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LAMPIRAN

LAMPIRAN 1. Mendapatkan titik kesetimbangan V pada Persamaan (4.14)

$$w_2\phi U - \delta V + m_4M + \gamma E = 0$$

$$\begin{aligned} & w_2\phi\left(\frac{\Omega_1V+\Omega_2}{\Omega_3V^2+\Omega_4V+\Omega_5}\right) - \delta V + m_4\left(\frac{m_1}{m_2V+m_3+m_4}\right) + \\ & \gamma\left(\frac{(m_1m_2\Omega_3+\Omega_1\Omega_6)V^3+(\Omega_1\Omega_7+\Omega_2\Omega_6+m_1m_2\Omega_4)V^2+(m_1m_2\Omega_5+\Omega_2\Omega_7)V}{(\Omega_8V+\Omega_9)(\Omega_3V^2+\Omega_4V+\Omega_5)}\right) = 0 \\ & \frac{1}{(\Omega_3V^2+\Omega_4V+\Omega_5)(m_2V+m_3+m_4)(\Omega_9V+\Omega_8)}((\Omega_1\phi w_2V + \Omega_2\phi w_2)(m_2V + m_3 + \\ & m_4)(\Omega_9V + \Omega_8) + m_4m_1(\Omega_3V^2 + \Omega_4V + \Omega_5)(\Omega_8V + \Omega_9) - \delta V(\Omega_3V^2 + \Omega_4V + \\ & \Omega_5)(m_2V + m_3 + m_4)(\Omega_9V + V_8) + (\gamma\Omega_1\Omega_6V^3 + \gamma\Omega_1\Omega_7V^2 + \gamma\Omega_2\Omega_6V^2 + \\ & \gamma\Omega_2\Omega_7V)(m_2V + m_3 + m_4) + \gamma m_2m_2V(\Omega_3V^2 + \Omega_4V + \Omega_5)(m_2V + m_3 + \\ & m_4)) = 0 \end{aligned}$$

Kalikan kedua ruas dengan $\frac{1}{(\Omega_3V^2+\Omega_4V+\Omega_5)(m_2V+m_3+m_4)(\Omega_9V+\Omega_8)}$ diperoleh,

$$\begin{aligned} & ((\Omega_1\phi w_2V + \Omega_2\phi w_2)(m_2V + m_3 + m_4)(\Omega_9V + \Omega_8) + m_4m_1(\Omega_3V^2 + \Omega_4V + \\ & \Omega_5)(\Omega_8V + \Omega_9) - \delta V(\Omega_3V^2 + \Omega_4V + \Omega_5)(m_2V + m_3 + m_4)(\Omega_9V + V_8) + \\ & (\gamma\Omega_1\Omega_6V^3 + \gamma\Omega_1\Omega_7V^2 + \gamma\Omega_2\Omega_6V^2 + \gamma\Omega_2\Omega_7V)(m_2V + m_3 + m_4) + \\ & \gamma m_2m_2V(\Omega_3V^2 + \Omega_4V + \Omega_5)(m_2V + m_3 + m_4)) = 0 \\ & -\delta m_2\Omega_3\Omega_8V^5 + (\gamma m_2(m_1m_2\Omega_3 + \Omega_1\Omega_6) - \delta(\Omega_8(m_2\Omega_4 + m_3\Omega_3 + m_4\Omega_3) + \\ & m_2\Omega_3\Omega_9))V^4 + (\gamma(m_2(m_1m_3\Omega_3 + m_1m_4\Omega_3 + \Omega_1\Omega_7 + \Omega_2\Omega_6 + m_1m_2\Omega_4) + \\ & \Omega_1\Omega_6(m_3 + m_4)) + m_1m_4\Omega_3\Omega_8 + m_2\phi w_2\Omega_1\Omega_9 - \delta(\Omega_8(m_2\Omega_5 + m_3\Omega_4 + \\ & m_4\Omega_4) + \Omega_9(m_2\Omega_4 + m_3\Omega_3 + m_4\Omega_3)))V^3 + (\gamma(m_2(m_1m_3\Omega_4 + m_1m_4\Omega_4 + \\ & \Omega_2\Omega_7 + m_1m_2\Omega_5) + (m_3 + m_4)(\Omega_1\Omega_7 + \Omega_2\Omega_6)) + m_1m_4(\Omega_3\Omega_9 + \Omega_4\Omega_8) + \\ & \phi w_2(m_2\Omega_1\Omega_9 + m_2\Omega_2\Omega_8 + m_3\Omega_1\Omega_8 + m_4\Omega_1\Omega_8) - \delta(\Omega_8(m_3\Omega_5 + m_4\Omega_5) + \\ & \Omega_9(m_2\Omega_5 + m_3\Omega_4 + m_4\Omega_4)))V^2 + (\gamma(m_2(m_1m_3\Omega_5 + m_1m_4\Omega_5) + \\ & m_3 + m_4)) + m_1m_4(\Omega_4\Omega_9 + \Omega_5\Omega_8) + \phi w_2(m_2\Omega_2\Omega_9 + m_3\Omega_1\Omega_9 + \\ & m_4\Omega_1\Omega_9 + m_4\Omega_2\Omega_8) - \delta(\Omega_5\Omega_9)(m_3 + m_4)V + m_3\phi w_2\Omega_2\Omega_9 + \\ & \Omega_2\Omega_9 + m_1m_4\Omega_5\Omega_9 = 0. \end{aligned}$$



LAMPIRAN 2. Syarat Kestabilan Kriteia Routh-Hurwitz untuk $b_3 > 0$

$$\begin{aligned}
 b_3 = & \left((-\eta\gamma m_2^2\Omega_3 + \eta m_2^2\Omega_3\delta + m_2^2\rho\Omega_3\eta) V^5 + (m_2^2\rho\Omega_3\delta + 2m_2\rho\Omega_3\theta\eta - \right. \\
 & \eta\gamma m_2\Omega_3\delta + m_2\rho\Omega_3\delta\eta - 2\eta\gamma m_2\Omega_3\theta - \eta\gamma m_2^2\Omega_4 + \eta m_2^2\Omega_4\delta + m_2^2\rho\Omega_3\alpha_1 + m_2^2\rho\Omega_4\eta + \\
 & m_2^2\Omega_3\delta\alpha_1 + 2\eta m_2\Omega_3\delta\theta) V^4 + (m_2^2\rho\Omega_4\delta + 2m_2\rho\Omega_3\theta\alpha_1 + 2m_2\rho\Omega_4\theta\eta + \\
 & 2m_2\Omega_3\delta\theta\alpha_1 + m_1m_2m_4\Omega_3\eta + w_2\phi\eta m_2^2\Omega_1 - \gamma m_1m_2\Omega_3\eta - \eta\gamma m_2\Omega_4\delta - \eta\gamma\Omega_3\delta\theta + \\
 & m_2\rho\Omega_3\delta\alpha_1 + m_2\rho\Omega_4\delta\eta + \rho\Omega_3\delta\theta\eta - 2\eta\gamma m_2\Omega_4\theta + 2m_2\rho\Omega_3\delta\theta - \eta\gamma\Omega_3\theta^2 - \\
 & \eta\gamma m_2^2\Omega_5 + \eta m_2^2\Omega_5\delta - \gamma\eta m_2^2\Omega_1 + m_2^2\rho\Omega_4\alpha_1 + m_2^2\rho\Omega_5\eta + \rho\Omega_3\theta^2\eta + m_2^2\Omega_4\delta\alpha_1 + \\
 & 2\eta m_2\Omega_4\delta\theta) V^3 + (m_2^2\rho\Omega_5\delta + \rho\Omega_3\delta\theta^2 + 2m_2\rho\Omega_5\theta\eta + 2m_2\rho\Omega_4\theta\alpha_1 + m_1m_2m_4\Omega_4\eta + \\
 & w_2\phi m_1m_2m_4\Omega_3 + 2w_2\phi\eta m_2\Omega_1\theta + m_1m_2m_4\Omega_3\alpha_1 + 2m_2\Omega_4\delta\theta\alpha_1 + w_2\phi\eta m_2^2\Omega_2 - \\
 & 2\eta\gamma m_2\Omega_5\theta - \gamma\eta m_2\Omega_1\alpha_1 - \gamma m_1m_2\Omega_3\alpha_1 - \gamma m_1m_2\Omega_4\eta - \eta\gamma m_2\Omega_5\delta - \eta\gamma\Omega_4\delta\theta + \\
 & m_2\rho\Omega_5\delta\eta + \rho\Omega_4\delta\theta\eta + \eta_2\rho\Omega_4\delta\alpha_1 + \rho\Omega_3\delta\theta\alpha_1 - 2\gamma\eta m_2\Omega_1\theta - \gamma m_1m_2\Omega_3\theta + \\
 & m_1m_2m_4\rho\Omega_3\alpha_1 + 2m_2\rho\Omega_4\delta\theta + w_2\theta\rho\eta m_2\Omega_1 - w_2\theta\gamma m_1m_2\Omega_3 - w_2\theta\gamma\eta m_2\Omega_1 - \\
 & \eta\gamma\Omega_4\theta^2 + \eta\Omega_4\delta\theta^2 - \gamma\eta m_2^2\Omega_2 + \rho\Omega_4\theta^2\eta + m_2^2\rho\Omega_5\alpha_1 + \rho\Omega_3\theta^2\alpha_1 + m_2^2\Omega_5\delta\alpha_1 + \\
 & \Omega_3\delta\theta^2\alpha_1 + 2\eta m_2\Omega_5\delta\theta) V^2 + (\rho\Omega_4\delta\theta^2 + 2m_2\rho\Omega_5\theta\alpha_1 + m_1m_2m_4\Omega_4\alpha_1 + \\
 & w_2\phi m_1m_2m_4\Omega_4 + 2w_2\phi\eta m_2\Omega_2\theta + 2m_2\Omega_5\delta\theta\alpha_1 + m_1m_2m_4\Omega_5 + w_2\phi\eta\Omega_1\theta^2 - \\
 & \gamma\eta m_2\Omega_2\alpha_1 - \gamma\eta\Omega_1\theta\alpha_1 - \gamma m_1m_2\Omega_4\alpha_1 - \eta\gamma\Omega_5\delta\theta - \gamma m_1m_2\Omega_5\eta + m_2\rho\Omega_5\delta\alpha_1 + \\
 & \rho\Omega_4\delta\theta\alpha_1 + \rho\Omega_5\delta\theta\eta - 2\gamma\eta m_2\Omega_2\theta - \gamma m_1m_2\Omega_4\theta + m_1m_2m_4\rho\Omega_4 + 2m_2\rho\Omega_5\delta\theta + \\
 & w_2\phi\rho\eta m_2\Omega_2 + w_2\phi\rho\eta\Omega_1\theta - w_2\theta\gamma\eta m_2\Omega_2 - w_2\phi\gamma\eta\Omega_1\theta - w_2\phi\gamma m_1m_2\Omega_4 - \\
 & \eta\gamma\Omega_5\theta^2 + \eta\Omega_5\delta\theta^2 - \gamma\eta\Omega_1\theta^2 + \rho\Omega_4\theta^2\alpha_1 + \rho\Omega_5\theta^2\eta + \Omega_4\delta\theta^2\alpha_1) V \right) > 0
 \end{aligned}$$

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$$\begin{aligned}
 & (\eta m_2^2\Omega_3\delta + m_2^2\rho\Omega_3\eta) V^5 + (m_2^2\rho\Omega_3\delta + 2m_2\rho\Omega_3\theta\eta + m_2\rho\Omega_3\delta\eta + \eta m_2^2\Omega_4\delta + \\
 & m_2^2\rho\Omega_3\alpha_1 + m_2^2\rho\Omega_4\eta + m_2^2\Omega_3\delta\alpha_1 + 2\eta m_2\Omega_3\delta\theta) V^4 + (m_2^2\rho\Omega_4\delta + 2m_2\rho\Omega_3\theta\alpha_1 + \\
 & 2m_2\rho\Omega_4\theta\eta + 2m_2\Omega_3\delta\theta\alpha_1 + m_1m_2m_4\Omega_3\eta + w_2\phi\eta m_2^2\Omega_1 + m_2\rho\Omega_3\delta\alpha_1 + m_2\rho\Omega_4\delta\eta + \\
 & \rho\Omega_3\delta\theta\eta + 2m_2\rho\Omega_3\delta\theta + \eta m_2^2\Omega_5\delta + m_2^2\rho\Omega_4\alpha_1 + m_2^2\rho\Omega_5\eta + \rho\Omega_3\theta^2\eta + m_2^2\Omega_4\delta\alpha_1 + \\
 & 2\eta m_2\Omega_4\delta\theta) V^3 + (m_2^2\rho\Omega_5\delta + \rho\Omega_3\delta\theta^2 + 2m_2\rho\Omega_5\theta\eta + 2m_2\rho\Omega_4\theta\alpha_1 + m_1m_2m_4\Omega_4\eta + \\
 & w_2\phi m_1m_2m_4\Omega_3 + 2w_2\phi\eta m_2\Omega_1\theta + m_1m_2m_4\Omega_3\alpha_1 + 2m_2\Omega_4\delta\theta\alpha_1 + w_2\phi\eta m_2^2\Omega_2 + \\
 & m_2\rho\Omega_5\delta\eta + \rho\Omega_4\delta\theta\eta + \eta_2\rho\Omega_4\delta\alpha_1 + \rho\Omega_3\delta\theta\alpha_1 + m_1m_2m_4\rho\Omega_3\alpha_1 + 2m_2\rho\Omega_4\delta\theta + \\
 & \Omega_1 + \eta\Omega_4\delta\theta^2 + \rho\Omega_4\theta^2\eta + m_2^2\rho\Omega_5\alpha_1 + \rho\Omega_3\theta^2\alpha_1 + m_2^2\Omega_5\delta\alpha_1 + \Omega_3\delta\theta^2\alpha_1 + \\
 & \theta) V^2 + (\rho\Omega_4\delta\theta^2 + 2m_2\rho\Omega_5\theta\alpha_1 + m_1m_2m_4\Omega_4\alpha_1 + w_2\phi m_1m_2m_4\Omega_4 + \\
 & \Omega_2\theta + 2m_2\Omega_5\delta\theta\alpha_1 + m_1m_2m_4\Omega_5 + w_2\phi\eta\Omega_1\theta^2 + m_2\rho\Omega_5\delta\alpha_1 + \\
 & + \rho\Omega_5\delta\theta\eta + m_1m_2m_4\rho\Omega_4 + 2m_2\rho\Omega_5\delta\theta + w_2\phi\rho\eta m_2\Omega_2 + w_2\phi\rho\eta\Omega_1\theta +
 \end{aligned}$$



$$\begin{aligned}
& \eta\Omega_5\delta\theta^2 + \rho\Omega_4\theta^2\alpha_1 + \rho\Omega_5\theta^2\eta + \Omega_4\delta\theta^2\alpha_1)V > (\eta\gamma m_2^2\Omega_3)V^5 + (\eta\gamma m_2\Omega_3\delta + \\
& 2\eta\gamma m_2\Omega_3\theta + \eta\gamma m_2^2\Omega_4)V^4 + (\gamma m_1m_2\Omega_3\eta + \eta\gamma m_2\Omega_4\delta + \eta\gamma\Omega_3\delta\theta + 2\eta\gamma m_2\Omega_4\theta + \\
& \eta\gamma\Omega_3\theta^2 + \eta\gamma m_2^2\Omega_5 + \gamma\eta m_2^2\Omega_1)V^3 + (2\eta\gamma m_2\Omega_5\theta + \gamma\eta m_2\Omega_1\alpha_1 + \gamma m_1m_2\Omega_3\alpha_1 + \\
& \gamma m_1m_2\Omega_4\eta + \eta\gamma m_2\Omega_5\delta + \eta\gamma\Omega_4\delta\theta + 2\gamma\eta m_2\Omega_1\theta + \gamma m_1m_2\Omega_3\theta + w_2\theta\gamma m_1m_2\Omega_3 + \\
& w_2\theta\gamma\eta m_2\Omega_1 + \eta\gamma\Omega_4\theta^2 + \gamma\eta m_2^2\Omega_2)V^2 + (\gamma\eta m_2\Omega_2\alpha_1 + \gamma\eta\Omega_1\theta\alpha_1 + \gamma m_1m_2\Omega_4\alpha_1 + \\
& \eta\gamma\Omega_5\delta\theta + \gamma m_1m_2\Omega_5\eta + 2\gamma\eta m_2\Omega_2\theta + \gamma m_1m_2\Omega_4\theta + w_2\theta\gamma\eta m_2\Omega_2 + w_2\phi\gamma\eta\Omega_1\theta + \\
& w_2\phi\gamma m_1m_2\Omega_4 + \eta\gamma\Omega_5\theta^2 + \gamma\eta\Omega_1\theta^2)V
\end{aligned}$$

maka $b_3 > 0$.



