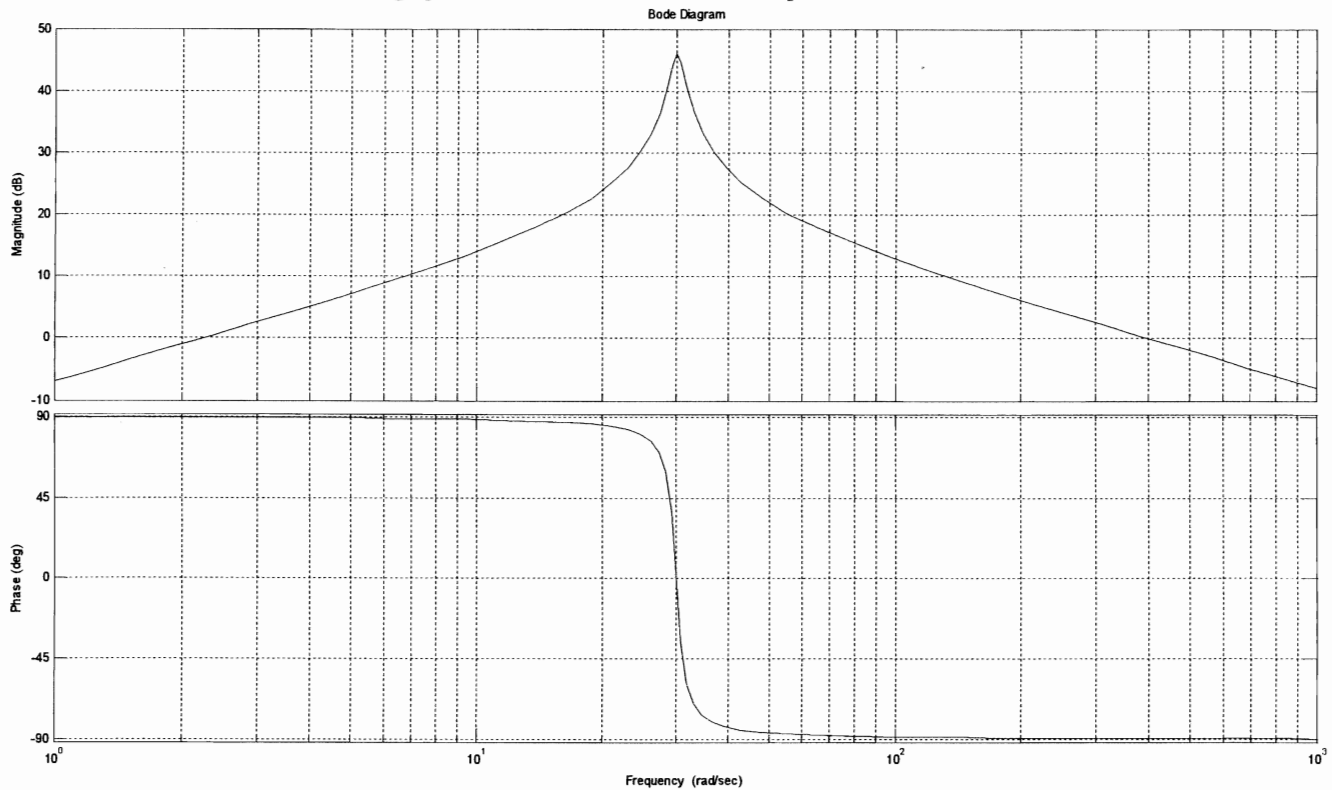


科目	自動控制	適用系所	航太與系統工程學系控制組	時間	100 分鐘
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※請務必在答案卷作答區內作答。 共 3 頁第 1 頁

一、 Answer the following questions based on the Bode plot shown below:



(a) (5%) What is the approximate Transfer Function of above system:

(A) $TF = \frac{S + k}{S^2 + 2\zeta\omega_n S + \omega_n^2}$ (B) $TF = \frac{k}{S^2 + 2\zeta\omega_n S + \omega_n^2}$

(C) $TF = \frac{1}{(S + k)(S^2 + 2\zeta\omega_n S + \omega_n^2)}$ (D) $TF = \frac{kS}{S^2 + 2\zeta\omega_n S + \omega_n^2}$ (E) None of above.

(b) (5%) What is the approximate value of constant (k) : (A) 400 (B) 200 (C) 100 (D) 10 (E) None of above.

(c) (5%) What is the approximate value of natural frequency (ω_n) : (A) 12 (B) 30 (C) 20 (D) 10 (E) None of above.

