

The respective matrices are

$$\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}, \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}, \begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix}$$

j	k	0	1
	0	(0.6, 0)	(0.25, 0)
	1	(-0.125, -1.4)	(-0.8, -0.45)
	2	(-1, 0)	(0.35, 0)
	3	(-0.125, 1.4)	(-0.8, 0.45)
	4	(0.6, 0)	(0.25, 0)

Finally the $m=8$ table.

The respective matrices are

$$\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}, \begin{pmatrix} \frac{1}{\sqrt{2}} & -\frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} \end{pmatrix}, \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}, \begin{pmatrix} -\frac{1}{\sqrt{2}} & -\frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} & -\frac{1}{\sqrt{2}} \end{pmatrix}, \begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix}$$

j	k	0
	0	(0.4125, 0)
	1	(-0.1862, -1.142)
	2	(-0.5, 0.175)
	3	(0.0612, 0.7581)
	4	(0.175, 0)
	5	(-0.0612, -0.2581)
	6	(-0.5, -0.175)
	7	(-0.1862, 1.142)
	8	(0.4125, 0)

The required polynomial is

$$g(x) = 0.20625x - 0.1862x \cos x - 1.142 \sin x - 0.5x \cos 2x + 0.0875 \sin 2x + 0.06124 \cos 3x + 0.2581 \sin 3x$$