LAMPIRAN 3. Syarat Kestabilan Kriteria Routh-Hurwitz untuk $b_4 > 0$

$$\begin{aligned}
 b_4 = & ((m_2^2 \rho \Omega_3 \delta \eta - \eta \gamma m_2^2 \Omega_3 \delta) V^5 + (-2\eta \gamma m_2 \Omega_3 \delta \theta - \eta \gamma m_2^2 \Omega_4 \delta + \\
 & m_2^2 \rho \Omega_3 \delta \alpha_1 + m_2^2 \rho \Omega_4 \delta \eta + 2m_2 \rho \Omega_3 \delta \theta \eta) V^4 + (-\gamma m_1 m_2 \Omega_3 \theta \eta - \\
 & 2\eta \gamma m_2 \Omega_4 \delta \theta - w_2 \phi \gamma \eta m_2^2 \Omega_1 - \eta \gamma m_2^2 \Omega_5 \delta + m_2^2 \rho \Omega_4 \delta \alpha_1 + m_2^2 \rho \Omega_5 \delta \eta - \\
 & \gamma \eta m_2^2 \Omega_1 \alpha_1 - \eta \gamma \Omega_3 \delta \theta^2 + \rho \Omega_3 \delta \theta^2 \eta + w_2 \phi \rho \eta m_2^2 \Omega_1 + 2m_2 \rho \Omega_3 \delta \theta \alpha_1 + \\
 & 2m_2 \rho \Omega_4 \delta \theta \eta + m_1 m_2 m_4 \rho \Omega_3 \eta) V^3 + (-2\gamma \eta m_2 \Omega_1 \theta \alpha_1 - \gamma m_1 m_2 \Omega_3 \theta \alpha_1 - \\
 & \gamma m_1 m_2 \Omega_4 \theta \eta - 2\eta \gamma m_2 \Omega_5 \delta \theta - w_2 \theta \gamma \eta m_2^2 \Omega_5 - w_2 \phi \gamma m_1 m_2 \Omega_3 \theta - \\
 & 2w_2 \phi \gamma \eta m_2 \Omega_1 \theta + w_2 \phi m_1 m_2 m_4 \rho \Omega_3 + 2w_2 \phi \rho \eta m_2 \Omega_1 \theta + \rho \Omega_4 \delta \theta^2 \eta + \\
 & m_2^2 \rho \Omega_5 \delta \alpha_1 + \rho \Omega_3 \delta \theta^2 \alpha_1 - \eta \gamma \Omega_4 \delta \theta^2 - \gamma \eta m_2^2 \Omega_2 \alpha_1 + 2m_2 \rho \Omega_5 \delta \theta \eta + \\
 & w_2 \phi \rho \eta m_2^2 \Omega_2 + m_1 m_2 m_4 \rho \Omega_3 \alpha_1 + 2m_2 \rho \Omega_4 \delta \theta \alpha_1 + \\
 & m_1 m_2 m_4 \rho \Omega_1 \eta) V^2 + (-2\gamma \eta m_2 \Omega_2 \theta \alpha_1 - \gamma m_1 m_2 \Omega_4 \theta \alpha_1 - w_2 \phi \gamma \eta \Omega_1 \theta^2 - \\
 & \gamma m_1 m_2 \Omega_5 \theta \eta - 2w_2 \phi \gamma \eta m_2 \Omega_2 \theta - w_2 \phi \gamma m_1 m_2 \Omega_4 \theta + 2w_2 \phi \rho \eta m_2 \Omega_2 \theta + \\
 & w_2 \phi m_1 m_2 m_4 \rho \Omega_4 + \rho \Omega_4 \delta \theta^2 \alpha_1 + \rho \Omega_5 \delta \theta^2 \eta - \gamma \eta \Omega_1 \theta^2 \alpha_1 - \eta \gamma \Omega_5 \delta \theta^2 + \\
 & w_2 \phi \rho \eta \Omega_1 \theta^2 + 2m_2 \rho \Omega_5 \delta \theta \alpha_1 + m_1 m_2 m_4 \rho \Omega_5 \eta + m_1 m_2 m_4 \rho \Omega_4 \alpha_1) V + \\
 & \rho \Omega_5 \delta \theta^2 \alpha_1 - \eta \eta \Omega_2 \theta^2 \alpha_1 - w_2 \phi \gamma m_1 m_2 \Omega_5 \theta + w_2 \phi \rho \eta \Omega_2 \theta^2 + m_1 m_2 m_4 \rho \Omega_5 \alpha_1 - \\
 & w_2 \phi \gamma \eta \Omega_2 \theta^2 - \gamma m_1 m_2 \Omega_5 \theta \alpha_1 + w_2 \phi m_1 m_2 m_4 \rho \Omega_5) > 0
 \end{aligned}$$

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$$\begin{aligned}
 & (m_2^2 \rho \Omega_3 \delta \eta) V^5 + (+m_2^2 \rho \Omega_3 \delta \alpha_1 + m_2^2 \rho \Omega_4 \delta \eta + 2m_2 \rho \Omega_3 \delta \theta \eta) V^4 + \\
 & (m_2^2 \rho \Omega_4 \delta \alpha_1 + m_2^2 \rho \Omega_5 \delta \eta + \rho \Omega_3 \delta \theta^2 \eta + w_2 \phi \rho \eta m_2^2 \Omega_1 + 2m_2 \rho \Omega_3 \delta \theta \alpha_1 + \\
 & 2m_2 \rho \Omega_4 \delta \theta \eta + m_1 m_2 m_4 \rho \Omega_3 \eta) V^3 + (w_2 \phi m_1 m_2 m_4 \rho \Omega_3 + 2w_2 \phi \rho \eta m_2 \Omega_1 \theta + \\
 & \rho \Omega_4 \delta \theta^2 \eta + m_2^2 \rho \Omega_5 \delta \alpha_1 + \rho \Omega_3 \delta \theta^2 \alpha_1 + 2m_2 \rho \Omega_5 \delta \theta \eta + w_2 \phi \rho \eta m_2^2 \Omega_2 + \\
 & m_1 m_2 m_4 \rho \Omega_3 \alpha_1 + 2m_2 \rho \Omega_4 \delta \theta \alpha_1 + m_1 m_2 m_4 \rho \Omega_1 \eta) V^2 + (2w_2 \phi \rho \eta m_2 \Omega_2 \theta + \\
 & w_2 \phi m_1 m_2 m_4 \rho \Omega_4 + \rho \Omega_4 \delta \theta^2 \alpha_1 + \rho \Omega_5 \delta \theta^2 \eta + w_2 \phi \rho \eta \Omega_1 \theta^2 + 2m_2 \rho \Omega_5 \delta \theta \alpha_1 + \\
 & m_1 m_2 m_4 \rho \Omega_5 \eta + m_1 m_2 m_4 \rho \Omega_4 \alpha_1) V + \rho \Omega_5 \delta \theta^2 \alpha_1 + w_2 \phi \rho \eta \Omega_2 \theta^2 + \\
 & m_1 m_2 m_4 \rho \Omega_5 \alpha_1 + w_2 \phi m_1 m_2 m_4 \rho \Omega_5 > (\eta \gamma m_2^2 \Omega_3 \delta) V^5 + (2\eta \gamma m_2 \Omega_3 \delta \theta + \\
 & \eta \gamma m_2^2 \Omega_4 \delta) V^4 + (\gamma m_1 m_2 \Omega_3 \theta \eta + 2\eta \gamma m_2 \Omega_4 \delta \theta + w_2 \phi \gamma \eta m_2^2 \Omega_1 + \eta \gamma m_2^2 \Omega_5 \delta +
 \end{aligned}$$



$$\begin{aligned}
 & \alpha_1 + \eta \gamma \Omega_3 \delta \theta^2) V^3 + (2\gamma \eta m_2 \Omega_1 \theta \alpha_1 + \gamma m_1 m_2 \Omega_3 \theta \alpha_1 + \\
 & \alpha_4 \theta \eta + 2\eta \gamma m_2 \Omega_5 \delta \theta + w_2 \theta \gamma \eta m_2^2 \Omega_5 + w_2 \phi \gamma m_1 m_2 \Omega_3 \theta + \\
 & m_2 \Omega_2 \Omega_1 \theta + \eta \gamma \Omega_4 \delta \theta^2 + \gamma \eta m_2^2 \Omega_2 \alpha_1) V^2 + (2\gamma \eta m_2 \Omega_2 \theta \alpha_1 +
 \end{aligned}$$

$$\begin{aligned} & \gamma m_1 m_2 \Omega_4 \theta \alpha_1 + w_2 \phi \gamma \eta \Omega_1 \theta^2 + \gamma m_1 m_2 \Omega_5 \theta \eta + 2w_2 \phi \gamma \eta m_2 \Omega_2 \theta + \\ & w_2 \phi \gamma m_1 m_2 \Omega_4 \theta + \gamma \eta \Omega_1 \theta^2 \alpha_1 + \eta \gamma \Omega_5 \delta \theta^2) V + \gamma \eta \Omega_2 \theta^2 \alpha_1 + w_2 \phi \gamma m_1 m_2 \Omega_5 \theta + \\ & w_2 \phi \gamma \eta \Omega_2 \theta^2 + \gamma m_1 m_2 \Omega_5 \theta \alpha_1 \end{aligned}$$

maka $b_4 > 0$.



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LAMPIRAN 4. Syarat Kestabilan Kriteria Routh-Hurwitz untuk $b_1 b_2 > b_3$

$$\begin{aligned}
b_1 b_2 - b_3 = & ((m_2^2 \Omega_3 + m_2 \Omega_3 \eta) V^4 + (m_2^2 \Omega_4 + m_2 \Omega_3 \delta + m_2 \Omega_4 \eta + \theta \Omega_3 \eta + \\
& m_2 \Omega_3 \alpha_1 + m_2 \rho \Omega_3 + 2m_2 \Omega_3 \theta) V^3 + (m_2 \Omega_5 + \Omega_3 \theta^2 + m_2 \Omega_4 \delta + \Omega_3 \delta \theta + \\
& m_2 \rho \Omega_4 + \rho \Omega_3 \theta + \Omega_3 \theta \alpha_1 + m_2 \Omega_5 \eta + \Omega_4 \theta \eta + m_2 \Omega_4 \alpha_1 + 2m_2 \Omega_4 \theta) V^2 + \\
& (\Omega_4 \theta^2 + m_2 \Omega_5 \delta + \Omega_4 \delta \theta + m_2 \rho \Omega_5 + \rho \Omega_4 \theta + \Omega_4 \theta \alpha_1 + \Omega_5 \theta \eta + m_2 \Omega_5 \alpha_1 + \\
& 2m_2 \Omega_5 \theta) V + \Omega_5 \theta \alpha_1 + \rho \Omega_5 \theta + \Omega_5 \delta \theta + \Omega_5 \theta^2) (m_2^2 \Omega_3 \eta V^5 + (m_2^2 \Omega_4 \eta + \\
& m_2^2 \Omega_3 \alpha_1 - \eta \gamma m_2 \Omega_3 + m_2 \rho \Omega_3 \eta + m_2 \Omega_3 \delta \eta + 2m_2 \Omega_3 \theta \eta + m_2^2 \Omega_3 \delta + \\
& m_2^2 \rho \Omega_3) V^4 + (m_2^2 \Omega_5 \eta + \Omega_3 \theta^2 \eta + m_2^2 \Omega_4 \alpha_1 + 2m_2 \rho \Omega_3 \theta + 2m_2 \Omega_3 \delta \theta - \\
& \eta \gamma m_2 \Omega_4 - \eta \gamma \Omega_3 \theta + m_2 \rho \Omega_3 \delta + m_2 \rho \Omega_3 \alpha_1 + 2m_2 \Omega_3 \theta \alpha_1 + m_2 \rho \Omega_4 \eta + \\
& m_2 \Omega_4 \delta \eta + 2m_2 \Omega_4 \theta \eta + \rho \Omega_3 \theta \eta + \Omega_3 \delta \theta \eta + m_2 \Omega_3 \alpha_1 \delta + m_2^2 \rho \Omega_4 + m_2^2 \Omega_4 \delta) V^3 + \\
& (\Omega_3 \theta^2 \alpha_1 + \Omega_4 \theta^2 \eta + m_2^2 \Omega_5 \alpha_1 + w_2 \phi \eta m_2 \Omega_1 + 2m_2 \rho \Omega_4 \theta + m_1 m_2 m_4 \Omega_3 + \\
& 2m_2 \Omega_4 \delta \theta - \gamma m_1 m_2 \Omega_3 - \eta \gamma m_2 \Omega_5 - \eta \gamma \Omega_4 \theta - 2m_2 \Omega_5 \theta \eta + \rho \Omega_4 \theta \eta + \Omega_4 \delta \theta \eta + \\
& m_2 \rho \Omega_4 \delta + \rho \Omega_3 \delta \theta + m_2 \rho \Omega_4 \alpha_1 + 2m_2 \Omega_4 \theta \alpha_1 + \rho \Omega_3 \theta \alpha_1 + \Omega_3 \delta \theta \alpha_1 + \\
& m_2 \rho \Omega_5 \eta + m_2 \Omega_5 \delta \eta + \gamma \eta m_2 \Omega_1 + m_2 \Omega_4 \alpha_1 \delta + m_2^2 \rho \Omega_5 + \rho \Omega_3 \theta^2 + m_2^2 \Omega_5 \delta + \\
& \Omega_3 \delta \theta^2) V^2 + (\Omega_4 \theta^2 \alpha_1 + \Omega_5 \theta^2 \eta + w_2 \theta \eta m_2 \Omega_2 + w_2 \theta \eta \Omega_1 \theta + 2m_2 \rho \Omega_5 \theta + \\
& m_1 m_2 m_4 \Omega_4 + 2m_2 \Omega_5 \delta \theta - \gamma \eta \Omega_1 \theta - \gamma m_1 m_2 \Omega_4 - \eta \gamma \Omega_5 \theta + 2m_2 \Omega_5 \theta \alpha_1 + \rho \Omega_4 \theta \alpha_1 + \\
& \Omega_4 \delta \theta \alpha_1 + \rho \Omega_5 \theta \eta + \Omega_5 \delta \theta \eta + m_2 \rho \Omega_5 \delta + \rho \Omega_4 \delta \theta + m_2 \rho \Omega_5 \alpha_1 - \gamma \eta m_2 \Omega_2 + \\
& m_2 \Omega_5 \alpha_1 \delta + \rho \Omega_4 \theta^2 + \Omega_4 \delta \theta^2) V + + \rho \Omega_5 \theta^2 + \Omega_5 \delta \theta^2 + \rho \Omega_5 \delta \theta + \rho \Omega_5 \theta \alpha_1 + \Omega_5 \delta \theta \alpha_1 - \\
& \gamma \eta \Omega_2 \theta - \gamma m_1 m_2 \Omega_5 + w_2 \phi \eta \Omega_2 \theta + \Omega_5 \theta^2 \alpha_1 + m_1 m_2 m_4 \Omega_5) - ((-\eta \gamma m_2^2 \Omega_3 + \\
& \eta m_2^2 \Omega_3 \delta + m_2^2 \rho \Omega_3 \eta) V^5 + (m_2^2 \rho \Omega_3 \delta + 2m_2 \rho \Omega_3 \theta \eta - \eta \gamma m_2 \Omega_3 \delta + m_2 \rho \Omega_3 \delta \eta - \\
& 2\eta \gamma m_2 \Omega_3 \theta - \eta \gamma m_2^2 \Omega_4 + \eta m_2^2 \Omega_4 \delta + m_2^2 \rho \Omega_3 \alpha_1 + m_2^2 \rho \Omega_4 \eta + m_2^2 \Omega_3 \delta \alpha_1 + \\
& 2\eta m_2 \Omega_3 \delta \theta) V^4 + (m_2^2 \rho \Omega_4 \delta + 2m_2 \rho \Omega_3 \theta \alpha_1 + 2m_2 \rho \Omega_4 \theta \eta + 2m_2 \Omega_3 \delta \theta \alpha_1 + \\
& m_1 m_2 m_4 \Omega_3 \eta + w_2 \phi \eta m_2^2 \Omega_1 - \gamma m_1 m_2 \Omega_3 \eta - \eta \gamma m_2 \Omega_4 \delta - \eta \gamma \Omega_3 \delta \theta + m_2 \rho \Omega_3 \delta \alpha_1 + \\
& m_2 \rho \Omega_4 \delta \eta + \rho \Omega_3 \delta \theta \eta - 2\eta \gamma m_2 \Omega_4 \theta + 2m_2 \rho \Omega_3 \delta \theta - \eta \gamma \Omega_3 \theta^2 - \eta \gamma m_2^2 \Omega_5 + \eta m_2^2 \Omega_5 \delta - \\
& \eta \gamma m_2^2 \Omega_1 + m_2^2 \rho \Omega_4 \alpha_1 + m_2^2 \rho \Omega_5 \eta + \rho \Omega_3 \theta^2 \eta + m_2^2 \Omega_4 \delta \alpha_1 + 2\eta m_2 \Omega_4 \delta \theta) V^3 + \\
& (m_2^2 \rho \Omega_5 \delta + \rho \Omega_3 \delta \theta^2 + 2m_2 \rho \Omega_5 \theta \eta + 2m_2 \rho \Omega_4 \theta \alpha_1 + m_1 m_2 m_4 \Omega_4 \eta + \\
& 2m_2 \Omega_4 \Omega_3 + 2w_2 \phi \eta m_2 \Omega_1 \theta + m_1 m_2 m_4 \Omega_3 \alpha_1 + 2m_2 \Omega_4 \delta \theta \alpha_1 + w_2 \phi \eta m_2^2 \Omega_2 - \\
& \theta - \gamma \eta m_2 \Omega_1 \alpha_1 - \gamma m_1 m_2 \Omega_3 \alpha_1 - \gamma m_1 m_2 \Omega_4 \eta - \eta \gamma m_2 \Omega_5 \delta - \eta \gamma \Omega_4 \delta \theta + \\
& + \rho \Omega_4 \delta \theta \eta + \eta_2 \rho \Omega_4 \delta \alpha_1 + \rho \Omega_3 \delta \theta \alpha_1 - 2\gamma \eta m_2 \Omega_1 \theta - \gamma m_1 m_2 \Omega_3 \theta +
\end{aligned}$$



