1. **Sketch the Bode diagrams for the transfer functions.** (20%)

   (1) $\dfrac{100}{(s+1)(s-1)}$

   (2) $\dfrac{1-s}{s+1}$

   (3) $\dfrac{1}{(s+0.1)(s+1)}$

   (4) $\dfrac{100}{s^2(s+1)}$

2. **Consider the system shown in Fig. 1.**
   (1) Sketch the root-locus diagram. (15%)
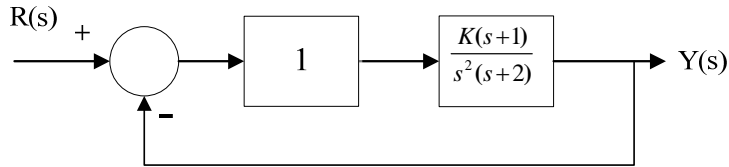   (2) Verify the result of (1) by calculating the locations of the roots as a function of K. (15%)

   R(s) $+$ ⊗ $-$ → 1 → $\dfrac{K(s+1)}{s^2(s+2)}$ → Y(s)

   Fig. 1

3. **A unit feedback system is shown in Fig.2.**
   (1) Determine the error coefficients K_p, K_v and K_a for the system. (10%)
   (2) Determine the steady state actuating signal $e_{ss}(t)$ when input $r(t)=2tu(t)$ where $u(t)$ denotes a unit step function. (15%)
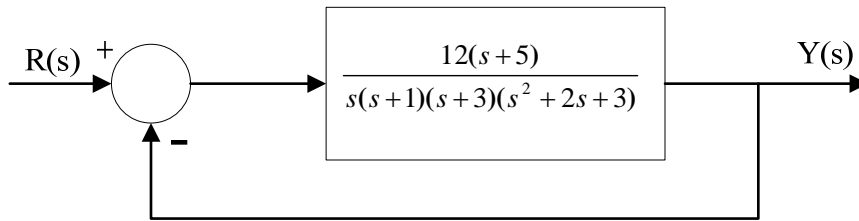
   R(s) $+$ ⊗ $-$ → $\dfrac{12(s+5)}{s(s+1)(s+3)(s^2+2s+3)}$ → Y(s)

   Fig. 2

4. **Consider a closed-loop system as shown in Fig. 3.**
   (1) Determine the critical value of K for stability by use the Nyquist stability criterion. ($K \geqq 0$) (10%)
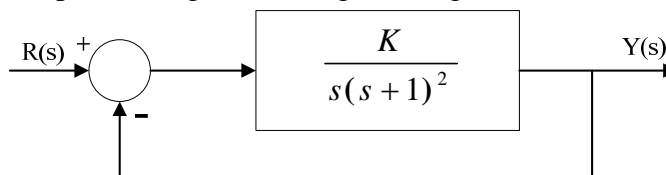   (2) If K=1, determine the phase margin and the gain margin. (15%)

   R(s) $+$ ⊗ $-$ → $\dfrac{K}{s(s+1)^2}$ → Y(s)

   Fig.3