Here are some examples of equations.

$$
\begin{aligned}
L &= 2\pi\rho a_0 bU\left(U\theta - \dot{h} + (\frac{a_0}{2} - a_1)\dot{\theta}\right)C(i\omega) \\
&+ \pi\rho a_0^2 b\left(U\dot{\theta} - \ddot{h} - a_1\ddot{\theta}\right)
\end{aligned}
\tag{1}
$$

That one was nice, but these are better.

$$
\begin{aligned}
\dot{\phi} &= \psi_2 + g_1\theta + h_3 v, \tag{2}\\
\dot{\psi}_2 &= -g_0\psi_2 + g_2\theta - C_f sign(\dot{\phi}), \tag{3}\\
\dot{\theta} &= v \tag{4}
\end{aligned}
$$

Oh, and don't forget...

$$
\begin{aligned}
\dot{V}(x) &= \phi\psi_2 + g_1\phi\theta + h_3\phi v - g_0\psi_2^2 + g_2\psi_2\theta + m\theta v \\
&= \begin{bmatrix} \phi \\ \psi_2 \\ \theta \end{bmatrix}^T \begin{bmatrix} 0 & 1/2 & g_1/2 \\ 1/2 & -g_0 & g_2/2 \\ g_1/2 & g_2/2 & 0 \end{bmatrix} \begin{bmatrix} \phi \\ \psi_2 \\ \theta \end{bmatrix} + \begin{bmatrix} h_3 & 0 & m \end{bmatrix} \begin{bmatrix} \phi \\ \psi_2 \\ \theta \end{bmatrix} v
\end{aligned}
\tag{5}
$$

which is a Lyapunov equation. This next one is my favorite.

$$
v = \begin{cases} \left(c_0 + \frac{a+\sqrt{a^2+b^2}}{b}\right)b & \text{if} \quad \gamma \neq 0 \\ 0 & \text{if} \quad \gamma = 0 \end{cases},
\tag{6}
$$

And finally,

$$
\begin{aligned}
\begin{bmatrix} \dot{\phi} \\ \ddot{\phi} \end{bmatrix} &= \begin{bmatrix} 0 & 1 \\ 0 & -b_a/J_a \end{bmatrix}\begin{bmatrix} \phi \\ \dot{\phi} \end{bmatrix} + \begin{bmatrix} 0 \\ l/J_a \end{bmatrix}N \\
y &= \begin{bmatrix} 1 & 0 \end{bmatrix}\begin{bmatrix} \phi \\ \dot{\phi} \end{bmatrix} + \begin{bmatrix} 0 \end{bmatrix}N
\end{aligned}
\tag{7}
$$

This is how you would reference a particular equation, say (5), in the text. This is how you would write math in the text, $E = mc^2$.