$$\begin{aligned}
& m_1 m_2 m_4 \rho \Omega_{31} + 2 m_2 \rho \Omega_4 \delta \theta + w_2 \theta \rho \eta m_2 \Omega_1 - w_2 \theta \gamma m_1 m_2 \Omega_3 - w_2 \theta \gamma \eta m_2 \Omega_1 - \\
& \eta \gamma \Omega_4 \theta^2 + \eta \Omega_4 \delta \theta^2 - \gamma \eta m_2^2 \Omega_2 + \rho \Omega_4 \theta^2 \eta + m_2^2 \rho \Omega_5 \alpha_1 + \rho \Omega_3 \theta^2 \alpha_1 + m_2^2 \Omega_5 \delta \alpha_1 + \\
& \Omega_3 \delta \theta^2 \alpha_1 + 2 \eta m_2 \Omega_5 \delta \theta) V^2 + (\rho \Omega_4 \delta \theta^2 + 2 m_2 \rho \Omega_5 \theta \alpha_1 + m_1 m_2 m_4 \Omega_4 \alpha_1 + \\
& w_2 \phi m_1 m_2 m_4 \Omega_4 + 2 w_2 \phi \eta m_2 \Omega_2 \theta + 2 m_2 \Omega_5 \delta \theta \alpha_1 + m_1 m_2 m_4 \Omega_5 + w_2 \phi \eta \Omega_1 \theta^2 - \\
& \gamma \eta m_2 \Omega_2 \alpha_1 - \gamma \eta \Omega_1 \theta \alpha_1 - \gamma m_1 m_2 \Omega_4 \alpha_1 - \eta \gamma \Omega_5 \delta \theta - \gamma m_1 m_2 \Omega_5 \eta + m_2 \rho \Omega_5 \delta \alpha_1 + \\
& \rho \Omega_4 \delta \theta \alpha_1 + \rho \Omega_5 \delta \theta \eta - 2 \gamma \eta m_2 \Omega_2 \theta - \gamma m_1 m_2 \Omega_4 \theta + m_1 m_2 m_4 \rho \Omega_4 + 2 m_2 \rho \Omega_5 \delta \theta + \\
& w_2 \phi \rho \eta m_2 \Omega_2 + w_2 \phi \rho \eta \Omega_1 \theta - w_2 \theta \gamma \eta m_2 \Omega_2 - w_2 \phi \gamma \eta \Omega_1 \theta - w_2 \phi \gamma m_1 m_2 \Omega_4 - \\
& \eta \gamma \Omega_5 \theta^2 + \eta \Omega_5 \delta \theta^2 - \gamma \eta \Omega_1 \theta^2 + \rho \Omega_4 \theta^2 \alpha_1 + \rho \Omega_5 \theta^2 \eta + \Omega_4 \delta \theta^2 \alpha_1) V) \\
& ((m_2^2 \Omega_3 + m_2 \Omega_3 \eta) V^4 + (m_2^2 \Omega_4 + m_2 \Omega_3 \delta + m_2 \Omega_4 \eta + \theta \Omega_3 \eta + m_2 \Omega_3 \alpha_1 + \\
& m_2 \rho \Omega_3 + 2 m_2 \Omega_3 \theta) V^3 + (m_2 \Omega_5 + \Omega_3 \theta^2 + m_2 \Omega_4 \delta + \Omega_3 \delta \theta + m_2 \rho \Omega_4 + \\
& \rho \Omega_3 \theta + \Omega_3 \theta \alpha_1 + m_2 \Omega_5 \eta + \Omega_4 \theta \eta + m_2 \Omega_4 \alpha_1 + 2 m_2 \Omega_4 \theta) V^2 + (\Omega_4 \theta^2 + \\
& m_2 \Omega_5 \delta + \Omega_4 \delta \theta + m_2 \rho \Omega_5 + \rho \Omega_4 \theta + \Omega_4 \theta \alpha_1 + \Omega_5 \theta \eta + m_2 \Omega_5 \alpha_1 + 2 m_2 \Omega_5 \theta) V + \\
& \Omega_5 \theta \alpha_1 + \rho \Omega_5 \theta + \Omega_5 \delta \theta + \Omega_5 \theta^2) (m_2^2 \Omega_3 \eta V^5 + (m_2^2 \Omega_4 \eta + m_2^2 \Omega_3 \alpha_1 - \eta \gamma m_2 \Omega_3 + \\
& m_2 \rho \Omega_3 \eta + m_2 \Omega_3 \delta \eta + 2 m_2 \Omega_3 \theta \eta + m_2^2 \Omega_3 \delta + m_2^2 \rho \Omega_3) V^4 + (m_2^2 \Omega_5 \eta + \Omega_3 \theta^2 \eta + \\
& m_2^2 \Omega_4 \alpha_1 + 2 m_2 \rho \Omega_3 \theta + 2 m_2 \Omega_3 \delta \theta - \eta \gamma m_2 \Omega_4 - \eta \gamma \Omega_3 \theta + m_2 \rho \Omega_3 \delta + \\
& m_2 \rho \Omega_3 \alpha_1 + 2 m_2 \Omega_3 \theta \alpha_1 + m_2 \rho \Omega_4 \eta + m_2 \Omega_4 \delta \eta + 2 m_2 \Omega_4 \theta \eta + \rho \Omega_3 \theta \eta + \\
& \Omega_3 \delta \theta \eta + m_2 \Omega_3 \alpha_1 \delta + m_2^2 \rho \Omega_4 + m_2^2 \Omega_4 \delta) V^3 + (\Omega_3 \theta^2 \alpha_1 + \Omega_4 \theta^2 \eta + m_2^2 \Omega_5 \alpha_1 + \\
& w_2 \phi \eta m_2 \Omega_1 + 2 m_2 \rho \Omega_4 \theta + m_1 m_2 m_4 \Omega_3 + 2 m_2 \Omega_4 \delta \theta - \gamma m_1 m_2 \Omega_3 - \eta \gamma m_2 \Omega_5 - \\
& \eta \gamma \Omega_4 \theta - 2 m_2 \Omega_5 \theta \eta + \rho \Omega_4 \theta \eta + \Omega_4 \delta \theta \eta + m_2 \rho \Omega_4 \delta + \rho \Omega_3 \delta \theta + m_2 \rho \Omega_4 \alpha_1 + \\
& 2 m_2 \Omega_4 \theta \alpha_1 + \rho \Omega_3 \theta \alpha_1 + \Omega_3 \delta \theta \alpha_1 + m_2 \rho \Omega_5 \eta + m_2 \Omega_5 \delta \eta + \gamma \eta m_2 \Omega_1 + \\
& m_2 \Omega_4 \alpha_1 \delta + m_2^2 \rho \Omega_5 + \rho \Omega_3 \theta^2 + m_2^2 \Omega_5 \delta + \Omega_3 \delta \theta^2) V^2 + (\Omega_4 \theta^2 \alpha_1 + \Omega_5 \theta^2 \eta + \\
& w_2 \theta \eta m_2 \Omega_2 + w_2 \theta \eta \Omega_1 \theta + 2 m_2 \rho \Omega_5 \theta + m_1 m_2 m_4 \Omega_4 + 2 m_2 \Omega_5 \delta \theta - \eta \gamma \Omega_1 \theta - \\
& \gamma m_1 m_2 \Omega_4 - \eta \gamma \Omega_5 \theta + 2 m_2 \Omega_5 \theta \alpha_1 + \rho \Omega_4 \theta \alpha_1 + \Omega_4 \delta \theta \alpha_1 + \rho \Omega_5 \theta \eta + \Omega_5 \delta \theta \eta + \\
& m_2 \rho \Omega_5 \delta + \rho \Omega_4 \delta \theta + m_2 \rho \Omega_5 \alpha_1 - \eta \gamma m_2 \Omega_2 + m_2 \Omega_5 \alpha_1 \delta + \rho \Omega_4 \theta^2 + \Omega_4 \delta \theta^2) V + \\
& + \rho \Omega_5 \theta^2 + \Omega_5 \delta \theta^2 + \rho \Omega_5 \delta \theta + \rho \Omega_5 \theta \alpha_1 + \Omega_5 \delta \theta \alpha_1 - \eta \gamma \Omega_2 \theta - \gamma m_1 m_2 \Omega_5 + \\
& w_2 \phi \eta \Omega_2 \theta + \Omega_5 \theta^2 \alpha_1 + m_1 m_2 m_4 \Omega_5) - ((-\eta \gamma m_2^2 \Omega_3 + \eta m_2^2 \Omega_3 \delta + m_2^2 \rho \Omega_3 \eta) V^5 + \\
& (-\eta \gamma m_2^2 \Omega_4 + 2 m_2 \rho \Omega_3 \theta \eta - \eta \gamma m_2 \Omega_3 \delta + m_2 \rho \Omega_3 \delta \eta - 2 \eta \gamma m_2 \Omega_3 \theta - \eta \gamma m_2^2 \Omega_4 + \\
& m_2^2 \rho \Omega_3 \alpha_1 + m_2^2 \rho \Omega_4 \eta + m_2^2 \Omega_3 \delta \alpha_1 + 2 \eta m_2 \Omega_3 \delta \theta) V^4 + (m_2^2 \rho \Omega_4 \delta + \\
& \alpha_1 + 2 m_2 \rho \Omega_4 \theta \eta + 2 m_2 \Omega_3 \delta \theta \alpha_1 + m_1 m_2 m_4 \Omega_3 \eta + w_2 \phi \eta m_2^2 \Omega_1 - \\
& \eta - \eta \gamma m_2 \Omega_4 \delta - \eta \gamma \Omega_3 \delta \theta + m_2 \rho \Omega_3 \delta \alpha_1 + m_2 \rho \Omega_4 \delta \eta + \rho \Omega_3 \delta \theta \eta -
\end{aligned}$$



$$\begin{aligned}
& 2\eta\gamma m_2\Omega_4\theta + 2m_2\rho\Omega_3\delta\theta - \eta\gamma\Omega_3\theta^2 - \eta\gamma m_2^2\Omega_5 + \eta m_2^2\Omega_5\delta - \gamma\eta m_2^2\Omega_1 + m_2^2\rho\Omega_4\alpha_1 + \\
& m_2^2\rho\Omega_5\eta + \rho\Omega_3\theta^2\eta + m_2^2\Omega_4\delta\alpha_1 + 2\eta m_2\Omega_4\delta\theta) V^3 + (m_2^2\rho\Omega_5\delta + \rho\Omega_3\delta\theta^2 + \\
& 2m_2\rho\Omega_5\theta\eta + 2m_2\rho\Omega_4\theta\alpha_1 + m_1m_2m_4\Omega_4\eta + w_2\phi m_1m_2m_4\Omega_3 + 2w_2\phi\eta m_2\Omega_1\theta + \\
& m_1m_2m_4\Omega_3\alpha_1 + 2m_2\Omega_4\delta\theta\alpha_1 + w_2\phi\eta m_2^2\Omega_2 - 2\eta\gamma m_2\Omega_5\theta - \gamma\eta m_2\Omega_1\alpha_1 - \\
& \gamma m_1m_2\Omega_3\alpha_1 - \gamma m_1m_2\Omega_4\eta - \eta\gamma m_2\Omega_5\delta - \eta\gamma\Omega_4\delta\theta + m_2\rho\Omega_5\delta\eta + \rho\Omega_4\delta\theta\eta + \\
& \eta_2\rho\Omega_4\delta\alpha_1 + \rho\Omega_3\delta\theta\alpha_1 - 2\gamma\eta m_2\Omega_1\theta - \gamma m_1m_2\Omega_3\theta + m_1m_2m_4\rho\Omega_3\alpha_1 + 2m_2\rho\Omega_4\delta\theta + \\
& w_2\theta\rho\eta m_2\Omega_1 - w_2\theta\gamma m_1m_2\Omega_3 - w_2\theta\gamma\eta m_2\Omega_1 - \eta\gamma\Omega_4\theta^2 + \eta\Omega_4\delta\theta^2 - \gamma\eta m_2^2\Omega_2 + \\
& \rho\Omega_4\theta^2\eta + m_2^2\rho\Omega_5\alpha_1 + \rho\Omega_3\theta^2\alpha_1 + m_2^2\Omega_5\delta\alpha_1 + \Omega_3\delta\theta^2\alpha_1 + 2\eta m_2\Omega_5\delta\theta) V^2 + \\
& (\rho\Omega_4\delta\theta^2 + 2m_2\rho\Omega_5\theta\alpha_1 + m_1m_2m_4\Omega_4\alpha_1 + w_2\phi m_1m_2m_4\Omega_4 + 2w_2\phi\eta m_2\Omega_2\theta + \\
& 2m_2\Omega_5\delta\theta\alpha_1 + m_1m_2m_4\Omega_5 + w_2\phi\eta\Omega_1\theta^2 - \gamma\eta m_2\Omega_2\alpha_1 - \gamma\eta\Omega_1\theta\alpha_1 - \gamma m_1m_2\Omega_4\alpha_1 - \\
& \eta\gamma\Omega_5\delta\theta - \gamma m_1m_2\Omega_5\eta + m_2\rho\Omega_5\delta\alpha_1 + \rho\Omega_4\delta\theta\alpha_1 + \rho\Omega_5\delta\theta\eta - 2\gamma\eta m_2\Omega_2\theta - \\
& \gamma m_1m_2\Omega_4\theta + m_1m_2m_4\rho\Omega_4 + 2m_2\rho\Omega_5\delta\theta + w_2\phi\rho\eta m_2\Omega_2 + w_2\phi\rho\eta\Omega_1\theta - \\
& w_2\theta\gamma\eta m_2\Omega_2 - w_2\phi\gamma\eta\Omega_1\theta - w_2\phi\gamma m_1m_2\Omega_4 - \eta\gamma\Omega_5\theta^2 + \eta\Omega_5\delta\theta^2 - \gamma\eta\Omega_1\theta^2 + \\
& \rho\Omega_4\theta^2\alpha_1 + \rho\Omega_5\theta^2\eta + \Omega_4\delta\theta^2\alpha_1) V) > 0
\end{aligned}$$

Jika

$$\begin{aligned}
& ((m_2^2\Omega_3 + m_2\Omega_3\eta)V^4 + (m_2^2\Omega_4 + m_2\Omega_3\delta + m_2\Omega_4\eta + \theta\Omega_3\eta + m_2\Omega_3\alpha_1 + \\
& m_2\rho\Omega_3 + 2m_2\Omega_3\theta)V^3 + (m_2\Omega_5 + \Omega_3\theta^2 + m_2\Omega_4\delta + \Omega_3\delta\theta + m_2\rho\Omega_4 + \\
& \rho\Omega_3\theta + \Omega_3\theta\alpha_1 + m_2\Omega_5\eta + \Omega_4\theta\eta + m_2\Omega_4\alpha_1 + 2m_2\Omega_4\theta)V^2 + (\Omega_4\theta^2 + \\
& m_2\Omega_5\delta + \Omega_4\delta\theta + m_2\rho\Omega_5 + \rho\Omega_4\theta + \Omega_4\theta\alpha_1 + \Omega_5\theta\eta + m_2\Omega_5\alpha_1 + 2m_2\Omega_5\theta)V + \\
& \Omega_5\theta\alpha_1 + \rho\Omega_5\theta + \Omega_5\delta\theta + \Omega_5\theta^2) (m_2^2\Omega_3\eta V^5 + (m_2^2\Omega_4\eta + m_2^2\Omega_3\alpha_1 - \\
& \eta\gamma m_2\Omega_3 + m_2\rho\Omega_3\eta + m_2\Omega_3\delta\eta + 2m_2\Omega_3\theta\eta + m_2^2\Omega_3\delta + m_2^2\rho\Omega_3)V^4 + \\
& (m_2^2\Omega_5\eta + \Omega_3\theta^2\eta + m_2^2\Omega_4\alpha_1 + 2m_2\rho\Omega_3\theta + 2m_2\Omega_3\delta\theta - \eta\gamma m_2\Omega_4 - \eta\gamma\Omega_3\theta + \\
& m_2\rho\Omega_3\delta + m_2\rho\Omega_3\alpha_1 + 2m_2\Omega_3\theta\alpha_1 + m_2\rho\Omega_4\eta + m_2\Omega_4\delta\eta + 2m_2\Omega_4\theta\eta + \\
& \rho\Omega_3\theta\eta + \Omega_3\delta\theta\eta + m_2\Omega_3\alpha_1\delta + m_2^2\rho\Omega_4 + m_2^2\Omega_4\delta)V^3 + (\Omega_3\theta^2\alpha_1 + \Omega_4\theta^2\eta + \\
& m_2^2\Omega_5\alpha_1 + w_2\phi\eta m_2\Omega_1 + 2m_2\rho\Omega_4\theta + m_1m_2m_4\Omega_3 + 2m_2\Omega_4\delta\theta - \gamma m_1m_2\Omega_3 - \\
& \eta\gamma m_2\Omega_5 - \eta\gamma\Omega_4\theta - 2m_2\Omega_5\theta\eta + \rho\Omega_4\theta\eta + \Omega_4\delta\theta\eta + m_2\rho\Omega_4\delta + \rho\Omega_3\delta\theta +
\end{aligned}$$



$$\begin{aligned}
& + 2m_2\Omega_4\theta\alpha_1 + \rho\Omega_3\theta\alpha_1 + \Omega_3\delta\theta\alpha_1 + m_2\rho\Omega_5\eta + m_2\Omega_5\delta\eta + \\
& + m_2\Omega_4\alpha_1\delta + m_2^2\rho\Omega_5 + \rho\Omega_3\theta^2 + m_2^2\Omega_5\delta + \Omega_3\delta\theta^2)V^2 + \\
& + \Omega_5\theta^2\eta + w_2\theta\eta m_2\Omega_2 + w_2\theta\eta\Omega_1\theta + 2m_2\rho\Omega_5\theta + m_1m_2m_4\Omega_4 +
\end{aligned}$$

