1. The following differential equation describes the dynamics of skeletal muscle:

\[ Ky(t) + B \frac{dy(t)}{dt} + M \frac{d^2y(t)}{dt^2} = u(t). \]

where \( y(t) \) is the output, \( K \) is a spring constant, \( B \) is a dashpot viscosity constant, and \( M \) is a mass, and \( u(t) \) is the input. Let \( B = 2M \) and \( K = 4M \).

(a) Find the natural frequency and damping ratio of this system. Is the system overdamped, underdamped, or critically damped?

(b) Find the poles of this system and plot the pole-zero diagram.

(c) Assume the system is initially relaxed and the input is \( u(t) = q(t) \). Find the output \( y(t) \) for this case.

2. Let \( H(s) = \frac{5}{s+5} \) for a system. Find the frequency response \( H(j\omega) \) for this system. Plot the magnitude and phase of \( H(j\omega) \).

3. Let \( H(s) = \frac{5}{s+5} \) for a system. Find the steady state response of the system to the input \( u(t) = 3 - \sin(0.5t + 0.5) \).

4. The figure below shows a model of an incubator temperature control system. In this system \( x(t) \) is the desired temperature and \( y(t) \) is the actual temperature. \( G1(s), G2(s), \) and \( H1(s) \) model the heater, the subject, and the sensor. Let

\[ G1(s) = \frac{a}{s + a}, \quad G2(s) = \frac{b}{s + b}, \quad H1(s) = K. \]

Assume \( a, b, \) and \( K \) are positive, real constants with \( a > b \). Find the equivalent \( H(s) \) for this system in terms of \( a, b, \) and \( K \). Simplify and write in standard form.