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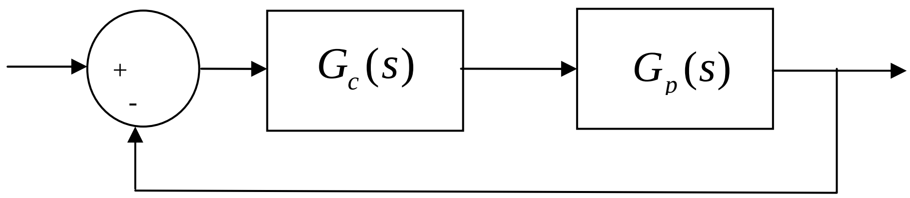
**ECE-320, Quiz #9**

**1)** Consider the following control system with plant $G_p(s) = \frac{1}{s+1}$ and PI controller $G_c(s) = \frac{k(s+z)}{s}$




Using the Routh array, we can conclude which of the following:

a) $k > 0$ b) $kz > 0$ c) $k > 0$ and $kz > 0$ d) $k > -1$ and $kz > 0$ e) none of these

**2)** Consider the characteristic equation $\Delta(s) = s^3 + ks^2 + 2s + 3$. Using the Routh-Hurwitz array, we can determine the system is stable for

a) all $k > 0$ b) no value of $k$ c) $0 < k < 1.5$ d) $k > 1.5$

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**3)** Consider the characteristic equation $\Delta(s) = 4s^4 + 3s^3 + ks^2 + s + 3$. Using the Routh-Hurwitz array, we can determine the system is stable for

a) all $k > 0$  b) no value of $k$  c) $k > 31/3$  d) $k > 4/3$

**4)** Assuming we have a characteristic equation that leads to the following Routh array:

$$\begin{array}{llll} s^4 & 1 & 2 & 1 \\ s^3 & 1 & 2 & \\ s^2 & 0 & 1 & \\ s^1 & & & \\ s^0 & & & \end{array}$$

Is this system stable?  a) yes  b) no  c) I don't really care

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**Problems** 5-8 refer to a characteristic equation that leads to the following Routh array

| | | | |
|---|---|---|---|
| $s^5$ | 1 | 3 | 2 |
| $s^4$ | 1 | 3 | 2 |
| $s^3$ | 0 | 0 | |
| $s^2$ | $\alpha$ | $\beta$ | |
| $s^1$ | | | |
| $s^0$ | | | |