$$\begin{aligned}
& 2m_2\Omega_5\delta\theta - \gamma\eta\Omega_1\theta - \gamma m_1m_2\Omega_4 - \eta\gamma\Omega_5\theta + 2m_2\Omega_5\theta\alpha_1 + \rho\Omega_4\theta\alpha_1 + \Omega_4\delta\theta\alpha_1 + \\
& \rho\Omega_5\theta\eta + \Omega_5\delta\theta\eta + m_2\rho\Omega_5\delta + \rho\Omega_4\delta\theta + m_2\rho\Omega_5\alpha_1 - \gamma\eta m_2\Omega_2 + m_2\Omega_5\alpha_1\delta + \rho\Omega_4\theta^2 + \\
& \Omega_4\delta\theta^2) V + +\rho\Omega_5\theta^2 + \Omega_5\delta\theta^2 + \rho\Omega_5\delta\theta + \rho\Omega_5\theta\alpha_1 + \Omega_5\delta\theta\alpha_1 - \gamma\eta\Omega_2\theta - \gamma m_1m_2\Omega_5 + \\
& w_2\phi\eta\Omega_2\theta + \Omega_5\theta^2\alpha_1 + m_1m_2m_4\Omega_5) > ((-\eta\gamma m_2^2\Omega_3 + \eta m_2^2\Omega_3\delta + m_2^2\rho\Omega_3\eta) V^5 + \\
& (m_2^2\rho\Omega_3\delta + 2m_2\rho\Omega_3\theta\eta - \eta\gamma m_2\Omega_3\delta + m_2\rho\Omega_3\delta\eta - 2\eta\gamma m_2\Omega_3\theta - \eta\gamma m_2^2\Omega_4 + \\
& \eta m_2^2\Omega_4\delta + m_2^2\rho\Omega_3\alpha_1 + m_2^2\rho\Omega_4\eta + m_2^2\Omega_3\delta\alpha_1 + 2\eta m_2\Omega_3\delta\theta) V^4 + (m_2^2\rho\Omega_4\delta + \\
& 2m_2\rho\Omega_3\theta\alpha_1 + 2m_2\rho\Omega_4\theta\eta + 2m_2\Omega_3\delta\theta\alpha_1 + m_1m_2m_4\Omega_3\eta + w_2\phi\eta m_2^2\Omega_1 - \\
& \gamma m_1m_2\Omega_3\eta - \eta\gamma m_2\Omega_4\delta - \eta\gamma\Omega_3\delta\theta + m_2\rho\Omega_3\delta\alpha_1 + m_2\rho\Omega_4\delta\eta + \rho\Omega_3\delta\theta\eta - \\
& 2\eta\gamma m_2\Omega_4\theta + 2m_2\rho\Omega_3\delta\theta - \eta\gamma\Omega_3\theta^2 - \eta\gamma m_2^2\Omega_5 + \eta m_2^2\Omega_5\delta - \gamma\eta m_2^2\Omega_1 + m_2^2\rho\Omega_4\alpha_1 + \\
& m_2^2\rho\Omega_5\eta + \rho\Omega_3\theta^2\eta + m_2^2\Omega_4\delta\alpha_1 + 2\eta m_2\Omega_4\delta\theta) V^3 + (m_2^2\rho\Omega_5\delta + \rho\Omega_3\delta\theta^2 + \\
& 2m_2\rho\Omega_5\theta\eta + 2m_2\rho\Omega_4\theta\alpha_1 + m_1m_2m_4\Omega_4\eta + w_2\phi m_1m_2m_4\Omega_3 + 2w_2\phi\eta m_2\Omega_1\theta + \\
& m_1m_2m_4\Omega_3\alpha_1 + 2m_2\Omega_4\delta\theta\alpha_1 + w_2\phi\eta m_2^2\Omega_2 - 2\eta\gamma m_2\Omega_5\theta - \gamma\eta m_2\Omega_1\alpha_1 - \\
& \gamma m_1m_2\Omega_3\alpha_1 - \gamma m_1m_2\Omega_4\eta - \eta\gamma m_2\Omega_5\delta - \eta\gamma\Omega_4\delta\theta + m_2\rho\Omega_5\delta\eta + \rho\Omega_4\delta\theta\eta + \\
& \eta_2\rho\Omega_4\delta\alpha_1 + \rho\Omega_3\delta\theta\alpha_1 - 2\gamma\eta m_2\Omega_1\theta - \gamma m_1m_2\Omega_3\theta + m_1m_2m_4\rho\Omega_3\alpha_1 + 2m_2\rho\Omega_4\delta\theta + \\
& w_2\theta\rho\eta m_2\Omega_1 - w_2\theta\gamma m_1m_2\Omega_3 - w_2\theta\gamma\eta m_2\Omega_1 - \eta\gamma\Omega_4\theta^2 + \eta\Omega_4\delta\theta^2 - \gamma\eta m_2^2\Omega_2 + \\
& \rho\Omega_4\theta^2\eta + m_2^2\rho\Omega_5\alpha_1 + \rho\Omega_3\theta^2\alpha_1 + m_2^2\Omega_5\delta\alpha_1 + \Omega_3\delta\theta^2\alpha_1 + 2\eta m_2\Omega_5\delta\theta) V^2 + \\
& (\rho\Omega_4\delta\theta^2 + 2m_2\rho\Omega_5\theta\alpha_1 + m_1m_2m_4\Omega_4\alpha_1 + w_2\phi m_1m_2m_4\Omega_4 + 2w_2\phi\eta m_2\Omega_2\theta + \\
& 2m_2\Omega_5\delta\theta\alpha_1 + m_1m_2m_4\Omega_5 + w_2\phi\eta\Omega_1\theta^2 - \gamma\eta m_2\Omega_2\alpha_1 - \gamma\eta\Omega_1\theta\alpha_1 - \gamma m_1m_2\Omega_4\alpha_1 - \\
& \eta\gamma\Omega_5\delta\theta - \gamma m_1m_2\Omega_5\eta + m_2\rho\Omega_5\delta\alpha_1 + \rho\Omega_4\delta\theta\alpha_1 + \rho\Omega_5\delta\theta\eta - 2\gamma\eta m_2\Omega_2\theta - \\
& \gamma m_1m_2\Omega_4\theta + m_1m_2m_4\rho\Omega_4 + 2m_2\rho\Omega_5\delta\theta + w_2\phi\eta m_2\Omega_2 + w_2\phi\eta\Omega_1\theta - \\
& w_2\theta\gamma\eta m_2\Omega_2 - w_2\phi\gamma\eta\Omega_1\theta - w_2\phi\gamma m_1m_2\Omega_4 - \eta\gamma\Omega_5\theta^2 + \eta\Omega_5\delta\theta^2 - \gamma\eta\Omega_1\theta^2 + \\
& \rho\Omega_4\theta^2\alpha_1 + \rho\Omega_5\theta^2\eta + \Omega_4\delta\theta^2\alpha_1) V)
\end{aligned}$$

maka $b_1b_2 - b_3 > 0$.





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LAMPIRAN 5. Syarat Kestabilan Kriteria Routh-Hurwitz untuk $b_1 b_2 b_3 > b_3^2 + b_1^2 b_4$

$$\begin{aligned}
 b_1 b_2 b_3 - b_3^2 - b_1^2 b_4 = & ((m_2^2 \Omega_3 + m_2 \Omega_3 \eta) V^4 + (m_2^2 \Omega_4 + m_2 \Omega_3 \delta + m_2 \Omega_4 \eta + \\
 & \theta \Omega_3 \eta + m_2 \Omega_3 \alpha_1 + m_2 \rho \Omega_3 + 2m_2 \Omega_3 \theta) V^3 + (m_2 \Omega_5 + \Omega_3 \theta^2 + m_2 \Omega_4 \delta + \\
 & \Omega_3 \delta \theta + m_2 \rho \Omega_4 + \rho \Omega_3 \theta + \Omega_3 \theta \alpha_1 + m_2 \Omega_5 \eta + \Omega_4 \theta \eta + m_2 \Omega_4 \alpha_1 + \\
 & 2m_2 \Omega_4 \theta) V^2 + (\Omega_4 \theta^2 + m_2 \Omega_5 \delta + \Omega_4 \delta \theta + m_2 \rho \Omega_5 + \rho \Omega_4 \theta + \Omega_4 \theta \alpha_1 + \Omega_5 \theta \eta + \\
 & m_2 \Omega_5 \alpha_1 + 2m_2 \Omega_5 \theta) V + \Omega_5 \theta \alpha_1 + \rho \Omega_5 \theta + \Omega_5 \delta \theta + \Omega_5 \theta^2) (m_2^2 \Omega_3 \eta V^5 + \\
 & (m_2^2 \Omega_4 \eta + m_2^2 \Omega_3 \alpha_1 - \eta \gamma m_2 \Omega_3 + m_2 \rho \Omega_3 \eta + m_2 \Omega_3 \delta \eta + 2m_2 \Omega_3 \theta \eta + m_2^2 \Omega_3 \delta + \\
 & m_2^2 \rho \Omega_3) V^4 + (m_2^2 \Omega_5 \eta + \Omega_3 \theta^2 \eta + m_2^2 \Omega_4 \alpha_1 + 2m_2 \rho \Omega_3 \theta + 2m_2 \Omega_3 \delta \theta - \\
 & \eta \gamma m_2 \Omega_4 - \eta \gamma \Omega_3 \theta + m_2 \rho \Omega_3 \delta + m_2 \rho \Omega_3 \alpha_1 + 2m_2 \Omega_3 \theta \alpha_1 + m_2 \rho \Omega_4 \eta + \\
 & m_2 \Omega_4 \delta \eta + 2m_2 \Omega_4 \theta \eta + \rho \Omega_3 \theta \eta + \Omega_3 \delta \theta \eta + m_2 \Omega_3 \alpha_1 \delta + m_2^2 \rho \Omega_4 + m_2^2 \Omega_4 \delta) V^3 + \\
 & (\Omega_3 \theta^2 \alpha_1 + \Omega_4 \theta^2 \eta + m_2^2 \Omega_5 \alpha_1 + w_2 \phi \eta m_2 \Omega_1 + 2m_2 \rho \Omega_4 \theta + m_1 m_2 m_4 \Omega_3 + \\
 & 2m_2 \Omega_4 \delta \theta - \gamma m_1 m_2 \Omega_3 - \eta \gamma m_2 \Omega_5 - \eta \gamma \Omega_4 \theta - 2m_2 \Omega_5 \theta \eta + \rho \Omega_4 \theta \eta + \Omega_4 \delta \theta \eta + \\
 & m_2 \rho \Omega_4 \delta + \rho \Omega_3 \delta \theta + m_2 \rho \Omega_4 \alpha_1 + 2m_2 \Omega_4 \theta \alpha_1 + \rho \Omega_3 \theta \alpha_1 + \Omega_3 \delta \theta \alpha_1 + \\
 & m_2 \rho \Omega_5 \eta + m_2 \Omega_5 \delta \eta + \gamma \eta m_2 \Omega_1 + m_2 \Omega_4 \alpha_1 \delta + m_2^2 \rho \Omega_5 + \rho \Omega_3 \theta^2 + m_2^2 \Omega_5 \delta + \\
 & \Omega_3 \delta \theta^2) V^2 + (\Omega_4 \theta^2 \alpha_1 + \Omega_5 \theta^2 \eta + w_2 \theta \eta m_2 \Omega_2 + w_2 \theta \eta \Omega_1 \theta + 2m_2 \rho \Omega_5 \theta + \\
 & m_1 m_2 m_4 \Omega_4 + 2m_2 \Omega_5 \delta \theta - \gamma \eta m_1 m_2 \Omega_4 - \eta \gamma \Omega_5 \theta + 2m_2 \Omega_5 \theta \alpha_1 + \rho \Omega_4 \theta \alpha_1 + \\
 & \Omega_4 \delta \theta \alpha_1 + \rho \Omega_5 \theta \eta + \Omega_5 \delta \theta \eta + m_2 \rho \Omega_5 \delta + \rho \Omega_4 \delta \theta + m_2 \rho \Omega_5 \alpha_1 - \gamma \eta m_2 \Omega_2 + \\
 & m_2 \Omega_5 \alpha_1 \delta + \rho \Omega_4 \theta^2 + \Omega_4 \delta \theta^2) V + +\rho \Omega_5 \theta^2 + \Omega_5 \delta \theta^2 + \rho \Omega_5 \delta \theta + \rho \Omega_5 \theta \alpha_1 + \Omega_5 \delta \theta \alpha_1 - \\
 & \gamma \eta \Omega_2 \theta - \gamma m_1 m_2 \Omega_5 + w_2 \phi \eta \Omega_2 \theta + \Omega_5 \theta^2 \alpha_1 + m_1 m_2 m_4 \Omega_5) ((-\eta \gamma m_2^2 \Omega_3 + \eta m_2^2 \Omega_3 \delta + \\
 & m_2^2 \rho \Omega_3 \eta) V^5 + (m_2^2 \rho \Omega_3 \delta + 2m_2 \rho \Omega_3 \theta \eta - \eta \gamma m_2 \Omega_3 \delta + m_2 \rho \Omega_3 \delta \eta - 2\eta \gamma m_2 \Omega_3 \theta - \\
 & \eta \gamma m_2^2 \Omega_4 + \eta m_2^2 \Omega_4 \delta + m_2^2 \rho \Omega_3 \alpha_1 + m_2^2 \rho \Omega_4 \eta + m_2^2 \Omega_3 \delta \alpha_1 + 2\eta m_2 \Omega_3 \delta \theta) V^4 + \\
 & (m_2^2 \rho \Omega_4 \delta + 2m_2 \rho \Omega_3 \theta \alpha_1 + 2m_2 \rho \Omega_4 \theta \eta + 2m_2 \Omega_3 \delta \theta \alpha_1 + m_1 m_2 m_4 \Omega_3 \eta + \\
 & w_2 \phi \eta m_2^2 \Omega_1 - \gamma m_1 m_2 \Omega_3 \eta - \eta \gamma m_2 \Omega_4 \delta - \eta \gamma \Omega_3 \delta \theta + m_2 \rho \Omega_3 \delta \alpha_1 + m_2 \rho \Omega_4 \delta \eta + \\
 & \rho \Omega_3 \delta \theta \eta - 2\eta \gamma m_2 \Omega_4 \theta + 2m_2 \rho \Omega_3 \delta \theta - \eta \gamma \Omega_3 \theta^2 - \eta \gamma m_2^2 \Omega_5 + \eta m_2^2 \Omega_5 \delta - \gamma \eta m_2^2 \Omega_1 + \\
 & m_2^2 \rho \Omega_4 \alpha_1 + m_2^2 \rho \Omega_5 \eta + \rho \Omega_3 \theta^2 \eta + m_2^2 \Omega_4 \delta \alpha_1 + 2\eta m_2 \Omega_4 \delta \theta) V^3 + (m_2^2 \rho \Omega_5 \delta + \\
 & 2m_2 \rho \Omega_5 \theta \eta + 2m_2 \rho \Omega_4 \theta \alpha_1 + m_1 m_2 m_4 \Omega_4 \eta + w_2 \phi m_1 m_2 m_4 \Omega_3 + \\
 & \Omega_1 \theta + m_1 m_2 m_4 \Omega_3 \alpha_1 + 2m_2 \Omega_4 \delta \theta \alpha_1 + w_2 \phi \eta m_2^2 \Omega_2 - 2\eta \gamma m_2 \Omega_5 \theta - \\
 & \Omega_1 - \gamma m_1 m_2 \Omega_3 \alpha_1 - \gamma m_1 m_2 \Omega_4 \eta - \eta \gamma m_2 \Omega_5 \delta - \eta \gamma \Omega_4 \delta \theta + m_2 \rho \Omega_5 \delta \eta +
 \end{aligned}$$



$$\begin{aligned}
& \rho\Omega_4\delta\theta\eta + \eta_2\rho\Omega_4\delta\alpha_1 + \rho\Omega_3\delta\theta\alpha_1 - 2\gamma\eta m_2\Omega_1\theta - \gamma m_1m_2\Omega_3\theta + m_1m_2m_4\rho\Omega_{31} + \\
& 2m_2\rho\Omega_4\delta\theta + w_2\theta\rho\eta m_2\Omega_1 - w_2\theta\gamma m_1m_2\Omega_3 - w_2\theta\gamma\eta m_2\Omega_1 - \eta\gamma\Omega_4\theta^2 + \eta\Omega_4\delta\theta^2 - \\
& \gamma\eta m_2^2\Omega_2 + \rho\Omega_4\theta^2\eta + m_2^2\rho\Omega_5\alpha_1 + \rho\Omega_3\theta^2\alpha_1 + m_2^2\Omega_5\delta\alpha_1 + \Omega_3\delta\theta^2\alpha_1 + \\
& 2\eta m_2\Omega_5\delta\theta) V^2 + (\rho\Omega_4\delta\theta^2 + 2m_2\rho\Omega_5\theta\alpha_1 + m_1m_2m_4\Omega_4\alpha_1 + w_2\phi m_1m_2m_4\Omega_4 + \\
& 2w_2\phi\eta m_2\Omega_2\theta + 2m_2\Omega_5\delta\theta\alpha_1 + m_1m_2m_4\Omega_5 + w_2\phi\eta\Omega_1\theta^2 - \gamma\eta m_2\Omega_2\alpha_1 - \gamma\eta\Omega_1\theta\alpha_1 - \\
& \gamma m_1m_2\Omega_4\alpha_1 - \eta\gamma\Omega_5\delta\theta - \gamma m_1m_2\Omega_5\eta + m_2\rho\Omega_5\delta\alpha_1 + \rho\Omega_4\delta\theta\alpha_1 + \rho\Omega_5\delta\theta\eta - \\
& 2\gamma\eta m_2\Omega_2\theta - \gamma m_1m_2\Omega_4\theta + m_1m_2m_4\rho\Omega_4 + 2m_2\rho\Omega_5\delta\theta + w_2\phi\rho\eta m_2\Omega_2 + \\
& w_2\phi\rho\eta\Omega_1\theta - w_2\theta\gamma\eta m_2\Omega_2 - w_2\phi\gamma\eta m_1m_2\Omega_4 - \eta\gamma\Omega_5\theta^2 + \eta\Omega_5\delta\theta^2 - \\
& \gamma\eta\Omega_1\theta^2 + \rho\Omega_4\theta^2\alpha_1 + \rho\Omega_5\theta^2\eta + \Omega_4\delta\theta^2\alpha_1) V) - ((-\eta\gamma m_2^2\Omega_3 + \eta m_2^2\Omega_3\delta + \\
& m_2^2\rho\Omega_3\eta) V^5 + (m_2^2\rho\Omega_3\delta + 2m_2\rho\Omega_3\theta\eta - \eta\gamma m_2\Omega_3\delta + m_2\rho\Omega_3\delta\eta - 2\eta\gamma m_2\Omega_3\theta - \\
& \eta\gamma m_2^2\Omega_4 + \eta m_2^2\Omega_4\delta + m_2^2\rho\Omega_3\alpha_1 + m_2^2\rho\Omega_4\eta + m_2^2\Omega_3\delta\alpha_1 + 2\eta m_2\Omega_3\delta\theta) V^4 + \\
& (m_2^2\rho\Omega_4\delta + 2m_2\rho\Omega_3\theta\alpha_1 + 2m_2\rho\Omega_4\theta\eta + 2m_2\Omega_3\delta\theta\alpha_1 + m_1m_2m_4\Omega_3\eta + \\
& w_2\phi\eta m_2^2\Omega_1 - \gamma m_1m_2\Omega_3\eta - \eta\gamma m_2\Omega_4\delta - \eta\gamma\Omega_3\delta\theta + m_2\rho\Omega_3\delta\alpha_1 + m_2\rho\Omega_4\delta\eta + \\
& \rho\Omega_3\delta\theta\eta - 2\eta\gamma m_2\Omega_4\theta + 2m_2\rho\Omega_3\delta\theta - \eta\gamma\Omega_3\theta^2 - \eta\gamma m_2^2\Omega_5 + \eta m_2^2\Omega_5\delta - \gamma\eta m_2^2\Omega_1 + \\
& m_2^2\rho\Omega_4\alpha_1 + m_2^2\rho\Omega_5\eta + \rho\Omega_3\theta^2\eta + m_2^2\Omega_4\delta\alpha_1 + 2\eta m_2\Omega_4\delta\theta) V^3 + (m_2^2\rho\Omega_5\delta + \\
& \rho\Omega_3\delta\theta^2 + 2m_2\rho\Omega_5\theta\eta + 2m_2\rho\Omega_4\theta\alpha_1 + m_1m_2m_4\Omega_4\eta + w_2\phi m_1m_2m_4\Omega_3 + \\
& 2w_2\phi\eta m_2\Omega_1\theta + m_1m_2m_4\Omega_3\alpha_1 + 2m_2\Omega_4\delta\theta\alpha_1 + w_2\phi\eta m_2^2\Omega_2 - 2\eta\gamma m_2\Omega_5\theta - \\
& \gamma\eta m_2\Omega_1\alpha_1 - \gamma m_1m_2\Omega_3\alpha_1 - \gamma m_1m_2\Omega_4\eta - \eta\gamma m_2\Omega_5\delta - \eta\gamma\Omega_4\delta\theta + m_2\rho\Omega_5\delta\eta + \\
& \rho\Omega_4\delta\theta\eta + \eta_2\rho\Omega_4\delta\alpha_1 + \rho\Omega_3\delta\theta\alpha_1 - 2\gamma\eta m_2\Omega_1\theta - \gamma m_1m_2\Omega_3\theta + m_1m_2m_4\rho\Omega_{31} + \\
& 2m_2\rho\Omega_4\delta\theta + w_2\theta\rho\eta m_2\Omega_1 - w_2\theta\gamma m_1m_2\Omega_3 - w_2\theta\gamma\eta m_2\Omega_1 - \eta\gamma\Omega_4\theta^2 + \eta\Omega_4\delta\theta^2 - \\
& \eta\gamma m_2^2\Omega_2 + \rho\Omega_4\theta^2\eta + m_2^2\rho\Omega_5\alpha_1 + \rho\Omega_3\theta^2\alpha_1 + m_2^2\Omega_5\delta\alpha_1 + \Omega_3\delta\theta^2\alpha_1 + \\
& 2\eta m_2\Omega_5\delta\theta) V^2 + (\rho\Omega_4\delta\theta^2 + 2m_2\rho\Omega_5\theta\alpha_1 + m_1m_2m_4\Omega_4\alpha_1 + w_2\phi m_1m_2m_4\Omega_4 + \\
& 2w_2\phi\eta m_2\Omega_2\theta + 2m_2\Omega_5\delta\theta\alpha_1 + m_1m_2m_4\Omega_5 + w_2\phi\eta\Omega_1\theta^2 - \gamma\eta m_2\Omega_2\alpha_1 - \gamma\eta\Omega_1\theta\alpha_1 - \\
& \gamma m_1m_2\Omega_4\alpha_1 - \eta\gamma\Omega_5\delta\theta - \gamma m_1m_2\Omega_5\eta + m_2\rho\Omega_5\delta\alpha_1 + \rho\Omega_4\delta\theta\alpha_1 + \rho\Omega_5\delta\theta\eta - \\
& 2\gamma\eta m_2\Omega_2\theta - \gamma m_1m_2\Omega_4\theta + m_1m_2m_4\rho\Omega_4 + 2m_2\rho\Omega_5\delta\theta + w_2\phi\rho\eta m_2\Omega_2 + \\
& w_2\phi\rho\eta\Omega_1\theta - w_2\theta\gamma\eta m_2\Omega_2 - w_2\phi\gamma\eta\Omega_1\theta - w_2\phi\gamma m_1m_2\Omega_4 - \eta\gamma\Omega_5\theta^2 + \eta\Omega_5\delta\theta^2 - \\
& \rho\Omega_4\theta^2\alpha_1 + \rho\Omega_5\theta^2\eta + \Omega_4\delta\theta^2\alpha_1) V)^2 - ((m_2^2\Omega_3 + m_2\Omega_3\eta) V^4 + \\
& m_2\Omega_3\delta + m_2\Omega_4\eta + \theta\Omega_3\eta + m_2\Omega_3\alpha_1 + m_2\rho\Omega_3 + 2m_2\Omega_3\theta) V^3 + \\
& - \Omega_3\theta^2 + m_2\Omega_4\delta + \Omega_3\delta\theta + m_2\rho\Omega_4 + \rho\Omega_3\theta + \Omega_3\theta\alpha_1 + m_2\Omega_5\eta +
\end{aligned}$$



