Linearization:

1. \[ \frac{dx}{dt} = u \cdot \sin\left(\frac{\pi}{2} \cdot x\right) + 5 \]

   operating point: \( u_{\text{op}} = 2 \), \( x_{\text{op}} = 1 \)

   Linearized equation:

   \[
   \frac{dx}{dt} = \left( u_{\text{op}} \cdot \sin\left(\frac{\pi}{2} \cdot x_{\text{op}}\right) + 5 \right) + \left( u_{\text{op}} \cdot \cos\left(\frac{\pi}{2} \cdot x_{\text{op}}\right) \frac{\pi}{2} \right) \cdot (x - x_{\text{op}}) + \sin\left(\frac{\pi}{2} \cdot x_{\text{op}}\right) \cdot (u - u_{\text{op}})
   \]

   \[ \frac{dx}{dt} = 5 + u \]

2. \[ \frac{dx}{dt} = -x \cdot y + 5 \]

   \[ \frac{dy}{dt} = 3 \cdot x^2 + 6 \cdot y \]

   operating point: steady state

   \[
   0 = -x_{\text{ss}} \cdot y_{\text{ss}} + 5
   \]

   \[
   0 = 3 \cdot x_{\text{ss}}^2 + 6 \cdot y_{\text{ss}}
   \]

   solving for steady states: \( x_{\text{ss}} = \frac{1}{\sqrt[3]{10}} \), \( y_{\text{ss}} = \frac{1}{2} \cdot \left(\sqrt[3]{10}\right)^2 \)

   linearized system:

   \[
   \frac{dx}{dt} = -y_{\text{ss}} \cdot (x - x_{\text{ss}}) - x_{\text{ss}} \cdot (y - y_{\text{ss}})
   \]

   \[
   \frac{dy}{dt} = (6 \cdot x_{\text{ss}}) \cdot (x - x_{\text{ss}}) + 6 \cdot (y - y_{\text{ss}})
   \]

   or

   \[
   \frac{dx}{dt} = \frac{1}{2} \cdot \left(\sqrt[3]{10}\right)^2 \cdot x - 10 - \frac{3}{\sqrt[3]{10}} \cdot y
   \]

   \[
   \frac{dy}{dt} = 6 \cdot \left(\sqrt[3]{10} \cdot x - \left(\frac{3}{\sqrt[3]{10}}\right)^2 \right) + 6 \cdot y
   \]
3. Given: \( \frac{dz}{dt} = 5z - z\sqrt{u} \)

and the linearized equation is given by: \( \frac{dz}{dt} = z + u + \alpha \)

The general linearized equation around the operating points are:

\[
\frac{dz}{dt} = \left(5z_{op} - z_{op}\sqrt{u_{op}}\right) + \left(5 - \sqrt{u_{op}}\right)(z - z_{op}) + \left(\frac{z_{op}}{2\sqrt{u_{op}}}\right)(u - u_{op})
\]

to match given linearized equation,

\[
5 - \sqrt{u_{op}} = 1 \quad \text{or} \quad u_{op} = 16
\]

\[
\frac{z_{op}}{2\sqrt{u_{op}}} = 1 \quad \text{or} \quad z_{op} = 8
\]

thus,

\[
\frac{dz}{dt} = -16 + z + u
\]

or

\[
\alpha = -16
\]