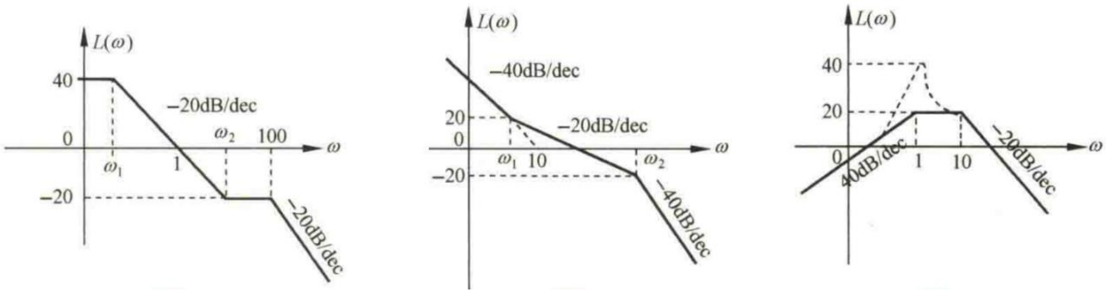
1. (4*6'=24') Plot the asymptotic magnitude-frequency response curve of the following transfer functions. (**Please plot on the provided Bode plot graph paper, ensuring that all key information is clearly labeled.**)
    a. $G(s) = \frac{2}{(2s+1)(8s+1)}$
    b. $G(s) = \frac{200}{s^2(s+1)(10s+1)}$
    c. $G(s) = \frac{8(10s+1)}{s(s^2+s+1)(0.5s+1)}$
    d. $G(s) = \frac{10(0.0025s^2+0.1s+1)}{s(s+1)(10s+1)}$
2. (3*6'=18') Given the log-magnitude frequency response curve of a minimum-phase system as shown in the figure, determine the system's open-loop transfer function. (The unit of ω is radians per second (rad/s).)



3. (13') The open-loop transfer function of the system is given as:

$$G(s) = \frac{K(-T_2 s + 1)}{s(T_1 s + 1)}, K, T_1, T_2 > 0$$

When $\omega = 1rad/s$, $\angle[G(j\omega)] = -180^{\circ}$, $|G(j\omega)| = 0.5$, when the input is a unit velocity signal, the steady-state error of the system is 0.1. Please derive the open-loop frequency expression for the system.
4. (10*2=20') The open-loop transfer functions of the following systems are known ($K, T, T_i > 0; i = 1,2, \ldots, 6$):

(a) $G(s) = \frac{K}{(T_1s+1)(T_2s+1)(T_3s+1)}$ (b) $G(s) = \frac{K}{s(T_1s+1)(T_2s+1)}$

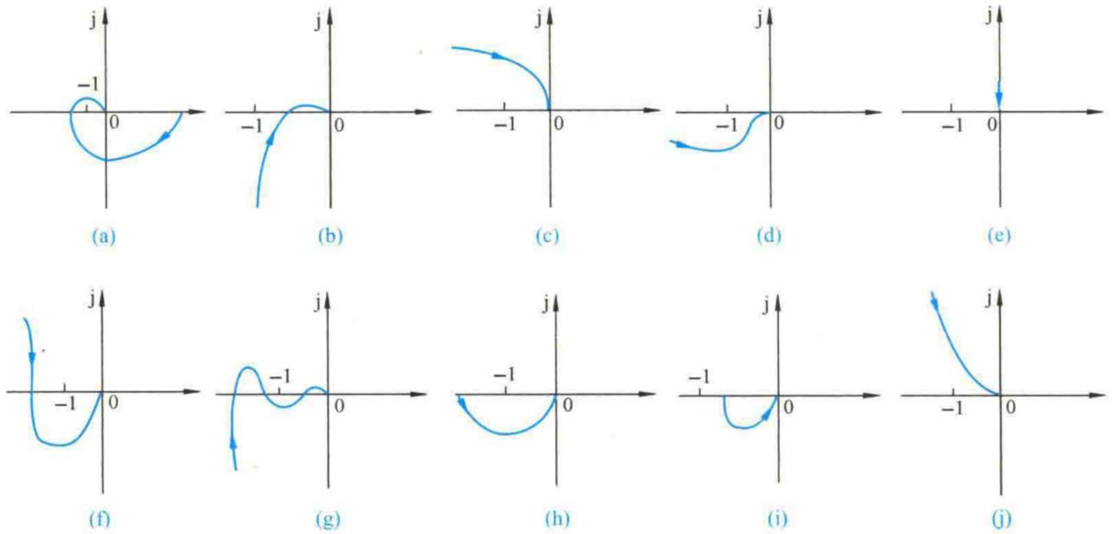
(c) $G(s) = \frac{K}{s^2(Ts+1)}$ (d) $G(s) = \frac{K(T_1s+1)}{s^2(T_2s+1)}$

(e) $G(s) = \frac{K}{s^3}$ (f) $G(s) = \frac{K(T_1s+1)(T_2s+1)}{s^3}$

(g) $G(s) = \frac{K(T_5s+1)(T_6s+1)}{s(T_1s+1)(T_2s+1)(T_3s+1)(T_4s+1)}$ (h) $G(s) = \frac{K}{Ts-1}$

(i) $G(s) = \frac{-K}{-Ts+1}$ (j) $G(s) = \frac{K}{s(Ts-1)}$

, and their open-loop amplitude-phase characteristic curves are illustrated in the figure below. Based on the Nyquist stability criterion, determine the closed-loop stability of each system. If a system is closed-loop unstable, identify the number of closed-loop poles in the right half of the s-plane.



5. (5*5’=25’) For the system in Figure below. (Calculators may be used to compute the results)

   a. Calculate the phase margin if the system is stable for time delays of 0, 0.1, 0.2, 0.5, and 1 second.

   b. Calculate the gain margin if the system is stable for each one of the time delays in Part **a**.

   c. Find out for which of the time delays in Part **a** the system is closed-loop stable.

   d. Find out by what amount the gain should be reduced to obtain a stable closed-loop system for those time delays for which the system was closed-loop unstable.