$$\begin{aligned}
& \Omega_4\theta\eta + m_2\Omega_4\alpha_1 + 2m_2\Omega_4\theta)V^2 + (\Omega_4\theta^2 + m_2\Omega_5\delta + \Omega_4\delta\theta + m_2\rho\Omega_5 + \\
& \rho\Omega_4\theta + \Omega_4\theta\alpha_1 + \Omega_5\theta\eta + m_2\Omega_5\alpha_1 + 2m_2\Omega_5\theta)V + \Omega_5\theta\alpha_1 + \rho\Omega_5\theta + \Omega_5\delta\theta + \\
& \Omega_5\theta^2)^2 \left((m_2^2\rho\Omega_3\delta\eta - \eta\gamma m_2^2\Omega_3\delta) V^5 + (-2\eta\gamma m_2\Omega_3\delta\theta - \eta\gamma m_2^2\Omega_4\delta + m_2^2\rho\Omega_3\delta\alpha_1 + \right. \\
& m_2^2\rho\Omega_4\delta\eta + 2m_2\rho\Omega_3\delta\theta\eta) V^4 + (-\gamma m_1 m_2\Omega_3\theta\eta - 2\eta\gamma m_2\Omega_4\delta\theta - w_2\phi\gamma\eta m_2^2\Omega_1 - \\
& \eta\gamma m_2^2\Omega_5\delta + m_2^2\rho\Omega_4\delta\alpha_1 + m_2^2\rho\Omega_5\delta\eta - \eta\gamma m_2^2\Omega_1\alpha_1 - \eta\gamma\Omega_3\delta\theta^2 + \rho\Omega_3\delta\theta^2\eta + \\
& w_2\phi\rho\eta m_2^2\Omega_1 + 2m_2\rho\Omega_3\delta\theta\alpha_1 + 2m_2\rho\Omega_4\delta\theta\eta + m_1 m_2 m_4 \rho\Omega_3\eta) V^3 + \\
& (-2\gamma\eta m_2\Omega_1\theta\alpha_1 - \gamma m_1 m_2\Omega_3\theta\alpha_1 - \gamma m_1 m_2\Omega_4\theta\eta - 2\eta\gamma m_2\Omega_5\delta\theta - w_2\theta\gamma\eta m_2^2\Omega_5 - \\
& w_2\phi\gamma m_1 m_2\Omega_3\theta - 2w_2\phi\gamma\eta m_2\Omega_1\theta + w_2\phi m_1 m_2 m_4 \rho\Omega_3 + 2w_2\phi\rho\eta m_2\Omega_1\theta + \\
& \rho\Omega_4\delta\theta^2\eta + m_2^2\rho\Omega_5\delta\alpha_1 + \rho\Omega_3\delta\theta^2\alpha_1 - \eta\gamma\Omega_4\delta\theta^2 - \eta\gamma m_2^2\Omega_2\alpha_1 + 2m_2\rho\Omega_5\delta\theta\eta + \\
& w_2\phi\rho\eta m_2^2\Omega_2 + m_1 m_2 m_4 \rho\Omega_3\alpha_1 + 2m_2\rho\Omega_4\delta\theta\alpha_1 + \\
& m_1 m_2 m_4 \rho\Omega_1\eta) V^2 + (-2\gamma\eta m_2\Omega_2\theta\alpha_1 - \gamma m_1 m_2\Omega_4\theta\alpha_1 - w_2\phi\gamma\eta\Omega_1\theta^2 - \\
& \gamma m_1 m_2\Omega_5\theta\eta - 2w_2\phi\gamma\eta m_2\Omega_2\theta - w_2\phi\gamma m_1 m_2\Omega_4\theta + 2w_2\phi\rho\eta m_2\Omega_2\theta + \\
& w_2\phi m_1 m_2 m_4 \rho\Omega_4 + \rho\Omega_4\delta\theta^2\alpha_1 + \rho\Omega_5\delta\theta^2\eta - \eta\gamma\Omega_1\theta^2\alpha_1 - \eta\gamma\Omega_5\delta\theta^2 + w_2\phi\rho\eta\Omega_1\theta^2 + \\
& 2m_2\rho\Omega_5\delta\theta\alpha_1 + m_1 m_2 m_4 \rho\Omega_5\eta + m_1 m_2 m_4 \rho\Omega_4\alpha_1) V + \rho\Omega_5\delta\theta^2\alpha_1 - \eta\gamma\Omega_2\theta^2\alpha_1 - \\
& w_2\phi\gamma m_1 m_2\Omega_5\theta + w_2\phi\rho\eta\Omega_2\theta^2 + m_1 m_2 m_4 \rho\Omega_5\alpha_1 - w_2\phi\gamma\eta\Omega_2\theta^2 - \gamma m_1 m_2\Omega_5\theta\alpha_1 + \\
& \left. w_2\phi m_1 m_2 m_4 \rho\Omega_5 \right)
\end{aligned}$$

$$\begin{aligned}
& ((m_2^2\Omega_3 + m_2\Omega_3\eta)V^4 + (m_2^2\Omega_4 + m_2\Omega_3\delta + m_2\Omega_4\eta + \theta\Omega_3\eta + m_2\Omega_3\alpha_1 + \\
& m_2\rho\Omega_3 + 2m_2\Omega_3\theta)V^3 + (m_2\Omega_5 + \Omega_3\theta^2 + m_2\Omega_4\delta + \Omega_3\delta\theta + m_2\rho\Omega_4 + \\
& \rho\Omega_3\theta + \Omega_3\theta\alpha_1 + m_2\Omega_5\eta + \Omega_4\theta\eta + m_2\Omega_4\alpha_1 + 2m_2\Omega_4\theta)V^2 + (\Omega_4\theta^2 + \\
& m_2\Omega_5\delta + \Omega_4\delta\theta + m_2\rho\Omega_5 + \rho\Omega_4\theta + \Omega_4\theta\alpha_1 + \Omega_5\theta\eta + m_2\Omega_5\alpha_1 + 2m_2\Omega_5\theta)V + \\
& \Omega_5\theta\alpha_1 + \rho\Omega_5\theta + \Omega_5\delta\theta + \Omega_5\theta^2) (m_2^2\Omega_3\eta V^5 + (m_2^2\Omega_4\eta + m_2^2\Omega_3\alpha_1 - \\
& \eta\gamma m_2\Omega_3 + m_2\rho\Omega_3\eta + m_2\Omega_3\delta\eta + 2m_2\Omega_3\theta\eta + m_2^2\Omega_3\delta + m_2^2\rho\Omega_3)V^4 + \\
& (m_2^2\Omega_5\eta + \Omega_3\theta^2\eta + m_2^2\Omega_4\alpha_1 + 2m_2\rho\Omega_3\theta + 2m_2\Omega_3\delta\theta - \eta\gamma m_2\Omega_4 - \eta\gamma\Omega_3\theta + \\
& m_2\rho\Omega_3\delta + m_2\rho\Omega_3\alpha_1 + 2m_2\Omega_3\theta\alpha_1 + m_2\rho\Omega_4\eta + m_2\Omega_4\delta\eta + 2m_2\Omega_4\theta\eta + \\
& \Omega_3\delta\theta\eta + m_2\Omega_3\alpha_1\delta + m_2^2\rho\Omega_4 + m_2^2\Omega_4\delta)V^3 + (\Omega_3\theta^2\alpha_1 + \Omega_4\theta^2\eta + \\
& + w_2\phi\eta m_2\Omega_1 + 2m_2\rho\Omega_4\theta + m_1 m_2 m_4 \Omega_3 + 2m_2\Omega_4\delta\theta - \gamma m_1 m_2\Omega_3 - \\
& - \eta\gamma\Omega_4\theta - 2m_2\Omega_5\theta\eta + \rho\Omega_4\theta\eta + \Omega_4\delta\theta\eta + m_2\rho\Omega_4\delta + \rho\Omega_3\delta\theta +
\end{aligned}$$



$$\begin{aligned}
& m_2\rho\Omega_4\alpha_1 + 2m_2\Omega_4\theta\alpha_1 + \rho\Omega_3\theta\alpha_1 + \Omega_3\delta\theta\alpha_1 + m_2\rho\Omega_5\eta + m_2\Omega_5\delta\eta + \\
& (\gamma\eta m_2\Omega_1 + m_2\Omega_4\alpha_1\delta + m_2^2\rho\Omega_5 + \rho\Omega_3\theta^2 + m_2^2\Omega_5\delta + \Omega_3\delta\theta^2)V^2 + \\
& (\Omega_4\theta^2\alpha_1 + \Omega_5\theta^2\eta + w_2\theta\eta m_2\Omega_2 + w_2\theta\eta\Omega_1\theta + 2m_2\rho\Omega_5\theta + m_1m_2m_4\Omega_4 + \\
& 2m_2\Omega_5\delta\theta - \gamma\eta\Omega_1\theta - \gamma m_1m_2\Omega_4 - \eta\gamma\Omega_5\theta + 2m_2\Omega_5\theta\alpha_1 + \rho\Omega_4\theta\alpha_1 + \Omega_4\delta\theta\alpha_1 + \\
& \rho\Omega_5\theta\eta + \Omega_5\delta\theta\eta + m_2\rho\Omega_5\delta + \rho\Omega_4\delta\theta + m_2\rho\Omega_5\alpha_1 - \gamma\eta m_2\Omega_2 + m_2\Omega_5\alpha_1\delta + \rho\Omega_4\theta^2 + \\
& \Omega_4\delta\theta^2)V + +\rho\Omega_5\theta^2 + \Omega_5\delta\theta^2 + \rho\Omega_5\delta\theta + \rho\Omega_5\theta\alpha_1 + \Omega_5\delta\theta\alpha_1 - \gamma\eta\Omega_2\theta - \gamma m_1m_2\Omega_5 + \\
& w_2\phi\eta\Omega_2\theta + \Omega_5\theta^2\alpha_1 + m_1m_2m_4\Omega_5) \left((-\eta\gamma m_2^2\Omega_3 + \eta m_2^2\Omega_3\delta + m_2^2\rho\Omega_3\eta) V^5 + \right. \\
& (m_2^2\rho\Omega_3\delta + 2m_2\rho\Omega_3\theta\eta - \eta\gamma m_2\Omega_3\delta + m_2\rho\Omega_3\delta\eta - 2\eta\gamma m_2\Omega_3\theta - \eta\gamma m_2^2\Omega_4 + \\
& \eta m_2^2\Omega_4\delta + m_2^2\rho\Omega_3\alpha_1 + m_2^2\rho\Omega_4\eta + m_2^2\Omega_3\delta\alpha_1 + 2\eta m_2\Omega_3\delta\theta)V^4 + (m_2^2\rho\Omega_4\delta + \\
& 2m_2\rho\Omega_3\theta\alpha_1 + 2m_2\rho\Omega_4\theta\eta + 2m_2\Omega_3\delta\theta\alpha_1 + m_1m_2m_4\Omega_3\eta + w_2\phi\eta m_2^2\Omega_1 - \\
& \gamma m_1m_2\Omega_3\eta - \eta\gamma m_2\Omega_4\delta - \eta\gamma\Omega_3\delta\theta + m_2\rho\Omega_3\delta\alpha_1 + m_2\rho\Omega_4\delta\eta + \rho\Omega_3\delta\theta\eta - \\
& 2\eta\gamma m_2\Omega_4\theta + 2m_2\rho\Omega_3\delta\theta - \eta\gamma\Omega_3\theta^2 - \eta\gamma m_2^2\Omega_5 + \eta m_2^2\Omega_5\delta - \gamma\eta m_2^2\Omega_1 + m_2^2\rho\Omega_4\alpha_1 + \\
& m_2^2\rho\Omega_5\eta + \rho\Omega_3\theta^2\eta + m_2^2\Omega_4\delta\alpha_1 + 2\eta m_2\Omega_4\delta\theta)V^3 + (m_2^2\rho\Omega_5\delta + \rho\Omega_3\delta\theta^2 + \\
& 2m_2\rho\Omega_5\theta\eta + 2m_2\rho\Omega_4\theta\alpha_1 + m_1m_2m_4\Omega_4\eta + w_2\phi m_1m_2m_4\Omega_3 + 2w_2\phi\eta m_2\Omega_1\theta + \\
& m_1m_2m_4\Omega_3\alpha_1 + 2m_2\Omega_4\delta\theta\alpha_1 + w_2\phi\eta m_2^2\Omega_2 - 2\eta\gamma m_2\Omega_5\theta - \gamma\eta m_2\Omega_1\alpha_1 - \\
& \gamma m_1m_2\Omega_3\alpha_1 - \gamma m_1m_2\Omega_4\eta - \eta\gamma m_2\Omega_5\delta - \eta\gamma\Omega_4\delta\theta + m_2\rho\Omega_5\delta\eta + \rho\Omega_4\delta\theta\eta + \\
& \eta_2\rho\Omega_4\delta\alpha_1 + \rho\Omega_3\delta\theta\alpha_1 - 2\gamma\eta m_2\Omega_1\theta - \gamma m_1m_2\Omega_3\theta + m_1m_2m_4\rho\Omega_3 + 2m_2\rho\Omega_4\delta\theta + \\
& w_2\theta\rho\eta m_2\Omega_1 - w_2\theta\gamma m_1m_2\Omega_3 - w_2\theta\gamma\eta m_2\Omega_1 - \eta\gamma\Omega_4\theta^2 + \eta\Omega_4\delta\theta^2 - \gamma\eta m_2^2\Omega_2 + \\
& \rho\Omega_4\theta^2\eta + m_2^2\rho\Omega_5\alpha_1 + \rho\Omega_3\theta^2\alpha_1 + m_2^2\Omega_5\delta\alpha_1 + \Omega_3\delta\theta^2\alpha_1 + 2\eta m_2\Omega_5\delta\theta)V^2 + \\
& (\rho\Omega_4\delta\theta^2 + 2m_2\rho\Omega_5\theta\alpha_1 + m_1m_2m_4\Omega_4\alpha_1 + w_2\phi m_1m_2m_4\Omega_4 + 2w_2\phi\eta m_2\Omega_2\theta + \\
& 2m_2\Omega_5\delta\theta\alpha_1 + m_1m_2m_4\Omega_5 + w_2\phi\eta\Omega_1\theta^2 - \gamma\eta m_2\Omega_2\alpha_1 - \gamma\eta\Omega_1\theta\alpha_1 - \gamma m_1m_2\Omega_4\alpha_1 - \\
& \eta\gamma\Omega_5\delta\theta - \gamma m_1m_2\Omega_5\eta + m_2\rho\Omega_5\delta\alpha_1 + \rho\Omega_4\delta\theta\alpha_1 + \rho\Omega_5\delta\theta\eta - 2\gamma\eta m_2\Omega_2\theta - \\
& \gamma m_1m_2\Omega_4\theta + m_1m_2m_4\rho\Omega_4 + 2m_2\rho\Omega_5\delta\theta + w_2\phi\eta m_2\Omega_2 + w_2\phi\eta\Omega_1\theta - \\
& w_2\theta\gamma\eta m_2\Omega_2 - w_2\phi\gamma\eta\Omega_1\theta - w_2\phi\gamma m_1m_2\Omega_4 - \eta\gamma\Omega_5\theta^2 + \eta\Omega_5\delta\theta^2 - \gamma\eta\Omega_1\theta^2 + \\
& \rho\Omega_4\theta^2\alpha_1 + \rho\Omega_5\theta^2\eta + \Omega_4\delta\theta^2\alpha_1)V) - \left((-\eta\gamma m_2^2\Omega_3 + \eta m_2^2\Omega_3\delta + m_2^2\rho\Omega_3\eta) V^5 + \right. \\
& (m_2^2\rho\Omega_3\delta + 2m_2\rho\Omega_3\theta\eta - \eta\gamma m_2\Omega_3\delta + m_2\rho\Omega_3\delta\eta - 2\eta\gamma m_2\Omega_3\theta - \eta\gamma m_2^2\Omega_4 + \\
& \eta m_2^2\Omega_4\delta + m_2^2\rho\Omega_3\alpha_1 + m_2^2\rho\Omega_4\eta + m_2^2\Omega_3\delta\alpha_1 + 2\eta m_2\Omega_3\delta\theta)V^4 + (m_2^2\rho\Omega_4\delta + \\
& \alpha_1 + 2m_2\rho\Omega_4\theta\eta + 2m_2\Omega_3\delta\theta\alpha_1 + m_1m_2m_4\Omega_3\eta + w_2\phi\eta m_2^2\Omega_1 - \\
& \eta\gamma m_2\Omega_4\delta - \eta\gamma\Omega_3\delta\theta + m_2\rho\Omega_3\delta\alpha_1 + m_2\rho\Omega_4\delta\eta + \rho\Omega_3\delta\theta\eta -
\end{aligned}$$