**5)** One of the factors of $\Delta(s)$ is

a) $s^4 + 3s^3 + 2s$ b) $s^3 + 3s^2 + 2s$ c) $s^5 + 3s^3 + 2s$ d) none of these

**6)** We should replace the row of zeros with which of the following rows

a) 1 3 b) 4 3 c) 4 6 d) none of these

**7)** The value of $\alpha$ is a) 1 b) 0 c) 9/2 d) 3/2 e) none of these

**8)** The value of $\beta$ is a) 0 b) 1 c) 2 d) 3 e) none of these

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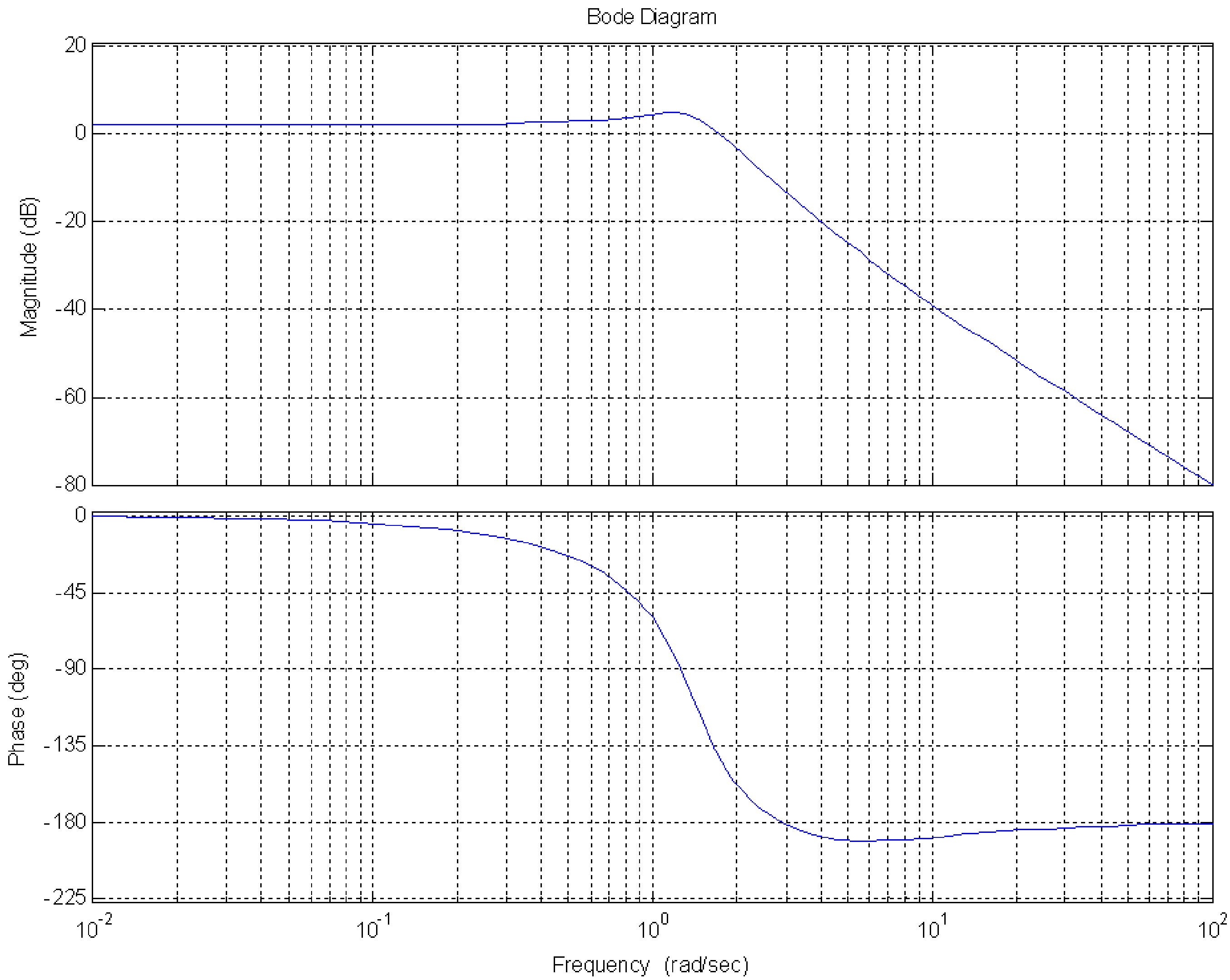
Problems 9-12 refer to the following open loop Bode plot of $G(s)H(s)$




**9)** The *gain crossover frequency used to determine the phase margin* for this system is best estimated as
a) 0 rad/sec  b) 1 rad/sec  c) 1.8 rad/sec  d) 12 rad/sec  e) 100 rad/sec

**10)** The *phase crossover frequency* for this system is best estimated as
a) 0 rad/sec  b) 1.8 rad/sec  c) 3 rad/sec  d) 30 rad/sec  e) 100 rad/sec

