$$\hat{M}^{(2,2)}(\beta) = \tilde{C}_0^{(2,2)} + \mathrm{e}^{-4\beta}\tilde{C}_4^{(2,2)} + \mathrm{e}^{-8\beta}\tilde{C}_8^{(2,2)}$$

$$\tilde{C}_0^{(2,2)} = \begin{bmatrix}
1 & \frac{1}{4} & \frac{1}{4} & 0 & \frac{1}{4} & 0 & 0 & 0 & \frac{1}{4} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & \frac{1}{4} & 0 & 0 & 0 & \frac{1}{4} & 0 & 0 & 0 & \frac{1}{4} & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & \frac{1}{4} & 0 & 0 & 0 & \frac{1}{4} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & \frac{1}{4} & \frac{1}{4} & \frac{1}{2} & 0 & 0 & 0 & \frac{1}{4} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & \frac{1}{2} & \frac{1}{4} & \frac{1}{4} & 0 & 0 & 0 & 0 & 0 & \frac{1}{4} & 0 & 0 & 0 \\
0 & \frac{1}{4} & 0 & 0 & \frac{1}{4} & \frac{1}{4} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{4} & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & \frac{1}{4} & 0 & \frac{1}{4} & \frac{1}{4} & \frac{1}{2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{4} & \frac{1}{4} & 0 & 0 & \frac{1}{4} & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & \frac{1}{4} & 0 & 0 & 0 & 0 & 0 & \frac{1}{4} & 0 & \frac{1}{2} & 0 & 0 & 0 & \frac{1}{4} & 0 \\
0 & 0 & 0 & \frac{1}{4} & 0 & 0 & 0 & 0 & 0 & \frac{1}{4} & \frac{1}{4} & \frac{3}{4} & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{4} & 0 & 0 & 0 & 0 & \frac{1}{4} & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{4} & 0 & 0 & \frac{1}{4} & \frac{1}{4} & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{4} & 0 & 0 & 0 & \frac{1}{4} & 0 & \frac{1}{4} & 0 & \frac{1}{2} & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{1}{4} & 0 & 0 & 0 & \frac{1}{4} & 0 & \frac{1}{4} & \frac{1}{4} & 1
\end{bmatrix}$$

$$\frac{1}{256}\begin{bmatrix}
-779 & -201 & -169 & 76 & -302 & -100 & -70 & 35 & -199 & -66 & 78 & 0 & -74 & -16 & 48 & 0 \\
100 & 39 & 44 & 33 & 25 & 17 & 22 & 33 & 38 & 13 & 0 & 0 & 10 & 4 & 3 & 0 \\
85 & 44 & 51 & 22 & 47 & 30 & 36 & 18 & 46 & 20 & 27 & 0 & 28 & 11 & 26 & 0 \\
76 & -21 & 8 & -25 & 17 & -31 & -8 & -32 & 34 & 20 & 58 & 85 & 16 & 3 & 37 & 45 \\
144 & 29 & 51 & 13 & -15 & -14 & 10 & 21 & 37 & 0 & 17 & 0 & -8 & -19 & 32 & 0 \\
68 & 20 & 30 & 34 & -14 & 2 & 12 & 39 & 14 & 4 & 5 & 0 & -2 & -13 & 14 & 0 \\
0 & 4 & 6 & 0 & 13 & 9 & 12 & 0 & 11 & 7 & 13 & 0 & 16 & 10 & 14 & 0 \\
35 & -25 & -1 & -21 & -2 & -22 & 8 & 9 & 16 & 13 & 43 & 90 & 16 & 31 & 67 & 130 \\
91 & 38 & 42 & 0 & 50 & 25 & 28 & 0 & 45 & 15 & 31 & 0 & 25 & 12 & 29 & 0 \\
0 & 4 & 0 & 0 & 4 & 5 & 1 & 0 & 5 & 9 & 0 & 0 & 8 & 8 & 0 & 0 \\
74 & 34 & 7 & 54 & 40 & 15 & -14 & 16 & -21 & 18 & -33 & 74 & -18 & -5 & -59 & 0 \\
40 & -13 & -60 & -92 & 12 & 3 & -3 & 18 & -11 & -18 & -93 & -60 & 14 & 67 & 13 & 186 \\
23 & 17 & 15 & 0 & 30 & 22 & 20 & 0 & 18 & 14 & 25 & 0 & 26 & 10 & 25 & 0 \\
6 & 17 & 3 & 0 & 26 & 23 & 10 & 0 & 8 & 5 & 9 & 0 & 10 & 12 & 11 & 0 \\
25 & 11 & -14 & 16 & 36 & 14 & -16 & 2 & -32 & -4 & -64 & 34 & -25 & -4 & -76 & 0 \\
12 & 3 & -13 & -110 & 33 & 2 & -48 & -159 & -9 & -50 & -116 & -223 & -42 & -111 & -184 & -361
\end{bmatrix}$$