112ME04

國立臺北科技大學 112 學年度碩士班招生考試

系所組別：1112 機械工程系機電整合碩士班甲組

第二節　自動控制　試題 (選考)

注意事項：

1.本試題共 4 題，共 100 分。
2.不必抄題，作答時請將試題題號及答案依照順序寫在答案卷上。
3.全部答案均須在答案卷之答案欄內作答，否則不予計分。

1. **(30%)** Consider the system dynamic equation $\dddot{y}(t) + 2\ddot{y}(t) - \dot{y}(t) - 2y(t) = u(t)$, where $y(t)$ is system output and $u(t)$ is system control input. Define the state variable as $x = [x_1 \ x_2 \ x_3]^T$, where $x_1 = y,\ x_2 = \dot{y},\ x_3 = \ddot{y}$.
   (a) Find the state-space equation for the system. (5%)
   (b) According to the result in part (a), is the system stable? (5%)
   (c) As in part (b), is the system controllable? (5%)
   (d) As in part (b), is the system observable? (5%)
   (e) By use of the state-feedback control law $u = -Kx$, find the state feedback gain matrix K so that the closed-loop system has poles at -1, -2, -3. (10%)

2. **(30%)** A unity feedback control system has a loop transfer function $L(s) = G_c(s)G(s) = K(s+1)/[s(s-2)(s+6)]$.
   (a) Determine the root locus on the real axis. (5%)
   (b) Determine the angles and centroid of asymptotes. (5%)
   (c) Determine the breakaway point. (5%)
   (d) Determine the points of the root locus crossing the imaginary axis, and the corresponding value of K. (5%)
   (e) Determine the departure angle of its root locus at the complex poles. (5%)
   (f) Determine the range of K such that the system is stable. (5%)

3. **(20%)** The asymptotic log-magnitude curve for a loop transfer function is given in Figure 1.
   (a) Estimate the transfer function for the system. (10%)
   (b) Sketch the corresponding Nyquist plot for the system. (10%)

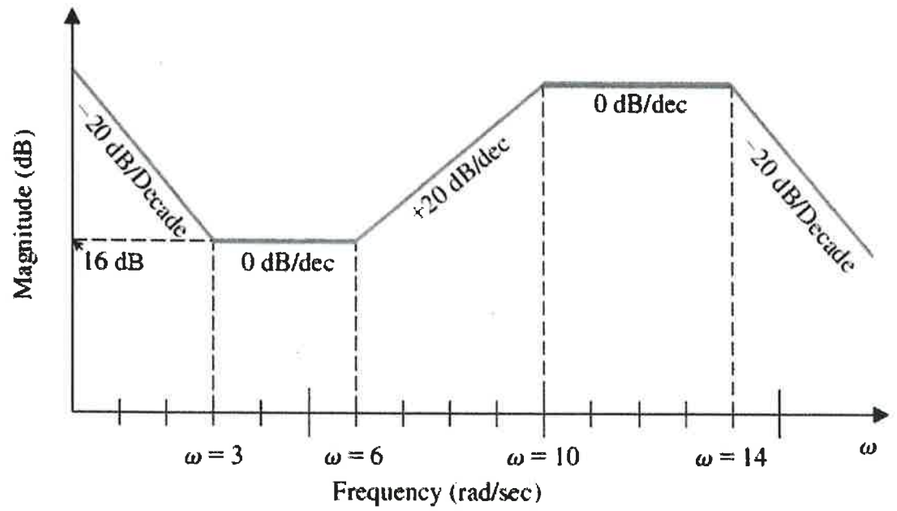

Figure 1.

4. **(20%)** Consider the closed-loop system in Figure 2.
   (a) Verify the transfer functions $T_1(s) = U(s)/N(s),\ T_2(s) = Y(s)/D(s)$. (10%)
   (b) When $R(s) = D(s) = 1/s,\ N(s) = 0,\ P(s) = 2/(s+1),\ C(s) = K_I/s$ (I-control). Please show $\lim_{t\to\infty} e(t) = 0$, where $e(t)$ is the result of inverse Laplace transform of $E(s)$. (10%)

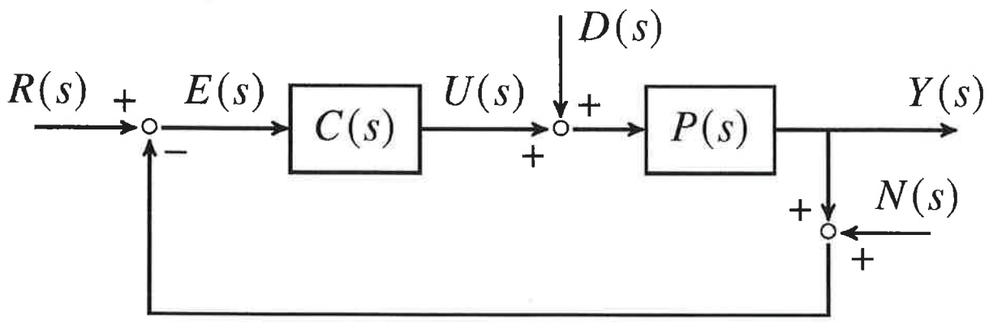

Figure 2.