2 Calculate the linear state space matrices **A**, **B**, **C**, and **D** for a system that is described by the following state equations, for deviations from $\mathbf{u}_{op} = [-1, \ -1]^T$, $\mathbf{x}_{op} = [1, \ 1, \ 0]^T$, and $\mathbf{y}_{op} = [0]$.

$$\dot{x}_1 = x_2^2 - \cos x_3$$
$$\dot{x}_2 = (1 + x_1 x_2) x_3$$
$$\dot{x}_3 = x_1 (u_1 + x_2)$$
$$y = (x_1 - 1) u_2$$

[*6 pts*]

3 A linear system is described by its transfer function $T(s) = \dfrac{s-1}{s^2 + 6s + 5}$.

3.1 Derive the time-domain expression for the unit step response of this system. [*5 pts*]

3.2 Sketch the unit step response of this system over 3 times the longer of the two time constants. [*4 pts*]

4 A linear system is described by its transfer function $T(s) = \dfrac{18 + 59.1s - 3s^2}{(s^2 + 0.3s + 9)(20 + s)}$.

4.1 Draw the Bode magnitude and phase angle plots of $T(j\omega)$ on the attached *EdS* graph paper for $0.03 \leq \omega \leq 30$. [*23 pts*]

4.2 Transfer the frequency response from the Bode plot to the adjacent logarithmic complex plane. Mark $\omega = 0.1$, 0.4, 3, and 10 on the frequency response. [*7 pts*]