The polynomials $\tilde{p}_i$, $i = 1, \cdots, 4$

$$
\begin{aligned}
\tilde{p}_1(\gamma_1,\gamma_2) \quad = \quad & \big(40{\gamma_1}^{10} + 20{\gamma_1}^{9}(7\gamma_2 + 12) + 6{\gamma_1}^{8}\left({\gamma_2}^{2} + 100\gamma_2 + 56\right) \\
& -{\gamma_1}^{7}\left(335{\gamma_2}^{3} + 564{\gamma_2}^{2} + 120\gamma_2 + 544\right) - 2{\gamma_1}^{6}\left(77{\gamma_2}^{4} + 723{\gamma_2}^{3} + 1146{\gamma_2}^{2} + 2008\gamma_2 + 972\right) \\
& +6{\gamma_1}^{5}\left(29{\gamma_2}^{5} + 87{\gamma_2}^{4} + 263{\gamma_2}^{3} + 20{\gamma_2}^{2} - 1190\gamma_2 - 408\right) \\
& -2{\gamma_1}^{4}\left(77{\gamma_2}^{6} - 261{\gamma_2}^{5} - 3414{\gamma_2}^{4} - 7458{\gamma_2}^{3} + 813{\gamma_2}^{2} + 2532\gamma_2 + 144\right) \\
& +{\gamma_1}^{3}\left(-335{\gamma_2}^{7} - 1446{\gamma_2}^{6} + 1578{\gamma_2}^{5} + 14916{\gamma_2}^{4} + 5996{\gamma_2}^{3} - 8100{\gamma_2}^{2} + 1968\gamma_2 + 2944\right) \\
& +6{\gamma_1}^{2}\left({\gamma_2}^{8} - 94{\gamma_2}^{7} - 382{\gamma_2}^{6} + 20{\gamma_2}^{5} - 271{\gamma_2}^{4} - 1350{\gamma_2}^{3} + 180{\gamma_2}^{2} + 848\gamma_2 + 256\right) \\
& +4\gamma_1\left(35{\gamma_2}^{9} + 150{\gamma_2}^{8} - 30{\gamma_2}^{7} - 1004{\gamma_2}^{6} - 1785{\gamma_2}^{5} - 1266{\gamma_2}^{4} + 492{\gamma_2}^{3} + 1272{\gamma_2}^{2} + 144\gamma_2 - 240\right) \\
& +8\left(5{\gamma_2}^{10} + 30{\gamma_2}^{9} + 42{\gamma_2}^{8} - 68{\gamma_2}^{7} - 243{\gamma_2}^{6} - 306{\gamma_2}^{5} - 36{\gamma_2}^{4} + 368{\gamma_2}^{3} + 192{\gamma_2}^{2} - 120\gamma_2 - 80\right)\big)
\end{aligned}
$$

$$
\begin{aligned}
\tilde{p}_2(\gamma_1,\gamma_2) \quad = \quad & \big(40{\gamma_1}^{10} + 20{\gamma_1}^{9}(13\gamma_2 + 12) + 6{\gamma_1}^{8}\left(91{\gamma_2}^{2} + 260\gamma_2 + 56\right) + {\gamma_1}^{7}\left(143{\gamma_2}^{3} + 3276{\gamma_2}^{2} + 2808\gamma_2 - 544\right) \\
& +{\gamma_1}^{6}\left(-1001{\gamma_2}^{4} + 858{\gamma_2}^{3} + 7956{\gamma_2}^{2} + 208\gamma_2 - 1944\right) \\
& -3{\gamma_1}^{5}\left(429{\gamma_2}^{5} + 2002{\gamma_2}^{4} - 2002{\gamma_2}^{3} - 4264{\gamma_2}^{2} + 1508\gamma_2 + 816\right) \\
& -{\gamma_1}^{4}\left(429{\gamma_2}^{6} + 7722{\gamma_2}^{5} + 7722{\gamma_2}^{4} - 26884{\gamma_2}^{3} - 4914{\gamma_2}^{2} + 7176\gamma_2 + 288\right) \\
& -2{\gamma_1}^{3}\left(1287{\gamma_2}^{6} + 6435{\gamma_2}^{5} - 8866{\gamma_2}^{4} - 10010{\gamma_2}^{3} + 6162{\gamma_2}^{2} + 1560\gamma_2 - 1472\right) \\
& -6{\gamma_1}^{2}\left(715{\gamma_2}^{6} - 858{\gamma_2}^{5} - 2145{\gamma_2}^{4} + 1716{\gamma_2}^{3} + 1092{\gamma_2}^{2} - 624\gamma_2 - 256\right) \\
& +12\gamma_1\left(143{\gamma_2}^{6} + 286{\gamma_2}^{5} - 429{\gamma_2}^{4} - 572{\gamma_2}^{3} + 312{\gamma_2}^{2} + 208\gamma_2 - 80\right) + 8\left(143{\gamma_2}^{6} - 429{\gamma_2}^{4} + 312{\gamma_2}^{2} - 8
\end{aligned}
$$