$$\begin{aligned}
& 2\eta\gamma m_2\Omega_4\theta + 2m_2\rho\Omega_3\delta\theta - \eta\gamma\Omega_3\theta^2 - \eta\gamma m_2^2\Omega_5 + \eta m_2^2\Omega_5\delta - \gamma\eta m_2^2\Omega_1 + m_2^2\rho\Omega_4\alpha_1 + \\
& m_2^2\rho\Omega_5\eta + \rho\Omega_3\theta^2\eta + m_2^2\Omega_4\delta\alpha_1 + 2\eta m_2\Omega_4\delta\theta) V^3 + (m_2^2\rho\Omega_5\delta + \rho\Omega_3\delta\theta^2 + \\
& 2m_2\rho\Omega_5\theta\eta + 2m_2\rho\Omega_4\theta\alpha_1 + m_1m_2m_4\Omega_4\eta + w_2\phi m_1m_2m_4\Omega_3 + 2w_2\phi\eta m_2\Omega_1\theta + \\
& m_1m_2m_4\Omega_3\alpha_1 + 2m_2\Omega_4\delta\theta\alpha_1 + w_2\phi\eta m_2^2\Omega_2 - 2\eta\gamma m_2\Omega_5\theta - \gamma\eta m_2\Omega_1\alpha_1 - \\
& \gamma m_1m_2\Omega_3\alpha_1 - \gamma m_1m_2\Omega_4\eta - \eta\gamma m_2\Omega_5\delta - \eta\gamma\Omega_4\delta\theta + m_2\rho\Omega_5\delta\eta + \rho\Omega_4\delta\theta\eta + \\
& \eta_2\rho\Omega_4\delta\alpha_1 + \rho\Omega_3\delta\theta\alpha_1 - 2\gamma\eta m_2\Omega_1\theta - \gamma m_1m_2\Omega_3\theta + m_1m_2m_4\rho\Omega_3\alpha_1 + 2m_2\rho\Omega_4\delta\theta + \\
& w_2\theta\rho\eta m_2\Omega_1 - w_2\theta\gamma m_1m_2\Omega_3 - w_2\theta\gamma\eta m_2\Omega_1 - \eta\gamma\Omega_4\theta^2 + \eta\Omega_4\delta\theta^2 - \gamma\eta m_2^2\Omega_2 + \\
& \rho\Omega_4\theta^2\eta + m_2^2\rho\Omega_5\alpha_1 + \rho\Omega_3\theta^2\alpha_1 + m_2^2\Omega_5\delta\alpha_1 + \Omega_3\delta\theta^2\alpha_1 + 2\eta m_2\Omega_5\delta\theta) V^2 + \\
& (\rho\Omega_4\delta\theta^2 + 2m_2\rho\Omega_5\theta\alpha_1 + m_1m_2m_4\Omega_4\alpha_1 + w_2\phi m_1m_2m_4\Omega_4 + 2w_2\phi\eta m_2\Omega_2\theta + \\
& 2m_2\Omega_5\delta\theta\alpha_1 + m_1m_2m_4\Omega_5 + w_2\phi\eta\Omega_1\theta^2 - \gamma\eta m_2\Omega_2\alpha_1 - \gamma\eta\Omega_1\theta\alpha_1 - \gamma m_1m_2\Omega_4\alpha_1 - \\
& \eta\gamma\Omega_5\delta\theta - \gamma m_1m_2\Omega_5\eta + m_2\rho\Omega_5\delta\alpha_1 + \rho\Omega_4\delta\theta\alpha_1 + \rho\Omega_5\delta\theta\eta - 2\gamma\eta m_2\Omega_2\theta - \\
& \gamma m_1m_2\Omega_4\theta + m_1m_2m_4\rho\Omega_4 + 2m_2\rho\Omega_5\delta\theta + w_2\phi\rho\eta m_2\Omega_2 + w_2\phi\rho\eta\Omega_1\theta - \\
& w_2\theta\gamma\eta m_2\Omega_2 - w_2\phi\gamma\eta\Omega_1\theta - w_2\phi\gamma m_1m_2\Omega_4 - \eta\gamma\Omega_5\theta^2 + \eta\Omega_5\delta\theta^2 - \gamma\eta\Omega_1\theta^2 + \\
& \rho\Omega_4\theta^2\alpha_1 + \rho\Omega_5\theta^2\eta + \Omega_4\delta\theta^2\alpha_1) V \Big)^2 - ((m_2^2\Omega_3 + m_2\Omega_3\eta) V^4 + (m_2^2\Omega_4 + \\
& m_2\Omega_3\delta + m_2\Omega_4\eta + \theta\Omega_3\eta + m_2\Omega_3\alpha_1 + m_2\rho\Omega_3 + 2m_2\Omega_3\theta) V^3 + (m_2\Omega_5 + \\
& \Omega_3\theta^2 + m_2\Omega_4\delta + \Omega_3\delta\theta + m_2\rho\Omega_4 + \rho\Omega_3\theta + \Omega_3\theta\alpha_1 + m_2\Omega_5\eta + \Omega_4\theta\eta + \\
& m_2\Omega_4\alpha_1 + 2m_2\Omega_4\theta) V^2 + (\Omega_4\theta^2 + m_2\Omega_5\delta + \Omega_4\delta\theta + m_2\rho\Omega_5 + \rho\Omega_4\theta + \\
& \Omega_4\theta\alpha_1 + \Omega_5\theta\eta + m_2\Omega_5\alpha_1 + 2m_2\Omega_5\theta) V + \Omega_5\theta\alpha_1 + \rho\Omega_5\theta + \Omega_5\delta\theta + \\
& \Omega_5\theta^2)^2 \Big((m_2^2\rho\Omega_3\delta\eta - \eta\gamma m_2^2\Omega_3\delta) V^5 + (-2\eta\gamma m_2\Omega_3\delta\theta - \eta\gamma m_2^2\Omega_4\delta + m_2^2\rho\Omega_3\delta\alpha_1 + \\
& m_2^2\rho\Omega_4\delta\eta + 2m_2\rho\Omega_3\delta\theta\eta) V^4 + (-\gamma m_1m_2\Omega_3\theta\eta - 2\eta\gamma m_2\Omega_4\delta\theta - w_2\phi\gamma\eta m_2^2\Omega_1 - \\
& \eta\gamma m_2^2\Omega_5\delta + m_2^2\rho\Omega_4\delta\alpha_1 + m_2^2\rho\Omega_5\delta\eta - \eta\gamma m_2^2\Omega_1\alpha_1 - \eta\gamma\Omega_3\delta\theta^2 + \rho\Omega_3\delta\theta^2\eta + \\
& w_2\phi\rho\eta m_2^2\Omega_1 + 2m_2\rho\Omega_3\delta\theta\alpha_1 + 2m_2\rho\Omega_4\delta\theta\eta + m_1m_2m_4\rho\Omega_3\eta) V^3 + \\
& (-2\gamma\eta m_2\Omega_1\theta\alpha_1 - \gamma m_1m_2\Omega_3\theta\alpha_1 - \gamma m_1m_2\Omega_4\theta\eta - 2\eta\gamma m_2\Omega_5\delta\theta - w_2\theta\gamma\eta m_2^2\Omega_5 - \\
& w_2\phi\gamma m_1m_2\Omega_3\theta - 2w_2\phi\gamma\eta m_2\Omega_1\theta + w_2\phi m_1m_2m_4\rho\Omega_3 + 2w_2\phi\rho\eta m_2\Omega_1\theta + \\
& \rho\Omega_4\delta\theta^2\eta + m_2^2\rho\Omega_5\delta\alpha_1 + \rho\Omega_3\delta\theta^2\alpha_1 - \eta\gamma\Omega_4\delta\theta^2 - \eta\gamma m_2^2\Omega_2\alpha_1 + 2m_2\rho\Omega_5\delta\theta\eta + \\
& \Omega_2 + m_1m_2m_4\rho\Omega_3\alpha_1 + 2m_2\rho\Omega_4\delta\theta\alpha_1 + \\
& \rho\Omega_1\eta) V^2 + (-2\gamma\eta m_2\Omega_2\theta\alpha_1 - \gamma m_1m_2\Omega_4\theta\alpha_1 - w_2\phi\gamma\eta\Omega_1\theta^2 - \\
& \Omega_5\theta\eta - 2w_2\phi\gamma\eta m_2\Omega_2\theta - w_2\phi\gamma m_1m_2\Omega_4\theta + 2w_2\phi\rho\eta m_2\Omega_2\theta +
\end{aligned}$$



$$\begin{aligned}
& w_2 \phi m_1 m_2 m_4 \rho \Omega_4 + \rho \Omega_4 \delta \theta^2 \alpha_1 + \rho \Omega_5 \delta \theta^2 \eta - \gamma \eta \Omega_1 \theta^2 \alpha_1 - \eta \gamma \Omega_5 \delta \theta^2 + w_2 \phi \rho \eta \Omega_1 \theta^2 + \\
& 2m_2 \rho \Omega_5 \delta \theta \alpha_1 + m_1 m_2 m_4 \rho \Omega_5 \eta + m_1 m_2 m_4 \rho \Omega_4 \alpha_1) V + \rho \Omega_5 \delta \theta^2 \alpha_1 - \gamma \eta \Omega_2 \theta^2 \alpha_1 - \\
& w_2 \phi \gamma m_1 m_2 \Omega_5 \theta + w_2 \phi \rho \eta \Omega_2 \theta^2 + m_1 m_2 m_4 \rho \Omega_5 \alpha_1 - w_2 \phi \gamma \eta \Omega_2 \theta^2 - \gamma m_1 m_2 \Omega_5 \theta \alpha_1 + \\
& w_2 \phi m_1 m_2 m_4 \rho \Omega_5 \Big) > 0
\end{aligned}$$

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$$\begin{aligned}
& ((m_2^2 \Omega_3 + m_2 \Omega_3 \eta) V^4 + (m_2^2 \Omega_4 + m_2 \Omega_3 \delta + m_2 \Omega_4 \eta + \theta \Omega_3 \eta + m_2 \Omega_3 \alpha_1 + \\
& m_2 \rho \Omega_3 + 2m_2 \Omega_3 \theta) V^3 + (m_2 \Omega_5 + \Omega_3 \theta^2 + m_2 \Omega_4 \delta + \Omega_3 \delta \theta + m_2 \rho \Omega_4 + \\
& \rho \Omega_3 \theta + \Omega_3 \theta \alpha_1 + m_2 \Omega_5 \eta + \Omega_4 \theta \eta + m_2 \Omega_4 \alpha_1 + 2m_2 \Omega_4 \theta) V^2 + (\Omega_4 \theta^2 + \\
& m_2 \Omega_5 \delta + \Omega_4 \delta \theta + m_2 \rho \Omega_5 + \rho \Omega_4 \theta + \Omega_4 \theta \alpha_1 + \Omega_5 \theta \eta + m_2 \Omega_5 \alpha_1 + 2m_2 \Omega_5 \theta) V + \\
& \Omega_5 \theta \alpha_1 + \rho \Omega_5 \theta + \Omega_5 \delta \theta + \Omega_5 \theta^2) (m_2^2 \Omega_3 \eta V^5 + (m_2^2 \Omega_4 \eta + m_2^2 \Omega_3 \alpha_1 - \\
& \eta \gamma m_2 \Omega_3 + m_2 \rho \Omega_3 \eta + m_2 \Omega_3 \delta \eta + 2m_2 \Omega_3 \theta \eta + m_2^2 \Omega_3 \delta + m_2^2 \rho \Omega_3) V^4 + \\
& (m_2^2 \Omega_5 \eta + \Omega_3 \theta^2 \eta + m_2^2 \Omega_4 \alpha_1 + 2m_2 \rho \Omega_3 \theta + 2m_2 \Omega_3 \delta \theta - \eta \gamma m_2 \Omega_4 - \eta \gamma \Omega_3 \theta + \\
& m_2 \rho \Omega_3 \delta + m_2 \rho \Omega_3 \alpha_1 + 2m_2 \Omega_3 \theta \alpha_1 + m_2 \rho \Omega_4 \eta + m_2 \Omega_4 \delta \eta + 2m_2 \Omega_4 \theta \eta + \\
& \rho \Omega_3 \theta \eta + \Omega_3 \delta \theta \eta + m_2 \Omega_3 \alpha_1 \delta + m_2^2 \rho \Omega_4 + m_2^2 \Omega_4 \delta) V^3 + (\Omega_3 \theta^2 \alpha_1 + \Omega_4 \theta^2 \eta + \\
& m_2^2 \Omega_5 \alpha_1 + w_2 \phi \eta m_2 \Omega_1 + 2m_2 \rho \Omega_4 \theta + m_1 m_2 m_4 \Omega_3 + 2m_2 \Omega_4 \delta \theta - \gamma m_1 m_2 \Omega_3 - \\
& \eta \gamma m_2 \Omega_5 - \eta \gamma \Omega_4 \theta - 2m_2 \Omega_5 \theta \eta + \rho \Omega_4 \theta \eta + \Omega_4 \delta \theta \eta + m_2 \rho \Omega_4 \delta + \rho \Omega_3 \delta \theta + \\
& m_2 \rho \Omega_4 \alpha_1 + 2m_2 \Omega_4 \theta \alpha_1 + \rho \Omega_3 \theta \alpha_1 + \Omega_3 \delta \theta \alpha_1 + m_2 \rho \Omega_5 \eta + m_2 \Omega_5 \delta \eta + \\
& \gamma \eta m_2 \Omega_1 + m_2 \Omega_4 \alpha_1 \delta + m_2^2 \rho \Omega_5 + \rho \Omega_3 \theta^2 + m_2^2 \Omega_5 \delta + \Omega_3 \delta \theta^2) V^2 + \\
& (\Omega_4 \theta^2 \alpha_1 + \Omega_5 \theta^2 \eta + w_2 \theta \eta m_2 \Omega_2 + w_2 \theta \eta \Omega_1 \theta + 2m_2 \rho \Omega_5 \theta + m_1 m_2 m_4 \Omega_4 + \\
& 2m_2 \Omega_5 \delta \theta - \gamma \eta \Omega_1 \theta - \gamma m_1 m_2 \Omega_4 - \eta \gamma \Omega_5 \theta + 2m_2 \Omega_5 \theta \alpha_1 + \rho \Omega_4 \theta \alpha_1 + \Omega_4 \delta \theta \alpha_1 + \\
& \rho \Omega_5 \theta \eta + \Omega_5 \delta \theta \eta + m_2 \rho \Omega_5 \delta + \rho \Omega_4 \delta \theta + m_2 \rho \Omega_5 \alpha_1 - \gamma \eta m_2 \Omega_2 + m_2 \Omega_5 \alpha_1 \delta + \rho \Omega_4 \theta^2 + \\
& \Omega_4 \delta \theta^2) V + + \rho \Omega_5 \theta^2 + \Omega_5 \delta \theta^2 + \rho \Omega_5 \delta \theta + \rho \Omega_5 \theta \alpha_1 + \Omega_5 \delta \theta \alpha_1 - \gamma \eta \Omega_2 \theta - \gamma m_1 m_2 \Omega_5 + \\
& w_2 \phi \eta \Omega_2 \theta + \Omega_5 \theta^2 \alpha_1 + m_1 m_2 m_4 \Omega_5) ((-\eta \gamma m_2^2 \Omega_3 + \eta m_2^2 \Omega_3 \delta + m_2^2 \rho \Omega_3 \eta) V^5 + \\
& (m_2^2 \rho \Omega_3 \delta + 2m_2 \rho \Omega_3 \theta \eta - \eta \gamma m_2 \Omega_3 \delta + m_2 \rho \Omega_3 \delta \eta - 2\eta \gamma m_2 \Omega_3 \theta - \eta \gamma m_2^2 \Omega_4 + \\
& m_2^2 \rho \Omega_3 \alpha_1 + m_2^2 \rho \Omega_4 \eta + m_2^2 \Omega_3 \delta \alpha_1 + 2\eta \gamma m_2 \Omega_3 \delta \theta) V^4 + (m_2^2 \rho \Omega_4 \delta + \\
& \alpha_1 + 2m_2 \rho \Omega_4 \theta \eta + 2m_2 \Omega_3 \delta \theta \alpha_1 + m_1 m_2 m_4 \Omega_3 \eta + w_2 \phi \eta m_2^2 \Omega_1 - \\
& \eta - \eta \gamma m_2 \Omega_4 \delta - \eta \gamma \Omega_3 \delta \theta + m_2 \rho \Omega_3 \delta \alpha_1 + m_2 \rho \Omega_4 \delta \eta + \rho \Omega_3 \delta \theta \eta -
\end{aligned}$$



