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ECE-320, Quiz #9

1) Consider the following state variable model

$$\dot{q}(t) = \begin{bmatrix} 0 & 1 \\ 1 & 1 \end{bmatrix} q(t) + \begin{bmatrix} 0 \\ 2 \end{bmatrix} u(t)$$
$$y(t) = \begin{bmatrix} 3 & 0 \end{bmatrix} q(t)$$

Assume state variable feedback of the form $u(t) = G_{pf} r(t) - Kq(t)$ The closed loop transfer function for this system is which of the following?

a) $G(s) = \dfrac{-6G_{pf}}{s(s-1+2k_2)-2k_1+1}$ b) $G(s) = \dfrac{6G_{pf}}{s(s-1+2k_2)-2k_1+1}$

c) $G(s) = \dfrac{6G_{pf}}{s(s-1+2k_2)+2k_1-1}$ d) $G(s) = \dfrac{-6G_{pf}}{s(s-1+2k_2)+2k_1-1}$

2) Consider the following state variable model

$$\dot{q}(t) = \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix} q(t) + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u(t)$$
$$y(t) = \begin{bmatrix} 1 & 0 \end{bmatrix} q(t)$$

Assume state variable feedback of the form $u(t) = G_{pf} r(t) - Kq(t)$ Is the closed loop transfer function for this system equal to

$$G(s) = \frac{G_{pf}}{s+1+k_1}$$

a) yes b) no

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3) Is the following system ***controllable***?

$$G(s) = \frac{8G_{pf}}{s^2 + 12s + (k_1 + k_2 + 20)}$$

a) Yes b) No c) impossible to determine

4) Is the following system **controllable**?

$$G(s) = \frac{G_{pf}}{s^2 + (k_2 + k_1 - 1)s + (k_2 + 2)}$$

a) Yes b) No c) impossible to determine

5) A system with state variable feedback has the following transfer function

$$G(s) = \frac{G_{pf}}{(s - k_1 k_2)^2}$$

Is the system controllable?

a) Yes b) No c) impossible to determine

6) Consider a plant that is unstable but is a controllable system. Is it possible to use state variable feedback to make this system stable?

a) Yes b) No

7) Is it possible for a system with state variable feedback to change the zeros of the plant (other than by pole-zero cancellation) ?

a) Yes b) No

8) Is it possible for a system with state variable feedback to introduce zeros into the closed loop system?

a) Yes b) No

9) If a plant has *n* poles, then a system with state variable feedback with no pole-zero cancellations will have

a) more than *n* poles b) less than *n* poles c) n poles d) it is not possible to tell

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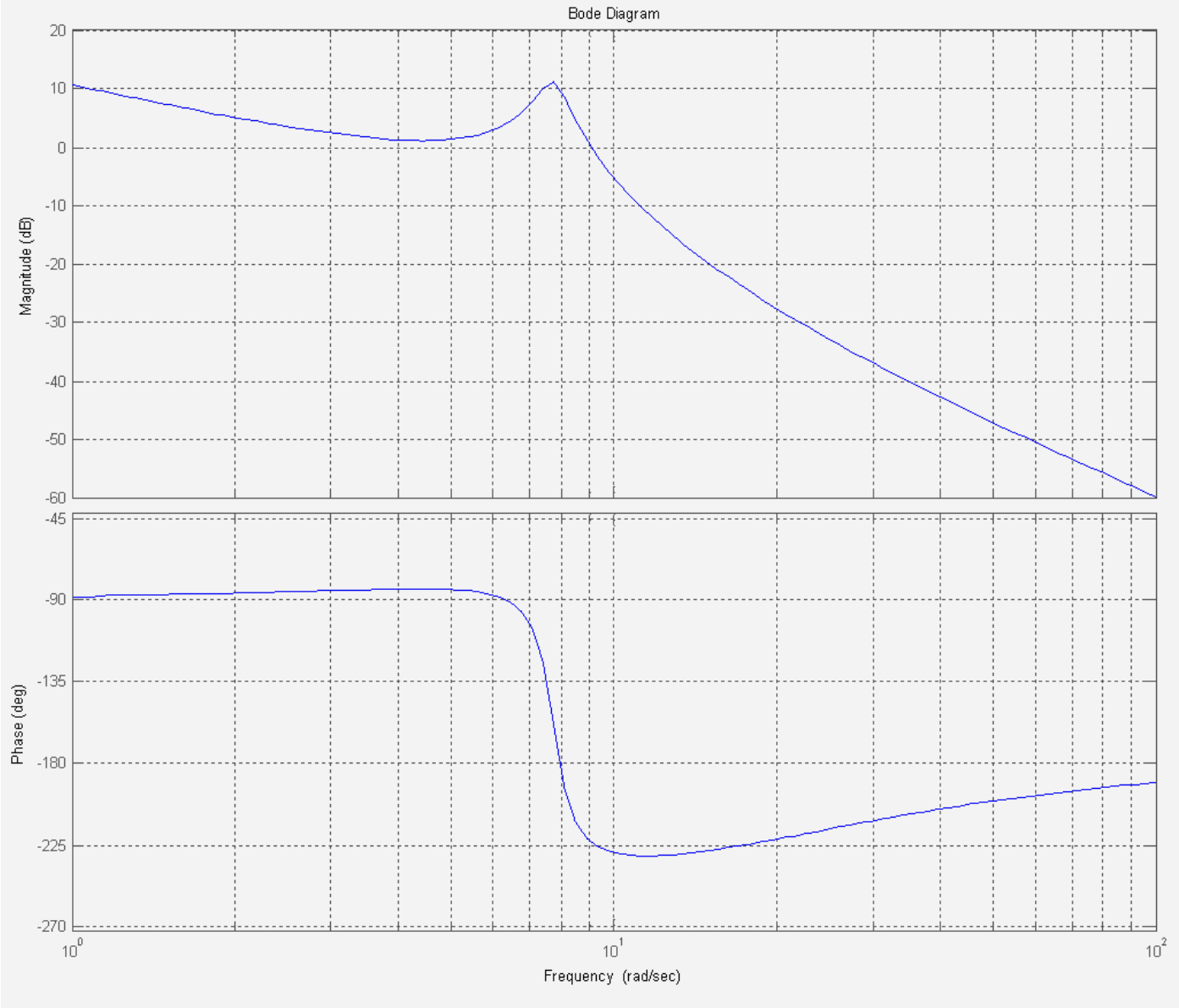
Problems 10-13 refer to the following open loop Bode plot of $G(s)H(s)$. The frequency range is from 1 to 100 radians/sec.



10) The *gain crossover frequency used to determine the phase margin* for this system is best estimated as

a) 9 rad/sec b) 8 rad/sec c) 7.5 rad/sec d) 1 rad/sec e) 10 rad/sec

11) The *phase crossover frequency* for this system is best estimated as

a) 9 rad/sec b) 8 rad/sec c) 7.5 rad/sec d) 1 rad/sec e) 10 rad/sec

12) The phase margin for this system is best estimated as

a) $+45^o$ b) -45^o c) $+135^o$ d) -135^o

13) The gain margin for this system is best estimated as

a) +10 dB b) - 10 dB b) ∞ dB c) 7 dB