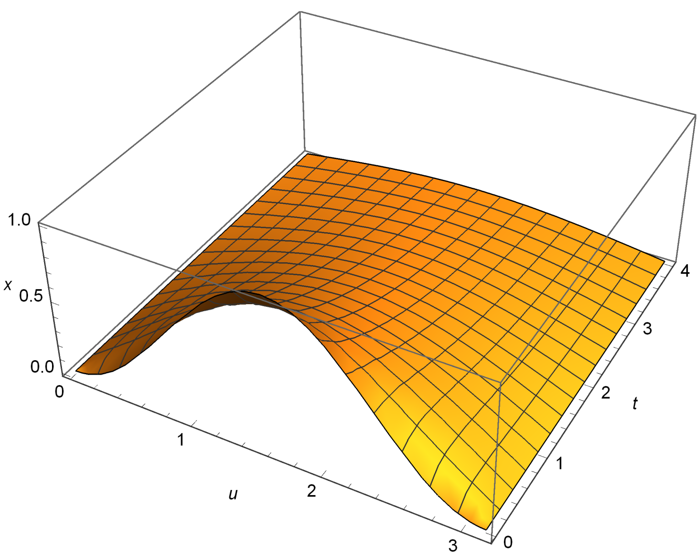
Out[∘]=



PRACTICAL 5

In[∘]:=
```
eqn =
  {D[u[x, t], t] == 1/2 * D[u[x, t], {x, 2}], u[x, 0] == (Sin[x])^2, u[0, t] == 0, u[π, t] == 0};
sol = NDSolve[eqn, u[x, t], {x, 0, π}, {t, 0, 4}];
Plot3D[u[x, t] /. sol, {x, 0, π}, {t, 0, 4}, AxesLabel → {u, t, x}]
```

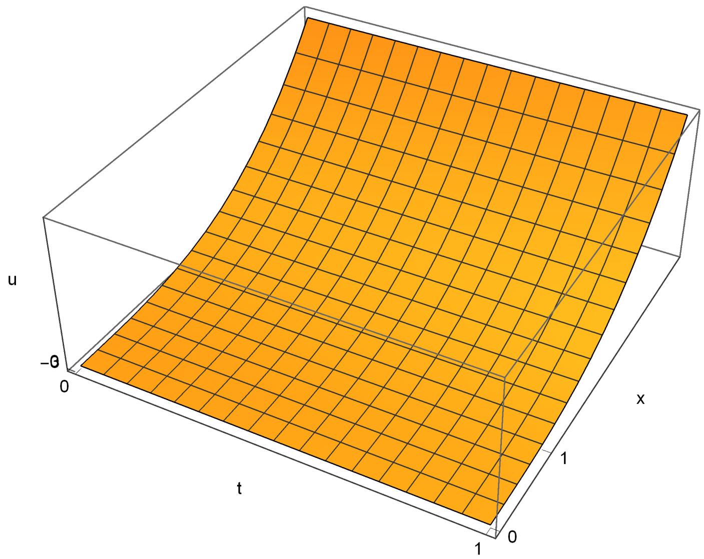
Out[∘]=



PRACTICAL 6

In[◦]:=
```
eqn = {D[u[x, t], {t, 2}] - 9 * D[u[x, t], {x, 2}] == 0, u[x, 0] == 0,
   Derivative[0, 1][u][x, 0] == x^3, Derivative[1, 0][u][0, t] == 0};
sol = NDSolve[eqn, u[x, t], {x, 0, 1}, {t, 0, 4}];
Plot3D[u[x, t] /. sol, {x, 0, 1}, {t, 0, 4},
 AxesLabel → {"t", "x", "u"}, Ticks → {{0, 1, 2, 3, 4}, {0, 1}, {-3, 0}}]
```

Out[◦]=



PRACTICAL 7 (Part 1)

The characteristic base curve for the given initial value problem are given by :