$$
\begin{aligned}
\tilde{p}_3(\gamma_1,\gamma_2) \quad = \quad & \big(40{\gamma_1}^{10} + 20{\gamma_1}^{9}\gamma_2 - 6{\gamma_1}^{8}\left(9{\gamma_2}^{2} + 104\right) + {\gamma_1}^{7}\left(312\gamma_2 - 93{\gamma_2}^{3}\right) + {\gamma_1}^{6}\left(45{\gamma_2}^{4} + 468{\gamma_2}^{2} + 3432\right) \\
& -3{\gamma_1}^{5}\gamma_2\left(3{\gamma_2}^{4} - 338{\gamma_2}^{2} + 1716\right) - {\gamma_1}^{4}\left(171{\gamma_2}^{6} - 2106{\gamma_2}^{4} + 12870{\gamma_2}^{2} + 4576\right) \\
& -2{\gamma_1}^{3}\gamma_2\left(42{\gamma_2}^{6} - 741{\gamma_2}^{4} + 7293{\gamma_2}^{2} - 5720\right) + 18{\gamma_1}^{2}{\gamma_2}^{2}\left(3{\gamma_2}^{6} - 13{\gamma_2}^{4} - 286{\gamma_2}^{2} + 572\right) \\
& +\gamma_1\left(50{\gamma_2}^{9} - 624{\gamma_2}^{7} + 2574{\gamma_2}^{5} - 2288{\gamma_2}^{3}\right) + 2{\gamma_2}^{4}\left(5{\gamma_2}^{6} - 78{\gamma_2}^{4} + 429{\gamma_2}^{2} - 572\right)\big)
\end{aligned}
$$

$$
\begin{aligned}
\tilde{p}_4(\gamma_1,\gamma_2) \quad = \quad & \big(40{\gamma_1}^{10} + 380{\gamma_1}^{9}\gamma_2 + 6{\gamma_1}^{8}\left(261{\gamma_2}^{2} - 104\right) + {\gamma_1}^{7}\left(3741{\gamma_2}^{3} - 5304\gamma_2\right) + 12{\gamma_1}^{6}\left(492{\gamma_2}^{4} - 1599{\gamma_2}^{2} + 286\right) \\
& +6{\gamma_1}^{5}\gamma_2\left(1128{\gamma_2}^{4} - 6617{\gamma_2}^{2} + 4290\right) + {\gamma_1}^{4}\left(5904{\gamma_2}^{6} - 50544{\gamma_2}^{4} + 64350{\gamma_2}^{2} - 4576\right) \\
& +{\gamma_1}^{3}\gamma_2\left(3741{\gamma_2}^{6} - 39702{\gamma_2}^{4} + 83226{\gamma_2}^{2} - 29744\right) + 18{\gamma_1}^{2}{\gamma_2}^{2}\left(87{\gamma_2}^{6} - 1066{\gamma_2}^{4} + 3575{\gamma_2}^{2} - 2860\right) \\
& +4\gamma_1{\gamma_2}^{3}\left(95{\gamma_2}^{6} - 1326{\gamma_2}^{4} + 6435{\gamma_2}^{2} - 7436\right) + 8{\gamma_2}^{4}\left(5{\gamma_2}^{6} - 78{\gamma_2}^{4} + 429{\gamma_2}^{2} - 572\right)\big)
\end{aligned}
$$