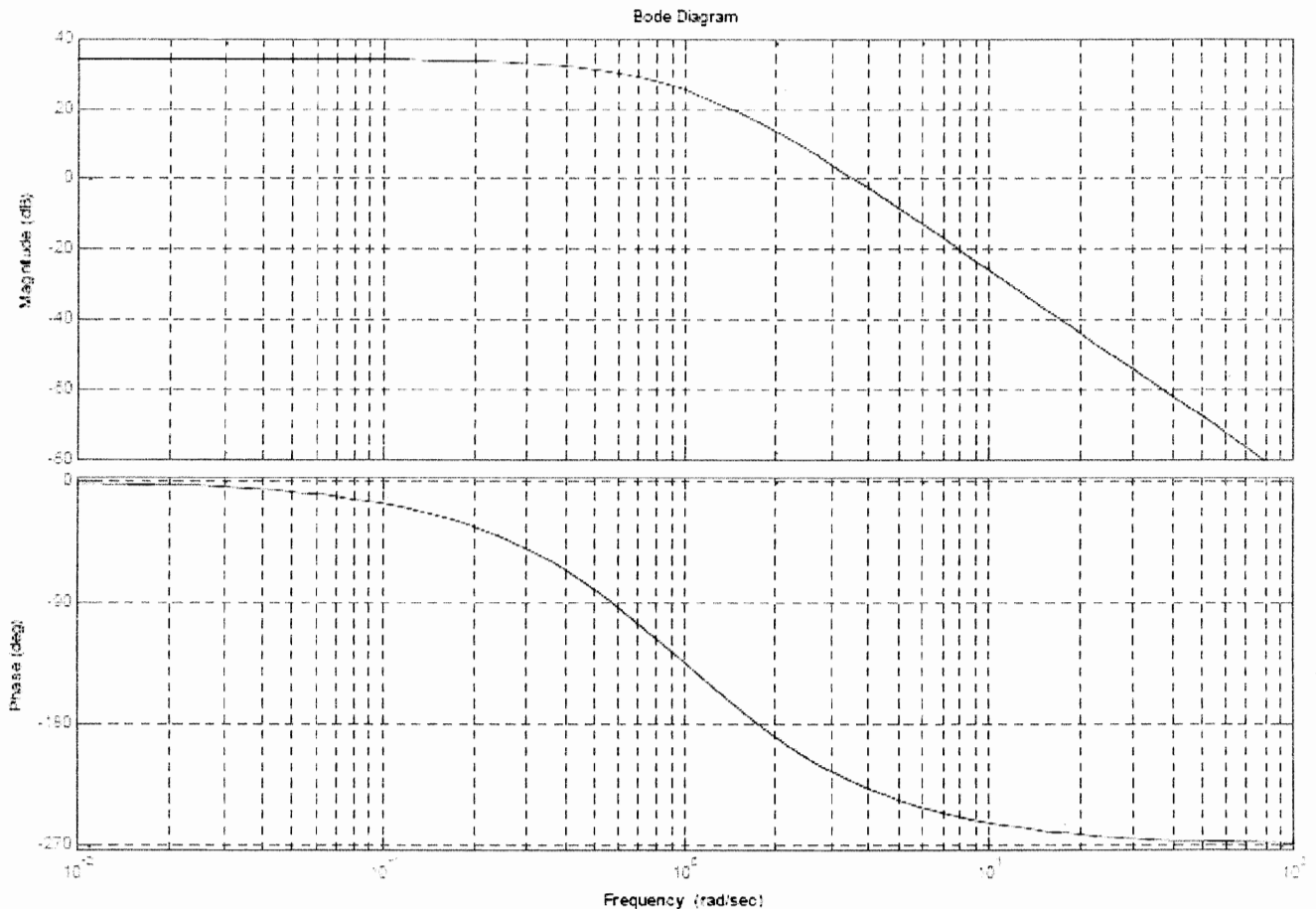
(d) (5%) What is the approximate value of damping ratio (ζ) : (A) 0.5 (B) 0.05 (C) 0.2 (D) 0.707 (E) None of above.

(e) (5%) What is the approximate value of time constant (τ) : (A) 0.01 (B) 0.1 (C) 1 (D) 10 (E) None of above.

二、

The open-loop Bode diagrams for a system are given below:

共 3 頁第 2 頁



- (5%) Explain why the system is closed-loop unstable.
- (10%) Try to multiply the original open-loop transfer function by a constant in order to stabilize the system with a Gain Margin of approximately 5 db. What is the Phase Margin (PM) in the system now?

三、 Consider a state matrix $A = \begin{bmatrix} -3 & 1 & 7 \\ 0 & -2 & 0 \\ 0 & 1 & -5 \end{bmatrix}$ for some state space system.

- (5%) Determine the characteristic equation based on A .
- (5%) Determine the dominant time constant for above of characteristic equation.
- (5%) What is the Diagonal Canonical Form ($\bar{A}_{DCF}$) of A (if any)?

四、

A certain system has the characteristic equation shown below:

$$S^3 + 10S^2 + 24S + K(S + 5) = 0.$$

- (10%) Draw the root locus plot for above characteristic equation.
- (5%) Find the range of K values for which the system will be stable.
- (5%) Find the value of K required so that the system has the fastest transient response.
- (5%) Find the range of K required so that the dominant time constant is no larger than 1/2.

五、

Answer the following questions for the corresponding Nyquist plots shown below.

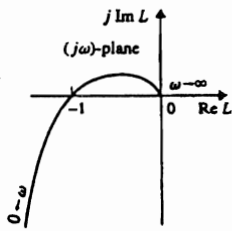


Fig.2

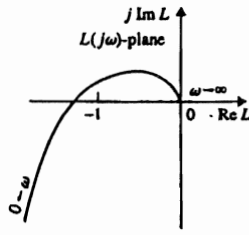


Fig.3

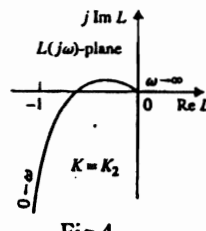


Fig.4

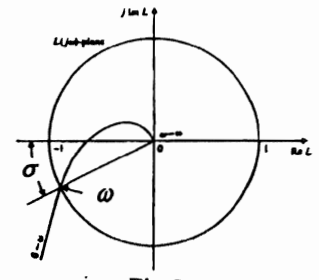


Fig.5

- (a) (5%) From Fig.2, the system is closed-loop: (A) Stable (B) Marginally Stable (C) Not Stable (D) None of the above.
- (b) (5%) From Fig.3, the system is closed-loop: (A) Stable (B) Marginally Stable (C) Not Stable (D) None of the above.
- (c) (5%) From Fig.4, the system is closed-loop: (A) Stable (B) Marginally Stable (C) Not Stable (D) None of the above.
- (d) (5%) From Fig.5, σ is: (A) Phase Margin (B) Gain Margin (C) Gain Cross-over Frequency (D) Phase Cross-over Frequency.