$$\begin{aligned}
& 2\eta\gamma m_2\Omega_4\theta + 2m_2\rho\Omega_3\delta\theta - \eta\gamma\Omega_3\theta^2 - \eta\gamma m_2^2\Omega_5 + \eta m_2^2\Omega_5\delta - \gamma\eta m_2^2\Omega_1 + m_2^2\rho\Omega_4\alpha_1 + \\
& m_2^2\rho\Omega_5\eta + \rho\Omega_3\theta^2\eta + m_2^2\Omega_4\delta\alpha_1 + 2\eta m_2\Omega_4\delta\theta) V^3 + (m_2^2\rho\Omega_5\delta + \rho\Omega_3\delta\theta^2 + \\
& 2m_2\rho\Omega_5\theta\eta + 2m_2\rho\Omega_4\theta\alpha_1 + m_1m_2m_4\Omega_4\eta + w_2\phi m_1m_2m_4\Omega_3 + 2w_2\phi\eta m_2\Omega_1\theta + \\
& m_1m_2m_4\Omega_3\alpha_1 + 2m_2\Omega_4\delta\theta\alpha_1 + w_2\phi\eta m_2^2\Omega_2 - 2\eta\gamma m_2\Omega_5\theta - \gamma\eta m_2\Omega_1\alpha_1 - \\
& \gamma m_1m_2\Omega_3\alpha_1 - \gamma m_1m_2\Omega_4\eta - \eta\gamma m_2\Omega_5\delta - \eta\gamma\Omega_4\delta\theta + m_2\rho\Omega_5\delta\eta + \rho\Omega_4\delta\theta\eta + \\
& \eta_2\rho\Omega_4\delta\alpha_1 + \rho\Omega_3\delta\theta\alpha_1 - 2\gamma\eta m_2\Omega_1\theta - \gamma m_1m_2\Omega_3\theta + m_1m_2m_4\rho\Omega_3\alpha_1 + 2m_2\rho\Omega_4\delta\theta + \\
& w_2\theta\rho\eta m_2\Omega_1 - w_2\theta\gamma m_1m_2\Omega_3 - w_2\theta\gamma\eta m_2\Omega_1 - \eta\gamma\Omega_4\theta^2 + \eta\Omega_4\delta\theta^2 - \gamma\eta m_2^2\Omega_2 + \\
& \rho\Omega_4\theta^2\eta + m_2^2\rho\Omega_5\alpha_1 + \rho\Omega_3\theta^2\alpha_1 + m_2^2\Omega_5\delta\alpha_1 + \Omega_3\delta\theta^2\alpha_1 + 2\eta m_2\Omega_5\delta\theta) V^2 + \\
& (\rho\Omega_4\delta\theta^2 + 2m_2\rho\Omega_5\theta\alpha_1 + m_1m_2m_4\Omega_4\alpha_1 + w_2\phi m_1m_2m_4\Omega_4 + 2w_2\phi\eta m_2\Omega_2\theta + \\
& 2m_2\Omega_5\delta\theta\alpha_1 + m_1m_2m_4\Omega_5 + w_2\phi\eta\Omega_1\theta^2 - \gamma\eta m_2\Omega_2\alpha_1 - \gamma\eta\Omega_1\theta\alpha_1 - \gamma m_1m_2\Omega_4\alpha_1 - \\
& \eta\gamma\Omega_5\delta\theta - \gamma m_1m_2\Omega_5\eta + m_2\rho\Omega_5\delta\alpha_1 + \rho\Omega_4\delta\theta\alpha_1 + \rho\Omega_5\delta\theta\eta - 2\gamma\eta m_2\Omega_2\theta - \\
& \gamma m_1m_2\Omega_4\theta + m_1m_2m_4\rho\Omega_4 + 2m_2\rho\Omega_5\delta\theta + w_2\phi\rho\eta m_2\Omega_2 + w_2\phi\rho\eta\Omega_1\theta - \\
& w_2\theta\gamma\eta m_2\Omega_2 - w_2\phi\gamma\eta\Omega_1\theta - w_2\phi\gamma m_1m_2\Omega_4 - \eta\gamma\Omega_5\theta^2 + \eta\Omega_5\delta\theta^2 - \gamma\eta\Omega_1\theta^2 + \\
& \rho\Omega_4\theta^2\alpha_1 + \rho\Omega_5\theta^2\eta + \Omega_4\delta\theta^2\alpha_1) V > ((-\eta\gamma m_2^2\Omega_3 + \eta m_2^2\Omega_3\delta + m_2^2\rho\Omega_3\eta) V^5 + \\
& (m_2^2\rho\Omega_3\delta + 2m_2\rho\Omega_3\theta\eta - \eta\gamma m_2\Omega_3\delta + m_2\rho\Omega_3\delta\eta - 2\eta\gamma m_2\Omega_3\theta - \eta\gamma m_2^2\Omega_4 + \\
& \eta m_2^2\Omega_4\delta + m_2^2\rho\Omega_3\alpha_1 + m_2^2\rho\Omega_4\eta + m_2^2\Omega_3\delta\alpha_1 + 2\eta m_2\Omega_3\delta\theta) V^4 + (m_2^2\rho\Omega_4\delta + \\
& 2m_2\rho\Omega_3\theta\alpha_1 + 2m_2\rho\Omega_4\theta\eta + 2m_2\Omega_3\delta\theta\alpha_1 + m_1m_2m_4\Omega_3\eta + w_2\phi\eta m_2^2\Omega_1 - \\
& \gamma m_1m_2\Omega_3\eta - \eta\gamma m_2\Omega_4\delta - \eta\gamma\Omega_3\delta\theta + m_2\rho\Omega_3\delta\alpha_1 + m_2\rho\Omega_4\delta\eta + \rho\Omega_3\delta\theta\eta - \\
& 2\eta\gamma m_2\Omega_4\theta + 2m_2\rho\Omega_3\delta\theta - \eta\gamma\Omega_3\theta^2 - \eta\gamma m_2^2\Omega_5 + \eta m_2^2\Omega_5\delta - \gamma\eta m_2^2\Omega_1 + m_2^2\rho\Omega_4\alpha_1 + \\
& m_2^2\rho\Omega_5\eta + \rho\Omega_3\theta^2\eta + m_2^2\Omega_4\delta\alpha_1 + 2\eta m_2\Omega_4\delta\theta) V^3 + (m_2^2\rho\Omega_5\delta + \rho\Omega_3\delta\theta^2 + \\
& 2m_2\rho\Omega_5\theta\eta + 2m_2\rho\Omega_4\theta\alpha_1 + m_1m_2m_4\Omega_4\eta + w_2\phi m_1m_2m_4\Omega_3 + 2w_2\phi\eta m_2\Omega_1\theta + \\
& m_1m_2m_4\Omega_3\alpha_1 + 2m_2\Omega_4\delta\theta\alpha_1 + w_2\phi\eta m_2^2\Omega_2 - 2\eta\gamma m_2\Omega_5\theta - \gamma\eta m_2\Omega_1\alpha_1 - \\
& \gamma m_1m_2\Omega_3\alpha_1 - \gamma m_1m_2\Omega_4\eta - \eta\gamma m_2\Omega_5\delta - \eta\gamma\Omega_4\delta\theta + m_2\rho\Omega_5\delta\eta + \rho\Omega_4\delta\theta\eta + \\
& \eta_2\rho\Omega_4\delta\alpha_1 + \rho\Omega_3\delta\theta\alpha_1 - 2\gamma\eta m_2\Omega_1\theta - \gamma m_1m_2\Omega_3\theta + m_1m_2m_4\rho\Omega_3\alpha_1 + 2m_2\rho\Omega_4\delta\theta + \\
& w_2\theta\rho\eta m_2\Omega_1 - w_2\theta\gamma m_1m_2\Omega_3 - w_2\theta\gamma\eta m_2\Omega_1 - \eta\gamma\Omega_4\theta^2 + \eta\Omega_4\delta\theta^2 - \gamma\eta m_2^2\Omega_2 + \\
& \rho\Omega_4\theta^2\eta + m_2^2\rho\Omega_5\alpha_1 + \rho\Omega_3\theta^2\alpha_1 + m_2^2\Omega_5\delta\alpha_1 + \Omega_3\delta\theta^2\alpha_1 + 2\eta m_2\Omega_5\delta\theta) V^2 + \\
& + 2m_2\rho\Omega_5\theta\alpha_1 + m_1m_2m_4\Omega_4\alpha_1 + w_2\phi m_1m_2m_4\Omega_4 + 2w_2\phi\eta m_2\Omega_2\theta + \\
& \alpha_1 + m_1m_2m_4\Omega_5 + w_2\phi\eta\Omega_1\theta^2 - \gamma\eta m_2\Omega_2\alpha_1 - \gamma\eta\Omega_1\theta\alpha_1 - \gamma m_1m_2\Omega_4\alpha_1 - \\
& - \gamma m_1m_2\Omega_5\eta + m_2\rho\Omega_5\delta\alpha_1 + \rho\Omega_4\delta\theta\alpha_1 + \rho\Omega_5\delta\theta\eta - 2\gamma\eta m_2\Omega_2\theta -
\end{aligned}$$



$$\begin{aligned}
& \gamma m_1 m_2 \Omega_4 \theta + m_1 m_2 m_4 \rho \Omega_4 + 2 m_2 \rho \Omega_5 \delta \theta + w_2 \phi \rho \eta m_2 \Omega_2 + w_2 \phi \rho \eta \Omega_1 \theta - \\
& w_2 \theta \gamma \eta m_2 \Omega_2 - w_2 \phi \gamma \eta \Omega_1 \theta - w_2 \phi \gamma m_1 m_2 \Omega_4 - \eta \gamma \Omega_5 \theta^2 + \eta \Omega_5 \delta \theta^2 - \gamma \eta \Omega_1 \theta^2 + \\
& \rho \Omega_4 \theta^2 \alpha_1 + \rho \Omega_5 \theta^2 \eta + \Omega_4 \delta \theta^2 \alpha_1) V \Big)^2 + ((m_2^2 \Omega_3 + m_2 \Omega_3 \eta) V^4 + (m_2^2 \Omega_4 + \\
& m_2 \Omega_3 \delta + m_2 \Omega_4 \eta + \theta \Omega_3 \eta + m_2 \Omega_3 \alpha_1 + m_2 \rho \Omega_3 + 2 m_2 \Omega_3 \theta) V^3 + (m_2 \Omega_5 + \\
& \Omega_3 \theta^2 + m_2 \Omega_4 \delta + \Omega_3 \delta \theta + m_2 \rho \Omega_4 + \rho \Omega_3 \theta + \Omega_3 \theta \alpha_1 + m_2 \Omega_5 \eta + \Omega_4 \theta \eta + \\
& m_2 \Omega_4 \alpha_1 + 2 m_2 \Omega_4 \theta) V^2 + (\Omega_4 \theta^2 + m_2 \Omega_5 \delta + \Omega_4 \delta \theta + m_2 \rho \Omega_5 + \rho \Omega_4 \theta + \\
& \Omega_4 \theta \alpha_1 + \Omega_5 \theta \eta + m_2 \Omega_5 \alpha_1 + 2 m_2 \Omega_5 \theta) V + \Omega_5 \theta \alpha_1 + \rho \Omega_5 \theta + \Omega_5 \delta \theta + \\
& \Omega_5 \theta^2 (m_2^2 \Omega_3 + m_2 \Omega_3 \eta) V^4 + (m_2^2 \Omega_4 + m_2 \Omega_3 \delta + m_2 \Omega_4 \eta + \theta \Omega_3 \eta + m_2 \Omega_3 \alpha_1 + \\
& m_2 \rho \Omega_3 + 2 m_2 \Omega_3 \theta) V^3 + (m_2 \Omega_5 + \Omega_3 \theta^2 + m_2 \Omega_4 \delta + \Omega_3 \delta \theta + m_2 \rho \Omega_4 + \\
& \rho \Omega_3 \theta + \Omega_3 \theta \alpha_1 + m_2 \Omega_5 \eta + \Omega_4 \theta \eta + m_2 \Omega_4 \alpha_1 + 2 m_2 \Omega_4 \theta) V^2 + (\Omega_4 \theta^2 + \\
& m_2 \Omega_5 \delta + \Omega_4 \delta \theta + m_2 \rho \Omega_5 + \rho \Omega_4 \theta + \Omega_4 \theta \alpha_1 + \Omega_5 \theta \eta + m_2 \Omega_5 \alpha_1 + 2 m_2 \Omega_5 \theta) V + \\
& \Omega_5 \theta \alpha_1 + \rho \Omega_5 \theta + \Omega_5 \delta \theta + \Omega_5 \theta^2)^2 (m_2^2 \rho \Omega_3 \delta \eta - \eta \gamma m_2^2 \Omega_3 \delta) V^5 + (-2 \eta \gamma m_2 \Omega_3 \delta \theta - \\
& \eta \gamma m_2^2 \Omega_4 \delta + m_2^2 \rho \Omega_3 \delta \alpha_1 + m_2^2 \rho \Omega_4 \delta \eta + 2 m_2 \rho \Omega_3 \delta \theta \eta) V^4 + (-\gamma m_1 m_2 \Omega_3 \theta \eta - \\
& 2 \eta \gamma m_2 \Omega_4 \delta \theta - w_2 \phi \gamma \eta m_2^2 \Omega_1 - \eta \gamma m_2^2 \Omega_5 \delta + m_2^2 \rho \Omega_4 \delta \alpha_1 + m_2^2 \rho \Omega_5 \delta \eta - \gamma \eta m_2^2 \Omega_1 \alpha_1 - \\
& \eta \gamma \Omega_3 \delta \theta^2 + \rho \Omega_3 \delta \theta^2 \eta + w_2 \phi \rho \eta m_2^2 \Omega_1 + 2 m_2 \rho \Omega_3 \delta \theta \alpha_1 + 2 m_2 \rho \Omega_4 \delta \theta \eta + \\
& m_1 m_2 m_4 \rho \Omega_3 \eta) V^3 + (-2 \gamma \eta m_2 \Omega_1 \theta \alpha_1 - \gamma m_1 m_2 \Omega_3 \theta \alpha_1 - \gamma m_1 m_2 \Omega_4 \theta \eta - \\
& 2 \eta \gamma m_2 \Omega_5 \delta \theta - w_2 \theta \gamma \eta m_2^2 \Omega_5 - w_2 \phi \gamma m_1 m_2 \Omega_3 \theta - 2 w_2 \phi \gamma \eta m_2 \Omega_1 \theta + \\
& w_2 \phi m_1 m_2 m_4 \rho \Omega_3 + 2 w_2 \phi \rho \eta m_2 \Omega_1 \theta + \rho \Omega_4 \delta \theta^2 \eta + m_2^2 \rho \Omega_5 \delta \alpha_1 + \rho \Omega_3 \delta \theta^2 \alpha_1 - \\
& \eta \gamma \Omega_4 \delta \theta^2 - \gamma \eta m_2^2 \Omega_2 \alpha_1 + 2 m_2 \rho \Omega_5 \delta \theta \eta + w_2 \phi \rho \eta m_2^2 \Omega_2 + m_1 m_2 m_4 \rho \Omega_3 \alpha_1 + \\
& 2 m_2 \rho \Omega_4 \delta \theta \alpha_1 + m_1 m_2 m_4 \rho \Omega_1 \eta) V^2 + (-2 \gamma \eta m_2 \Omega_2 \theta \alpha_1 - \gamma m_1 m_2 \Omega_4 \theta \alpha_1 - \\
& w_2 \phi \gamma \eta \Omega_1 \theta^2 - \gamma m_1 m_2 \Omega_5 \theta \eta - 2 w_2 \phi \gamma \eta m_2 \Omega_2 \theta - w_2 \phi \gamma m_1 m_2 \Omega_4 \theta + \\
& 2 w_2 \phi \rho \eta m_2 \Omega_2 \theta + w_2 \phi m_1 m_2 m_4 \rho \Omega_4 + \rho \Omega_4 \delta \theta^2 \alpha_1 + \rho \Omega_5 \delta \theta^2 \eta - \gamma \eta \Omega_1 \theta^2 \alpha_1 - \\
& \eta \gamma \Omega_5 \delta \theta^2 + w_2 \phi \rho \eta \Omega_1 \theta^2 + 2 m_2 \rho \Omega_5 \delta \theta \alpha_1 + m_1 m_2 m_4 \rho \Omega_5 \eta + m_1 m_2 m_4 \rho \Omega_4 \alpha_1) V + \\
& \rho \Omega_5 \delta \theta^2 \alpha_1 - \gamma \eta \Omega_2 \theta^2 \alpha_1 - w_2 \phi \gamma m_1 m_2 \Omega_5 \theta + w_2 \phi \rho \eta \Omega_2 \theta^2 + m_1 m_2 m_4 \rho \Omega_5 \alpha_1 - \\
& w_2 \phi \gamma \eta \Omega_2 \theta^2 - \gamma m_1 m_2 \Omega_5 \theta \alpha_1 + w_2 \phi m_1 m_2 m_4 \rho \Omega_5)
\end{aligned}$$

maka



$$b_3^2 - b_1^2 b_4 > 0$$

Optimization Software:
www.balesio.com

LAMPIRAN 6. Simulasi numerik model dengan kontrol konstan

```
function fixpointplot_UEVM
clc;
clear all;

t=0:0.1:1825;
initial_u=10000;
initial_e=1000;
initial_v=100;
initial_m=10;

[t,x]=ode45(@uevm,t,[initial_u;initial_e;initial_v;initial_m,]);

plot(t,x(:,1), 'g', t,x(:,2), 'red', t,x(:,3), 'blue', t,x(:,4), 'black',
'LineWidth',1)
legend('Pengangguran (U)', 'Pekerja non Migran (E)', 'Lowongan Kerja
(V)', 'Pekerja Migran (M)')
xlabel('Waktu (hari)');
ylabel('Populasi');
hold on
grid off

function dxdt=uevm(t,x)

Alpha = 500;
k = 0.000009;
m4 = 0.1;
gama = 0.00001;
alpha1 = 0.004;
alpha2 = 0.005;
m2 = 0.00002;
psi = 0.007;
delta = 0.05;
m1 = 100;
m3 = 0.05;
w1=0.2;
w2=0.8;

dxdt_1=Alpha-(1+w1)*k*x(1)*x(3)+m4*x(4)+gama*x(2)-alpha1*x(1)
dxdt_2=(1+w1)*k*x(1)*x(3)-gama*x(2)+m2*x(4)*x(3)-alpha2*x(2)
dxdt_3=w2*psi*x(1)-delta*x(3)+m4*x(4)+gama*x(2)
dxdt_4=m1-m2*x(4)*x(3)-m4*x(4)-m3*x(4)

dxdt=[dxdt_1;dxdt_2;dxdt_3;dxdt_4];
```