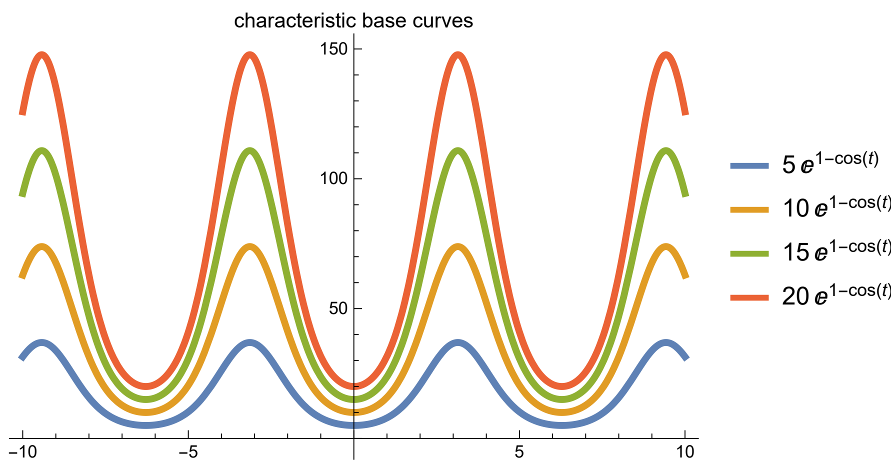
In[16]:=
```
charBaseCurves1 = DSolve[{x'[t] == x[t] * Sin[t], x[0] == x0}, x[t], t]
```

Out[16]= $\{\{x[t] \to e^{1-\text{Cos}[t]}\, x0\}\}$

In[17]:=
```
tab = Table[x[t] /. charBaseCurves1[[1]] /. {x0 → k}, {k, 5, 20, 5}]
Plot[Evaluate[tab], {t, -10, 10}, PlotStyle → Thickness[0.01],
 PlotLegends → Table[tab[[i]], {i, 1, 4}], PlotLabel → "characteristic base curves"]
```

Out[17]= $\{5\, e^{1-\text{Cos}[t]}, 10\, e^{1-\text{Cos}[t]}, 15\, e^{1-\text{Cos}[t]}, 20\, e^{1-\text{Cos}[t]}\}$

Out[18]=



The Traffic Density function ρ (x, t) or the solution for the given initial value problem are given by :

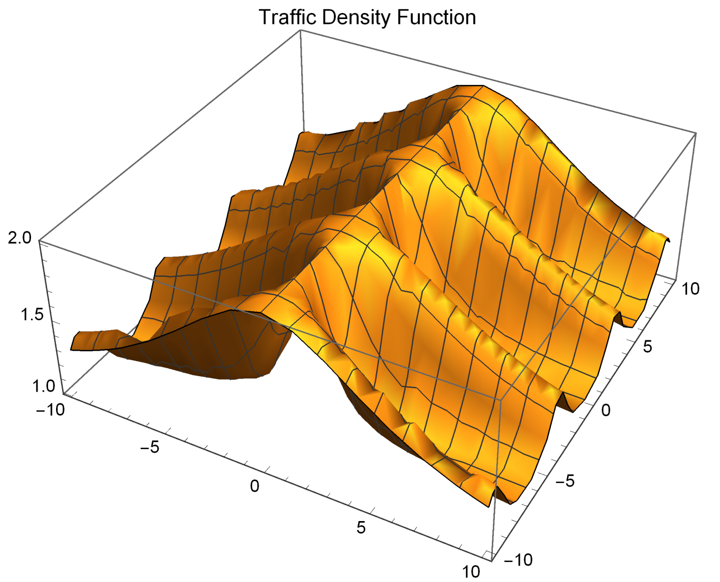
```
In[19]:= eqn1 = D[ρ[x, t], t] + x * Sin[t] * D[ρ[x, t], x] == 0;
sol1 = DSolve[{eqn1, ρ[x, 0] == 1 + 1/(1 + x^2)}, ρ[x, t], {x, t}]
```

Solve: Inverse functions are being used by Solve, so some solutions may not be found; use Reduce for complete solution information.