**11)** The phase margin for this system is best estimated as
a) $+45^o$  b) $-45^o$  c) $+135^o$  d) $-135^o$

**12)** The gain margin for this system is best estimated as
a) +12 dB  b) - 12 dB  c) $\infty$ dB  d) -2 dB

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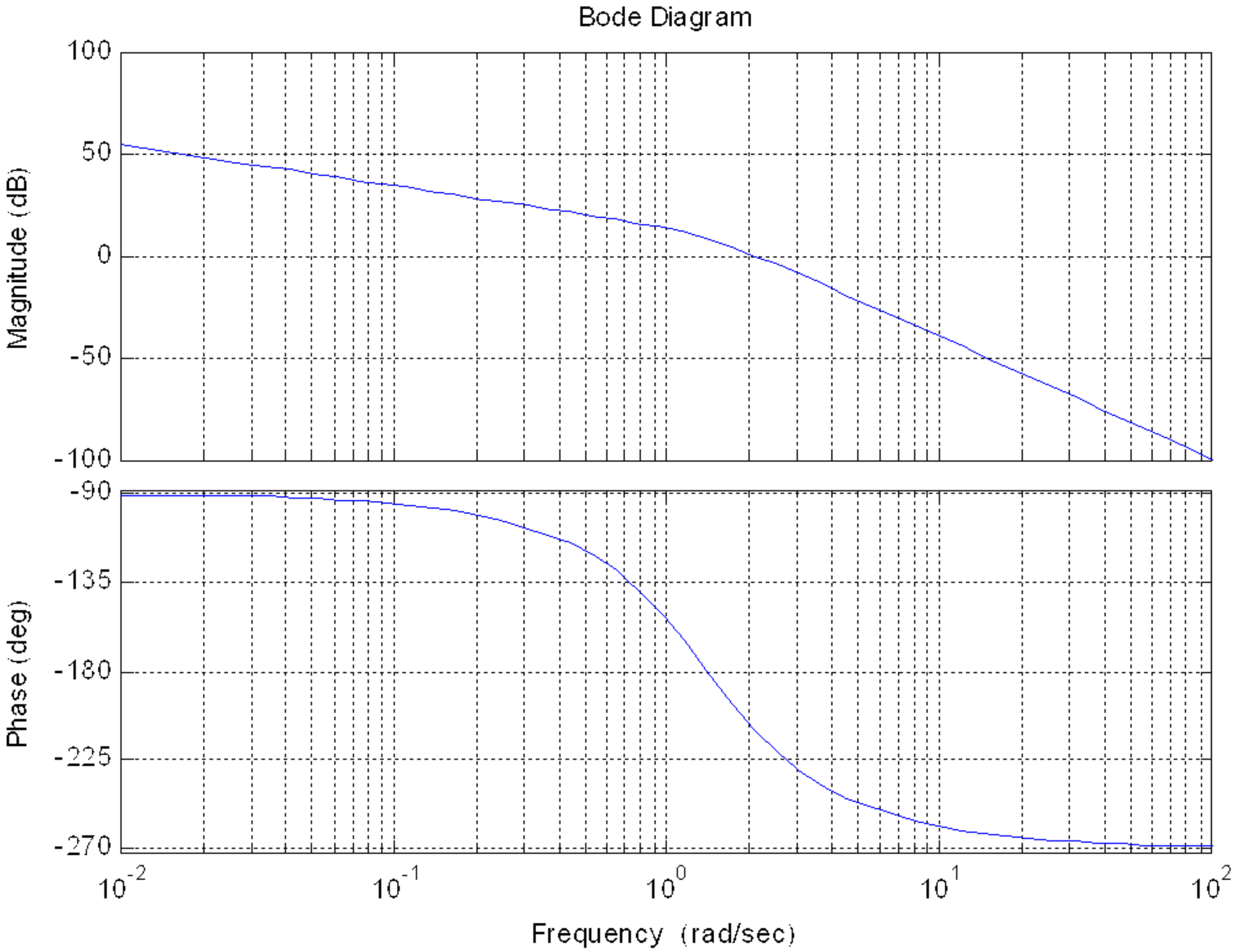
Problems 13-16 refer to the following open loop Bode plot of $G(s)H(s)$




**13)** The *gain crossover frequency used to determine the phase margin* for this system is best estimated as
a) 0 rad/sec b) 1 rad/sec c) 1.5 rad/sec d) 2 rad/sec e) 100 rad/sec

**14)** The *phase crossover frequency* for this system is best estimated as
a) 0 rad/sec b) 1 rad/sec c) 1.5 rad/sec d) 2 rad/sec e) 100 rad/sec

