```
danilevsky[matrix_] :=
 Module[
  {
   aMatrix = matrix,
   aMatrixNew,
   n = Length[matrix],
   bMatrix,
   k
  },
  Do[
   bMatrix = aMatrix;
   bMatrix[[k + 1]] = bMatrix[[k + 1]] * 1/aMatrix[[k + 1, k]];
   bMatrix = Table[
     If[i ≠ k + 1,
      aMatrix[[i, j]] - aMatrix[[i, k]] *
        bMatrix[[k + 1, j]],
      bMatrix[[i, j]]
     ],
     {i, n}, {j, n}];
   aMatrixNew =
    Table[
     If[
      j == k + 1,
      Total[Table[bMatrix[[i, t]] * aMatrix[[t, k]],
        {t, n}]],
      bMatrix[[i, j]]],
     {i, n}, {j, n}];
   aMatrix = aMatrixNew,
   {k, n - 1}];
  Reverse[Last[Transpose[aMatrix]]]
 ]
```

```
matrix = {{1., 2., 0., 0.}, {3., 1., 2., 0.},
   {0., 3., 1., 2.}, {0., 0., 3., 1.}};
matrix // MatrixForm
```

$$\begin{pmatrix} 1. & 2. & 0. & 0. \\ 3. & 1. & 2. & 0. \\ 0. & 3. & 1. & 2. \\ 0. & 0. & 3. & 1. \end{pmatrix}$$

```
poly[coef_] :=
 With[
  {n = Length[coef]},
  (-1)^n (x^n - Total[MapIndexed[#1 x^(n-#2) &, coef]])[[1]]]
```

```
Solve[poly[danilevsky[matrix]] == 0, x]
```

```
{{x → -2.96336}, {x → -0.513868},
 {x → 2.51387}, {x → 4.96336}}
```

```
Eigenvalues[matrix]
```

```
{4.96336, -2.96336, 2.51387, -0.513868}
```