LAMPIRAN 7. Simulasi numerik model dengan kontrol optimal dan tanpa kontrol

- Program utama :

```
clear all;
close all;
clc;

format long;

global A B C Alpha k m4 gama alpha1 alpha2 m2 psi delta m1 m3

ptf =[0; 0; 0; 0];
x0 = [10000; 1000; 100; 10];

% Nilai parameter diketahui
Alpha = 500;
k = 0.000009;
m4 = 0.1;
gama = 0.00001;
alpha1 = 0.004;
alpha2 = 0.005;
m2 = 0.00002;
psi = 0.007;
delta = 0.05;
m1 = 100;
m3 = 0.05;

A = 25; %Bobot Kontrol U
B = 5; %Bobot Kontrol w1
C = 5; %Bobot Kontrol w2

% time span:
Nt=1000;
tf =1825; % Waktu akhir(waktu proporsional)
Tu=linspace(0,tf,Nt);
%batas kontrol:
M1=0.2;
M2=0.8;
nv=2; % jumlah kontrol
Lb=M1.*ones(nv,Nt); % matrix batas bawah
Ub=M2.*ones(nv,Nt); % matrix batas atas
```



meter SD:
9;

```

u=zeros(nv,Nt);
options = odeset('AbsTol',1e-2,'RelTol',1e-2);
[Tx, X] = ode23s(@(t,x) state_UEVM2(t, x, u, Tu), Tu, x0,
options);
% -----
H_norm_lama=inf;
langkah(1)=1000;

for it = 1:10

    % Forward
    options = odeset('AbsTol',1e-2,'RelTol',1e-2);
    [Tx1, X1] = ode23s(@(t,x) state_UEVM2(t, x, u, Tu), Tu, x0,
options);

    options = odeset('AbsTol',1e-2,'RelTol',1e-2);
    [Tp, P] = ode23s(@(t, p) costate_UEVM2(t, p, u, Tu, X1),
fliplr(Tu), ptf, options);

    % Menghitung gradien H
    dH = gradH_UEVM2(X1, P, u);
    H_norm=norm(dH,2);
    % Menghitung fungsi objektif
    J = objektif_UEVM2(X1, u, Tu);
    if H_norm < eps
        % Nilai fungsi objektif
        Jopt=J;
        Uopt=u;
        break;
    else
        grad=dH/norm(dH,2);
        langkah(it)=15000;
        newu=u-langkah(ki)*grad;
        newu=simplebounds_UEVM2(newu,Lb,Ub);

        [Tx1, X1] = ode23s(@(t,x) state_UEVM2(t, x, newu, Tu), Tu,
x0, options);

        Jbaru= objektif_UEVM2(X1, newu, Tu);
        eror(ki)=abs(Jbaru-J);

        j=1;
        while eror(ki)>eps
            j=j+1;
            langkah(ki)=langkah(ki)*(0.5);
            newu=u-langkah(ki)*dH;
            newu=simplebounds_UEVM2(newu,Lb,Ub);
            [Tx1, X1] = ode23s(@(t,x) state_UEVM2(t, x, newu, Tu),
Tu, x0, options);

            Jbaru= objektif_UEVM2(X1, newu, Tu);
            eror(ki)=abs(Jbaru-J);

            disp(['eror: ',num2str(eror(ki))])
    end
end

```



```

        if j>30
            break
        end
    end

    u=newu;
    u=simplebounds_UEVM2(u,Lb,Ub);
    disp(['norm(dH,2): ',num2str(norm(dH,2))])
end;

eror(ki)=abs(Jbaru-J);
end

options = odeset('AbsTol',1e-2,'RelTol',1e-3);
[Tx1, X1] = ode23s(@(t,x) state_UEVM2(t, x, u, Tu), Tu, x0,
options);

figure(1)
plot(Tx, X(:, 1), '-r');
hold on
plot(Tx1, X1(:, 1), '--b');
xlabel('Waktu (hari)');
ylabel ('Pengangguran (U)');
legend('model tanpa kontrol','model dengan kontrol');
set(gcf,'color','w')

figure(2)
plot(Tx, X(:, 2), '-r');
hold on
plot(Tx1, X1(:, 2), '--b');
xlabel('Waktu (hari)');
ylabel ('Pekerja Non Migran(E)');
legend('model tanpa kontrol','model dengan kontrol');
set(gcf,'color','w')

figure(3)
plot(Tx, X(:, 3), '-r');
hold on
plot(Tx1, X1(:, 3), '--b');
xlabel('waktu (hari)');
ylabel ('Lowongan Kerja(V)');
legend('model tanpa kontrol','model dengan kontrol');
set(gcf,'color','w')

figure(4);
plot(Tx, X(:,4), '-r', 'LineWidth', 1);
hold on
plot(Tx1, X1(:,4), '--b');
xlabel('waktu (hari)');
ylabel ('Pekerja Migran (M)');
legend('model tanpa kontrol','model dengan kontrol');
set(gcf,'color','w')

```



5)
(121)

```

plot(Tu, u(1,:),'-r');
xlabel('waktu (hari)');
ylabel('w_1^(t)');
set(gcf,'color','w')
subplot(122)
plot(Tu, u(2,:),'--b');
xlabel('waktu (hari)');
ylabel('w_2^(t)');
set(gcf,'color','w')

```

- **Subprogram1: Fungsi state**

```

function dx = state_UEMV2(t, x, u, Tu)

global A B C Alpha k m4 gama alphal alpha2 m2 psi delta m1 m3

dx = zeros (4,1);

u1 = u(1,:);
u2 = u(2,:);
u1 = interp1(Tu, u1', t);
u2 = interp1(Tu, u2', t);

dx(1) = Alpha-(1+u1)*k*x(1).*x(3)+m4*x(4)+gama*x(2)-alphal*x(1);
dx(2) = (1+u1)*k*x(1).*x(3)-alpha2*x(2)-gama*x(2)+m2*x(4).*x(3);
dx(3) = u2*psi*x(1)-delta*x(3)+m4*x(4)+gama*x(2);
dx(4) = m1-m2*x(4).*x(3)-m4*x(4)-m3*x(4);

end

```

- **Subprogram2: Fungsi costate**

```

function dp = costate_UEMV2(t, p, u, Tu, X)

global A B C Alpha k m4 gama alphal alpha2 m2 psi delta m1 m3
dp = zeros(4, 1);

% Backward
x1 = X(:, 1);
x2 = X(:, 2);
x3 = X(:, 3);
x4 = X(:, 4);

% Interpolasi variabel state
x1 = interp1(Tu, x1, t);
x2 = interp1(Tu, x2, t);
x3 = interp1(Tu, x3, t);
x4 = interp1(Tu, x4, t);

u1 = u(1,:);
u2 = u(2,:);
u1 = interp1(Tu, u1', t);

```



```

u2 = interp1(Tu, u2', t);

dp(1) = -A-p(1)*(-(1+u1)*k*x3-alpha1)-p(2)*(1+u1)*k*x3-
p(3)*u2*psi;
dp(2) = -p(1)*gama-p(2)*(-alpha2-gama)-p(3)*gama;
dp(3) = -p(1)*(-(1+u1)*k*x1)-
p(2)*((1+u1)*k*x1+m2*x4)+p(3)*delta+p(4)*m2*x4;
dp(4) = -p(1)*m4-p(2)*m2*x3-p(3)*m4-p(4)*(-x3*m2-m3-m4);
end

```

- **Subprogram3: Fungsi tujuan**

```

function J = objektif_UEVM2(X, u, Tu)

global A B C

x1 = X(:,1);

u1 = u(1,:);
u2 = u(2,:);

J=A*x1+(B/2)*u1'.^2+(C/2)*u2'.^2;

J = trapz(Tu, J);

end

```

- **Subprogram4: Fungsi kontrol**

```

function dH = gradH_UEVM2(X, P, u)

global A B C Alpha k m4 gama alpha1 alpha2 m2 psi delta m1 m3

u1 = u(1,:);
u2 = u(2,:);

x1 = X(:, 1)';
x2 = X(:, 2)';
x3 = X(:, 3)';
x4 = X(:, 4)';

p1 = P(:, 1)';
p2 = P(:, 2)';
p3 = P(:, 3)';
p4 = P(:, 4)';

***1. *x2.*k.*p2-x1.*x2.*k.*p1+B*u1;
1.*psi.*p3+C*u2;
dH2];

```



- **Subprogram5: fungsi batas untuk u**

```
function s=simplebounds_UEVM2(s,Lb,Ub)

% untuk batas atas
ns_tmp=s;
I=ns_tmp<Lb;
ns_tmp(I)=Lb(I);

% untuk batas bawah
J=ns_tmp>Ub;
ns_tmp(J)=Ub(J);

% update u
s=ns_tmp;

end
```



LAMPIRAN 8. Simulasi numerik model dengan kontrol konstan, kontrol optimal dan tanpa kontrol

• Program Utama

```
clear all;
close all;
clc;

format long;

global A B C Alpha k m4 gama alpha1 alpha2 m2 psi delta m1 m3 w1
w2

ptf =[0; 0; 0; 0];
x0 = [10000; 1000; 100; 10];

% Nilai parameter diketahui

Alpha = 500;
k = 0.000009;
m4 = 0.1;
gama = 0.00001;
alpha1 = 0.004;
alpha2 = 0.005;
m2 = 0.00002;
psi = 0.007;
delta = 0.05;
m1 = 100;
m3 = 0.05;
w1=0.2;
w2=0.8;

% interval waktu:
Nt=1000;
tf =1825; % Waktu akhir(waktu proporsional)
Tu=linspace(0,tf,Nt);

%batas kontrol:
M1=0.2;
M2=0.8;
nv=2; % jumlah kontrol
Lb=M1.*ones(nv,Nt); % matrix batas bawah
ub=ones(nv,Nt); % matrix batas atas

% Fletcher Steepest Descent:
%
```



```

% -----
u=zeros(nv,Nt);
options = odeset('AbsTol',1e-2,'RelTol',1e-2);
[Tx, X] = ode23s(@(t,x) state_UEVM2(t, x, u, Tu), Tu, x0,
options);
% -----

H_norm_lama=inf;
langkah(1)=1000;

for it = 1:10

    % Forward
    options = odeset('AbsTol',1e-2,'RelTol',1e-2);
    [Tx1, X1] = ode23s(@(t,x) state_UEVM2(t, x, u, Tu), Tu, x0,
options);
    % Backward
    options = odeset('AbsTol',1e-2,'RelTol',1e-2);
    [Tp, P] = ode23s(@(t, p) costate_UEVM2(t, p, u, Tu, X1),
fliplr(Tu), ptf, options);

    % Menghitung gradien H
    dH = gradH_UEVM2(X1, P, u);
    H_norm=norm(dH,2);

    % Menghitung fungsi objektif
    J = objektif_UEVM2(X1, u, Tu);

    if H_norm < eps
        % Nilai fungsi objektif
        Jopt=J;
        Uopt=u;

        break;
    else
        grad=dH/norm(dH,2);
        langkah(it)=15000;
        newu=u-langkah(ki)*grad;
        newu=simplebounds_UEVM2(newu,Lb,Ub);

        [Tx1, X1] = ode23s(@(t,x) state_UEVM2(t, x, newu, Tu), Tu,
x0, options);

        Jbaru= objektif_UEVM2(X1, newu, Tu);
        eror(ki)=abs(Jbaru-J);

        j=1;
        while eror(ki)>eps
            j=j+1;
            langkah(ki)=langkah(ki)*(0.5);
            newu=u-langkah(ki)*dH;
            newu=simplebounds_UEVM2(newu,Lb,Ub);
            [Tx1, X1] = ode23s(@(t,x) state_UEVM2(t, x, newu, Tu),
options);
    end
end

```



```

Jbaru= objektif_UEVM2(X1, newu, Tu);
eror(ki)=abs(Jbaru-J);

disp(['eror: ',num2str(eror(ki))])

if j>30
    break
end

u=newu;
u=simplebounds_UEVM2(u,Lb,Ub);
disp(['norm(dH,2): ',num2str(norm(dH,2))])

end;

eror(ki)=abs(Jbaru-J);
end

options = odeset('AbsTol',1e-2,'RelTol',1e-3);
[Tx1, X1] = ode23s(@(t,x) state_UEVM2(t, x, u, Tu), Tu, x0,
options);

t=0:0.1:1825;
initial_u=10000;
initial_e=1000;
initial_v=100;
initial_m=10;

[t,x]=ode45(@fixpointplot_uevm_gabung,t,[initial_u;initial_e;initial_v;initial_m,]);

figure(1)
plot(Tx, X(:, 1), '-r','Linewidth',1.5);
hold on
plot(Tx1, X1(:, 1), '--b','Linewidth',1.5);
hold on
plot (t,x(:,1), '-m','Linewidth',1.5);
xlabel('Waktu (hari)');
ylabel ('Pengangguran (U)');
%title('Jumlah Pengangguran (U)');
legend('model tanpa kontrol','model dengan kontrol','kontrol konstan');
%color,'w')

2)
    X(:, 2), '-r','Linewidth',1.5);

```



```

hold on
plot(Tx1, X1(:, 2), '--b', 'Linewidth', 1.5);
hold on
plot (t,x(:,2), '-m', 'Linewidth', 1.5);
xlabel ('Waktu (hari)');
ylabel ('Pekerja Non Migran(E)');
%title('Pekerja Non Migran (E)');
legend('model tanpa kontrol','model dengan kontrol','kontrol konstan');
set (gcf,'color','w')

figure(3)
plot(Tx, X(:, 3), '-r', 'Linewidth', 1.5);
hold on
plot(Tx1, X1(:, 3), '--b', 'Linewidth', 1.5);
hold on
plot (t,x(:,3), '-m', 'Linewidth', 1.5);
xlabel ('waktu (hari)');
ylabel ('Lowongan Kerja(V)');
%title('Jumlah Lowongan Kerja (V)');
legend('model tanpa kontrol','model dengan kontrol','kontrol konstan');
set (gcf,'color','w')

figure(4);
plot(Tx, X(:,4), '-r', 'LineWidth', 1.5);
hold on
plot(Tx1, X1(:,4), '--b', 'Linewidth', 1.5);
hold on
plot (t,x(:,4), '-m', 'Linewidth', 1.5);
xlabel ('waktu (hari)');
ylabel ('Pekerja Migran (M)');
%title('Jumlah Pekerja Migrasi (M)');
legend('model tanpa kontrol','model dengan kontrol','kontrol konstan');
set (gcf,'color','w')

figure(5)
subplot(121)
plot(Tu, u(1,:),'-r');
xlabel ('waktu (hari)');
ylabel ('w_1^(t)');
set (gcf,'color','w')
subplot(122)
plot(Tu, u(2,:),'--b');
xlabel ('waktu (hari)');
ylabel ('w_2^(t)');
set (gcf,'color','w')

```



- **Subprogram1: Fungsi state**

```

function dx = state_UEVM2(t, x, u, Tu)

global A B C Alpha k m4 gama alpha1 alpha2 m2 psi delta m1 m3

dx = zeros (4,1);

u1 = u(1,:);
u2 = u(2,:);
u1 = interp1(Tu, u1', t);
u2 = interp1(Tu, u2', t);

dx(1) = Alpha-(1+u1)*k*x(1).*x(3)+m4*x(4)+gama*x(2)-alpha1*x(1);
dx(2) = (1+u1)*k*x(1).*x(3)-alpha2*x(2)-gama*x(2)+m2*x(4).*x(3);
dx(3) = u2*psi*x(1)-delta*x(3)+m4*x(4)+gama*x(2);
dx(4) = m1-m2*x(4).*x(3)-m4*x(4)-m3*x(4);

end

```

- **Subprogram2: Fungsi costate**

```

function dp = costate_UEVM2(t, p, u, Tu, X)

global A B C Alpha k m4 gama alpha1 alpha2 m2 psi delta m1 m3
dp = zeros(4, 1);

% Backward
x1 = X(:, 1);
x2 = X(:, 2);
x3 = X(:, 3);
x4 = X(:, 4);

% Interpolasi variabel state
x1 = interp1(Tu, x1, t);
x2 = interp1(Tu, x2, t);
x3 = interp1(Tu, x3, t);
x4 = interp1(Tu, x4, t);

u1 = u(1,:);
u2 = u(2,:);
u1 = interp1(Tu, u1', t);
u2 = interp1(Tu, u2', t);

-A-p(1)*(-(1+u1)*k*x3-alpha1)-p(2)*(1+u1)*k*x3-
*psi;
-p(1)*gama-p(2)*(-alpha2-gama)-p(3)*gama;

```



```

dp(3) = -p(1)*(-(1+u1)*k*x1)-
p(2)*((1+u1)*k*x1+m2*x4)+p(3)*delta+p(4)*m2*x4;
dp(4) = -p(1)*m4-p(2)*m2*x3-p(3)*m4-p(4)*(-x3*m2-m3-m4);
end

```

- **Subprogram3: Fungsi tujuan**

```

function J = objektif_UEVM2(X, u, Tu)

global A B C

x1 = X(:,1);

u1 = u(1,:);
u2 = u(2,:);

J=A*x1+(B/2)*u1'.^2+(C/2)*u2'.^2;

J = trapz(Tu, J);

end

```

- **Subprogram4: Fungsi kontrol**

```

function dH = gradH_UEVM2(X, P, u)

global A B C Alpha k m4 gama alpha1 alpha2 m2 psi delta m1 m3

u1 = u(1,:);
u2 = u(2,:);

x1 = X(:, 1)';
x2 = X(:, 2)';
x3 = X(:, 3)';
x4 = X(:, 4)';

p1 = P(:, 1)';
p2 = P(:, 2)';
p3 = P(:, 3)';
p4 = P(:, 4)';

dH1 = x1.*x2.*k.*p2-x1.*x2.*k.*p1+B*u1;
dH2 = x1.*psi.*p3+C*u2;

dH=[dH1; dH2];

end

```



Subprogram5: fungsi batas untuk u

```
s=simplebounds_UEVM2(s,Lb,Ub)
```

```

% untuk batas atas
ns_tmp=s;
I=ns_tmp<Lb;
ns_tmp(I)=Lb(I);

% untuk batas bawah
J=ns_tmp>Ub;
ns_tmp(J)=Ub(J);

% update u
s=ns_tmp;

end

```

- **Subprogram6: fungsi kontrol konstan**

```

function dxdt=fixpointplot_uevm_gabung(t,x)

global Alpha k m4 gama alpha1 alpha2 m2 psi delta m1 m3 w1 w2

dxdt_1=Alpha-(1+w1)*k*x(1)*x(3)+m4*x(4)+gama*x(2)-alpha1*x(1)
dxdt_2=(1+w1)*k*x(1)*x(3)-gama*x(2)+m2*x(4)*x(3)-alpha2*x(2)
dxdt_3=w2*psi*x(1)-delta*x(3)+m4*x(4)+gama*x(2)
dxdt_4=m1-m2*x(4)*x(3)-m4*x(4)-m3*x(4)

dxdt=[dxdt_1;dxdt_2;dxdt_3;dxdt_4];
end

```

