PRACTICAL - 6

Solution of WAVE Equation.

ques-1 :- f(x)=Sin x , g(x)= x^2, c=1 with u(x,0) = f(x) and $u_t(x,0) = g(x)$ also $u_{tt} - c^2 u_{xx} = 0$.

In[61]:=
```
waveEquation = D[u[x, t], {t, 2}] == D[u[x, t], {x, 2}];
initialConditions = {u[x, 0] == Sin[x], Derivative[0, 1][u][x, 0] == x^2};
sol = NDSolve[{waveEquation, initialConditions}, u[x, t], {x, -5, 5}, {t, -5, 5}]
```

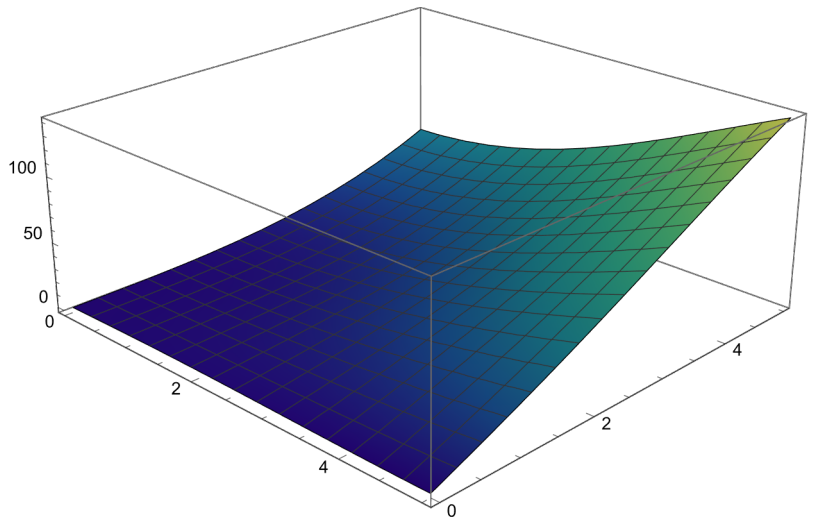
NDSolve: Warning: an insufficient number of boundary conditions have been specified for the direction of independent variable x. Artificial boundary effects may be present in the solution.

Out[63]=

$$\{\{u[x, t] \to \text{InterpolatingFunction}[\text{Domain: } \{\{-5., 5.\}, \{-5., 5.\}\} \text{ Output: scalar}][x, t]\}\}$$

In[64]:=
```
Plot3D[u[x, t] /. sol, {x, 0, 5}, {t, 0, 5}, ColorFunction → "BlueGreenYellow"]
```

Out[64]=

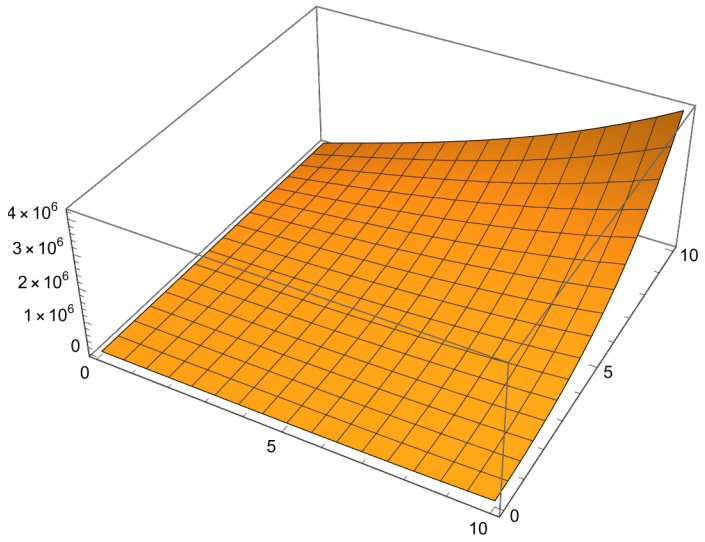


ques-2 :- f(x)=10 x^4 , g(x)= 0, c=2, u(0,t) = 0 with u(x,0) = f(x) and $u_t(x,0) = g(x)$ also $u_{tt} - c^2 u_{xx} = 0$.

