

Problem Class on Observer-Based Control

A system is described by the two differential equations

$$\frac{dq}{dt} + q - 2u + aw = 0$$

and

$$\frac{dw}{dt} - bq + 4u = 0$$

where q and w are functions of time, u is the control input, q is the measured output variable, a and b are constants.

1. Convert the above equations into an equivalent state space form.
2. Discuss the stability of the system with zero control input.
3. For which values of a and b is the system:
 - (a) reachable?
 - (b) observable?
4. Suppose $a = b = 1$. Use the separation principle to derive the state feedback and observer gains for a dynamic output feedback controller that places all the poles of the closed-loop system at -1 .