**15)** The phase margin for this system is best estimated as
a) $+30^o$ b) $-30^o$ c) $+60^o$ d) $-60^o$

**16)** The gain margin for this system is best estimated as
a) +5 dB b) - 5 dB c) $\infty$ dB d) 0 dB

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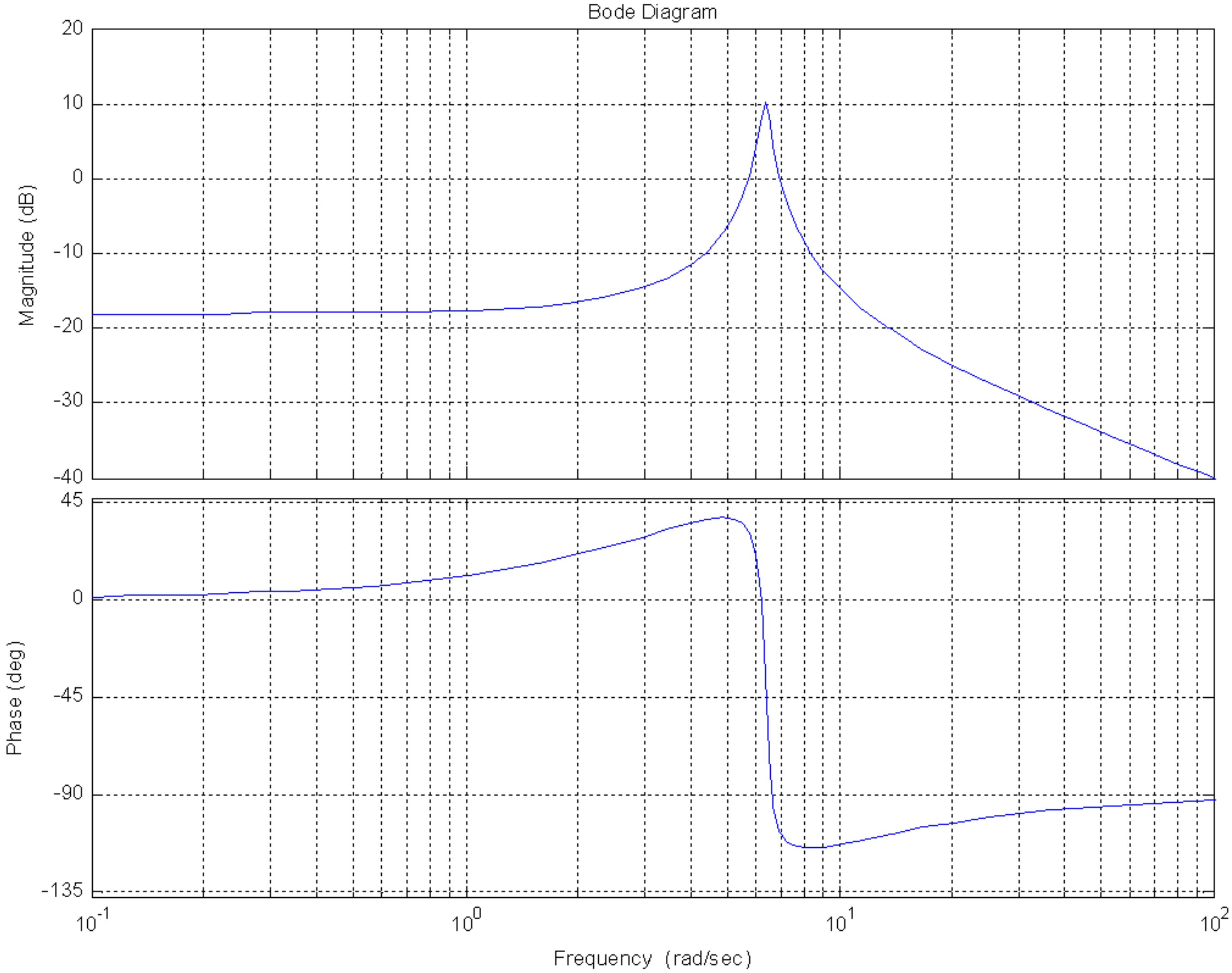
Problems 17-20 refer to the following open loop Bode plot of $G(s)H(s)$




**17)** The *gain crossover frequency used to determine the phase margin* for this system is best estimated as
a) 0 rad/sec b) 5.5 rad/sec c) 7 rad/sec d) 15 rad/sec

**18)** The *phase crossover frequency* for this system is best estimated as
a) 0 rad/sec b) 1 rad/sec c) 1.5 rad/sec d) 2 rad/sec e) none of these