In[71]:=
```
c = 2;
solution = NDSolve[{D[u[x, t], {t, 2}] == c^2 D[u[x, t], {x, 2}], u[x, 0] == 10 x^4,
    Derivative[0, 1][u][x, 0] == 0, u[0, t] == 0 }, u, {x, 0, 10}, {t, 0, 10}];

Plot3D[Evaluate[u[x, t] /. solution], {x, 0, 10}, {t, 0, 10}, PlotRange → All]
```

Out[73]=

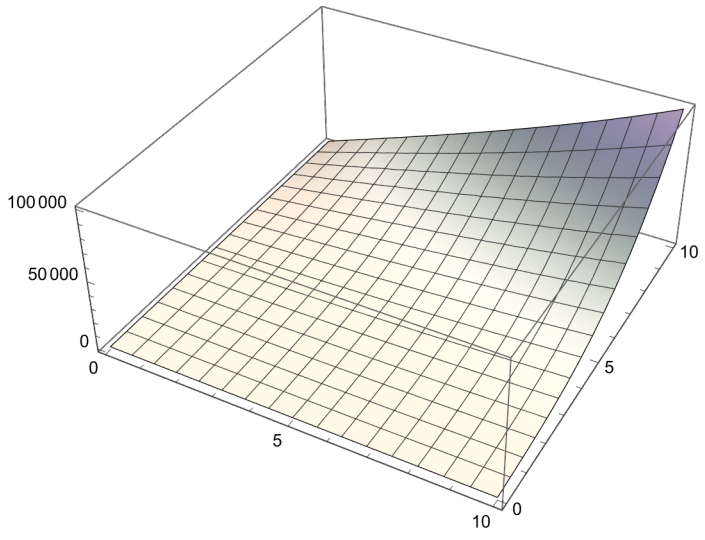


In[77]:=
```
ClearAll[x, u, t]
```

ques-3 :- f(x)=0 , g(x)= x^3, c=3, u(0,t) = 0 with u(x,0) = f(x) and u_t(x,0) = g(x) also $u_{tt} - c^2 u_{xx} = 0$

In[87]:=
```
c = 3;
sol1 = NDSolve[{D[u[x, t], {t, 2}] == c^2 D[u[x, t], {x, 2}], u[x, 0] == 0,
    Derivative[0, 1][u][x, 0] == x^3, u[0, t] == 0 }, u, {x, 0, 10}, {t, 0, 10}];
Plot3D[Evaluate[u[x, t] /. sol1], {x, 0, 10},
 {t, 0, 10}, PlotRange → All, ColorFunction → "PearlColors"]
```

Out[89]=



In[90]:=
```
ClearAll[x, u, t]
```

ques-4 :- f(x)= 10 x^2 (1- x^2) , g(x)= 0, c= 1, u(0,t) = 0,u(1,t)=0 with u(x,0) = f(x) and u_t(x,0) = g(x)

also $u_{tt} - c^2 u_{xx} = 0$

In[94]:=
```
c = 1;
solution =
  NDSolve[{D[u[x, t], {t, 2}] == c^2 D[u[x, t], {x, 2}], u[x, 0] == 10 x^2 (1 - x^2),
    Derivative[0, 1][u][x, 0] == 0, u[0, t] == 0, u[1, t] == 0}, u, {x, 0, 1}, {t, 0, 10}];
Plot3D[Evaluate[u[x, t] /. solution], {x, 0, 1}, {t, 0, 10}]
```

NDSolve: Warning: scaled local spatial error estimate of 735.7836765777907` at t = 10.` in the direction of independent variable x is much greater than the prescribed error tolerance. Grid spacing with 25 points may be too large to achieve the desired accuracy or precision. A singularity may have formed or a smaller grid spacing can be specified using the MaxStepSize or MinPoints method options.

Out[96]=