1. Consider the following unity feedback control system

\[ P(s) = \frac{1}{(s + 2)(s + 4)} \quad C(s) = \frac{K}{s} \]

(a) Compute the closed loop transfer function between the reference input, \( r(t) \), and the plant output \( y(t) \).

(b) Sketch a Bode plot for the loop transfer function \( L(s) = P(s)C(s) \).

(c) Using either the Nyquist criterion or a root locus plot, determine the largest gain, \( K_{\text{max}} \), for which the closed loop system is stable.

(d) Compute a minimal state space realization for the closed loop system.

(e) Design a full state feedback compensator that places the poles of the system at \( -1, -1, -1 \).

2. (a) Define complete controllability and complete observability for a state space system.

(b) True or false: controllability is invariant under state feedback.

(c) True or false: observability is invariant under state feedback.

(d) True or false: controllability is invariant under output feedback.

(e) True or false: observability is invariant under output feedback.