**19)** The phase margin for this system is best estimated as
a) $+70^o$ b) $-70^o$ c) $+135^o$ d) $-135^o$

**20)** The gain margin for this system is best estimated as
a) +5 dB b) - 5 dB c) $\infty$ dB d) 0 dB

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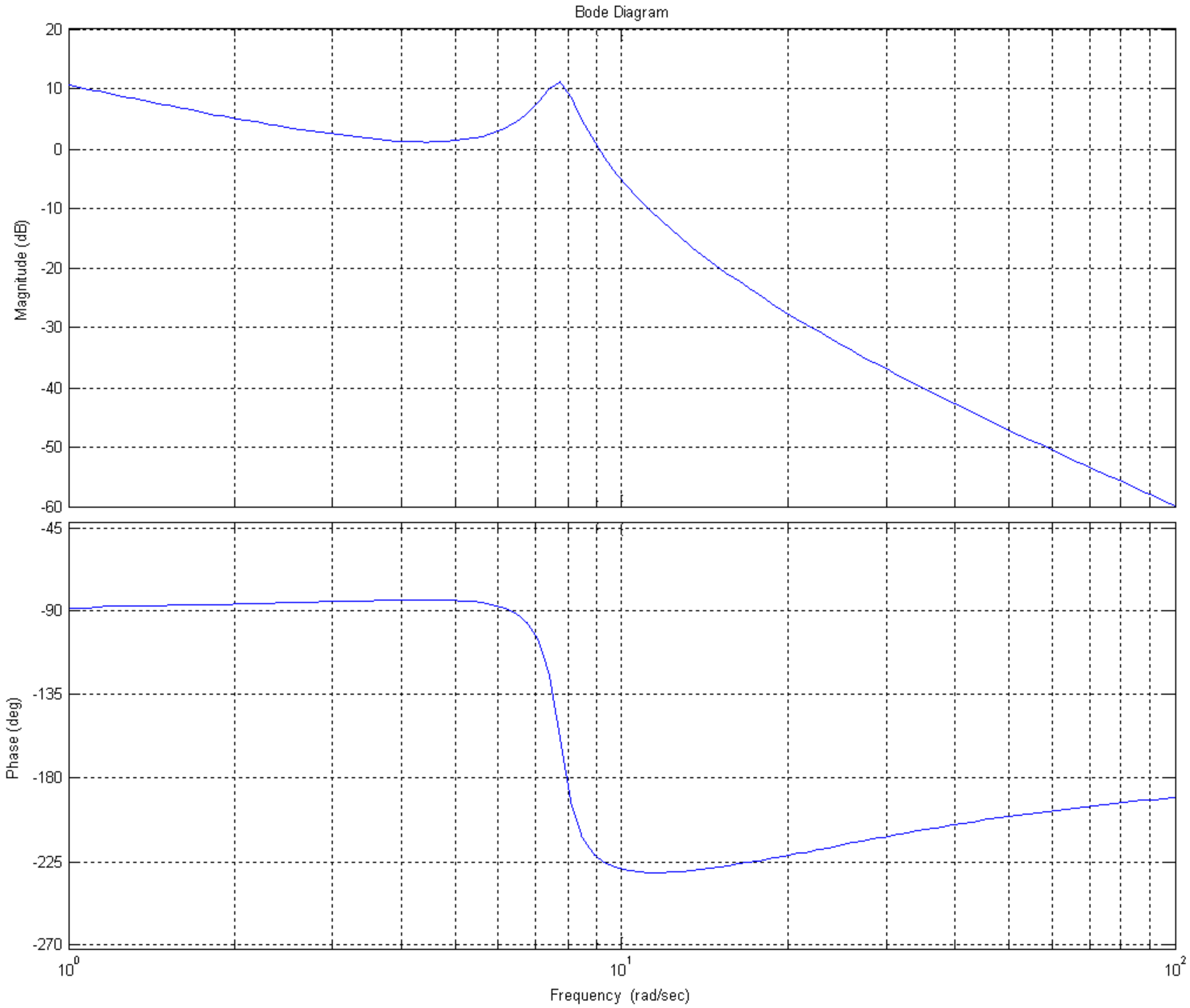
Problems 21-24 refer to the following open loop Bode plot of $G(s)H(s)$ . The frequency range is from 1 to 100 radians/sec.




**21)** 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

**22)** 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

**23)** The phase margin for this system is best estimated as

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

**24)** The gain margin for this system is best estimated as

a) +10 dB  b) - 10 dB  b) $\infty$ dB  c) 7 dB