Out[20]= $\left\{\left\{\rho[x, t] \to \frac{2\, e^2 + e^{2 \cos[t]}\, x^2}{e^2 + e^{2 \cos[t]}\, x^2}\right\}\right\}$

Hence ρ (x, t) is the traffic density function of the given initial value problem :

```
In[21]:= Plot3D[ρ[x, t] /. sol1, {x, -10, 10}, {t, -10, 10}, PlotLabel → "Traffic Density Function"]
```

Out[21]=


PRACTICAL 7 (Part 2)

The characteristic base curve for the given initial value problem are given by :

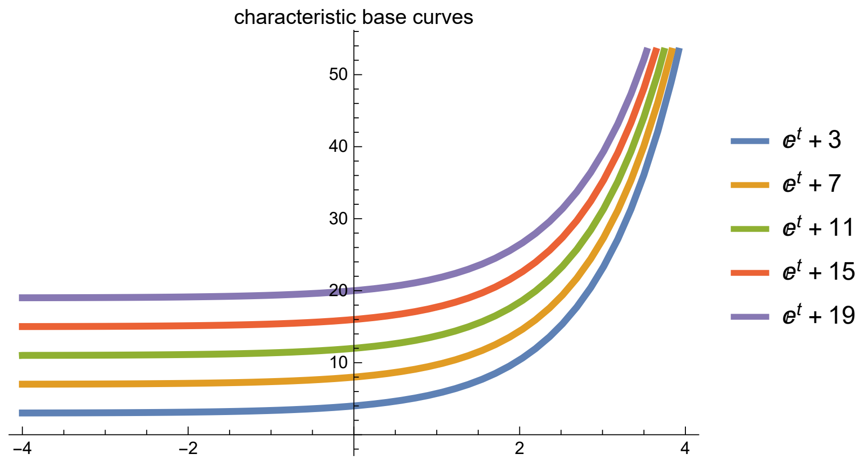
```
In[22]:= charBaseCurves2 = DSolve[{x'[t] == Exp[t], x[0] == x0}, x[t], t]
```

Out[22]= $\{\{x[t] \to -1 + e^t + x0\}\}$

In[23]:=
```
tab = Table[x[t] /. charBaseCurves2[[1]] /. {x0 → k}, {k, 4, 20, 4}]
Plot[Evaluate[tab], {t, -4, 4}, PlotStyle → Thickness[0.01],
 PlotLegends → Table[tab[[i]], {i, 1, 5}], PlotLabel → "characteristic base curves"]
```

Out[23]= $\{3+e^t, 7+e^t, 11+e^t, 15+e^t, 19+e^t\}$

Out[24]=



The Traffic Density function $\rho(x, t)$ or the solution for the given initial value problem are given by :

In[25]:=
```
eqn2 = D[ρ[x, t], t] + Exp[t] * D[ρ[x, t], x] == 2 ρ[x, t];
sol2 = DSolve[{eqn2, ρ[x, 0] == 1 + Sin[x] * Sin[x]}, ρ[x, t], {x, t}]
```

... Solve: Inverse functions are being used by Solve, so some solutions may not be found; use Reduce for complete solution information.

... Solve: Inverse functions are being used by Solve, so some solutions may not be found; use Reduce for complete solution information.

Out[26]= $\{\{\rho[x, t] \to e^{2t}(1 + \mathrm{Sin}[1 - e^t + x]^2)\}\}$

Hence $\rho(x, t)$ is the traffic density function of the given initial value problem :

In[27]:=
```
Plot3D[ρ[x, t] /. sol2, {x, -4, 4}, {t, -1, 1}, PlotLabel → "Traffic Density Function"]
```

Out[27]=