```
In[1]:= (* MA39110 / Assignment 3 / 16MA20053 / NER ROHIT *)
        ClearAll["Global`*"];

In[2]:= BlockThomas[a_, b_, c_, d_] :=
          Module[{b1 = Array[0 &, {Length[b], 1, 2, 2}], c1 = Array[0 &, {Length[c], 1, 2, 2}],
            d1 = Array[0 &, {Length[d], 1, 2, 1}], x = Array[0 &, {Length[b], 1, 2, 1}]},
           c1[[1, 1]] = Dot[Inverse[b[[1, 1]]], c[[1, 1]]];
           d1[[1, 1]] = Dot[Inverse[b[[1, 1]]], d[[1, 1]]];
           Do[
            b1[[i, 1]] = b[[i, 1]] - Dot[a[[i - 1, 1]], c1[[i - 1, 1]]];
            If[i ≠ Length[d], c1[[i, 1]] = Dot[Inverse[b1[[i, 1]]], c[[i, 1]]];];
            d1[[i, 1]] =
             Dot[Inverse[b1[[i, 1]]], d[[i, 1]] - Dot[a[[i - 1, 1]], d1[[i - 1, 1]]]];
            , {i, 2, Length[d]}];
           x[[Length[b], 1]] = d1[[Length[b], 1]];
           Do[
            x[[i, 1]] = d1[[i, 1]] - Dot[c1[[i, 1]], x[[i + 1, 1]]];
            , {i, Length[b] - 1, 1, -1}];
           x];

In[3]:= Model[n0_] := Module[{n = n0},
           x0 = 0; xf = 1; h = (xf - x0) / n;
           a = Array[{{0, 0}, {0, 0}} &, {n - 2, 1}];
           b = Array[{{0, 0}, {0, 0}} &, {n - 1, 1}];
           c = Array[{{0, 0}, {0, 0}} &, {n - 2, 1}];
           d = Array[{0, 0} &, {n - 1, 1}];
           X = Table[x0 + x * h, {x, 1, n - 1}];
           For[i = 1, i <= n - 1, i++,
            {
             b[[i, 1]] = {{-2 / h^2, -1}, {81, -2 / h^2}};
             d[[i, 1]] = {0, 81 * X[[i]]^2};
             If[i ≠ n - 1, {a[[i, 1]] = {{1 / h^2, 0}, {0, 1 / h^2}},
               c[[i, 1]] = {{1 / h^2, 0}, {0, 1 / h^2}}}];
            }];
           N[Flatten[BlockThomas[a, b, c, d]][[1 ;; ;; 2]]]];
```

In[4]:=
```
in = {25, 30, 40};
sol = Model[in[[1]]];
solt =
  DSolve[{y''''[x] + 81 y[x] == 81 x^2, y[0] == y[1] == y''[0] == y''[1] == 0}, y[x], x];
err1 = Abs[DSolveValue[{y''''[x] + 81 y[x] == 81 x^2,
       y[0] == y[1] == y''[0] == y''[1] == 0}, y[X], x] - sol];
perr1 = ListPlot[Transpose[{X, err1}], PlotStyle → Red];
N[Max[err1]]
p1 = Show[{Plot[Evaluate[y[x] /. solt], {x, x0, xf},
      PlotLabel → Style[StringForm["h = ``", N[h]], FontSize → 18]]},
    {ListPlot[Transpose[{X, sol}], PlotStyle → Red]}];
```

Out[9]= 0.000176946

In[11]:=
```
sol = Model[in[[2]]];
solt =
  DSolve[{y''''[x] + 81 y[x] == 81 x^2, y[0] == y[1] == y''[0] == y''[1] == 0}, y[x], x];
err2 = Abs[DSolveValue[{y''''[x] + 81 y[x] == 81 x^2,
       y[0] == y[1] == y''[0] == y''[1] == 0}, y[X], x] - sol];
perr2 = ListPlot[Transpose[{X, err2}], PlotStyle → Green];
N[Max[err2]]
p2 = Show[{Plot[Evaluate[y[x] /. solt], {x, x0, xf},
      PlotLabel → Style[StringForm["h = ``", N[h]], FontSize → 18]]},
    {ListPlot[Transpose[{X, sol}], PlotStyle → Red]}];
```

Out[15]= 0.000122922

In[17]:=
```
sol = Model[in[[3]]];
solt =
  DSolve[{y''''[x] + 81 y[x] == 81 x^2, y[0] == y[1] == y''[0] == y''[1] == 0}, y[x], x];
err3 = Abs[DSolveValue[{y''''[x] + 81 y[x] == 81 x^2,
       y[0] == y[1] == y''[0] == y''[1] == 0}, y[X], x] - sol];
perr3 = ListPlot[Transpose[{X, err3}], PlotStyle → Blue];
N[Max[err3]]
p3 = Show[{Plot[Evaluate[y[x] /. solt], {x, x0, xf},
      PlotLabel → Style[StringForm["h = ``", N[h]], FontSize → 18]]},
    {ListPlot[Transpose[{X, sol}], PlotStyle → Red]}];
```

Out[21]= 0.0000691074

In[23]:=
```
p4 = Show[{Plot[y[x] = 10^-4, {x, 0, 1}, PlotStyle → {Dashed, Black}]}, {perr1},
    {perr2}, {perr3}, PlotLabel → Style["Truncation Error", FontSize → 18],
    PlotRange → {{0, 1}, {0, 0.0002}}];
GraphicsGrid[{{p1, p2}, {p3, p4}}]
```

Out[24]=