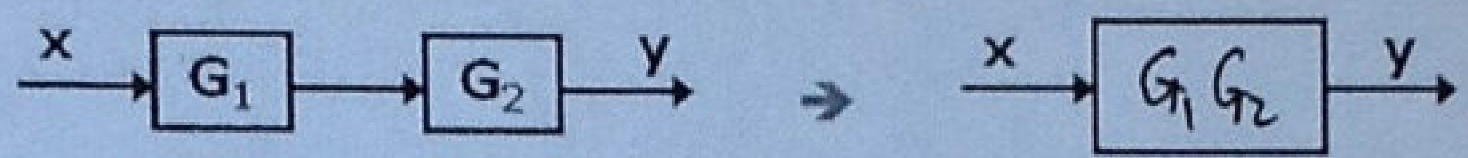
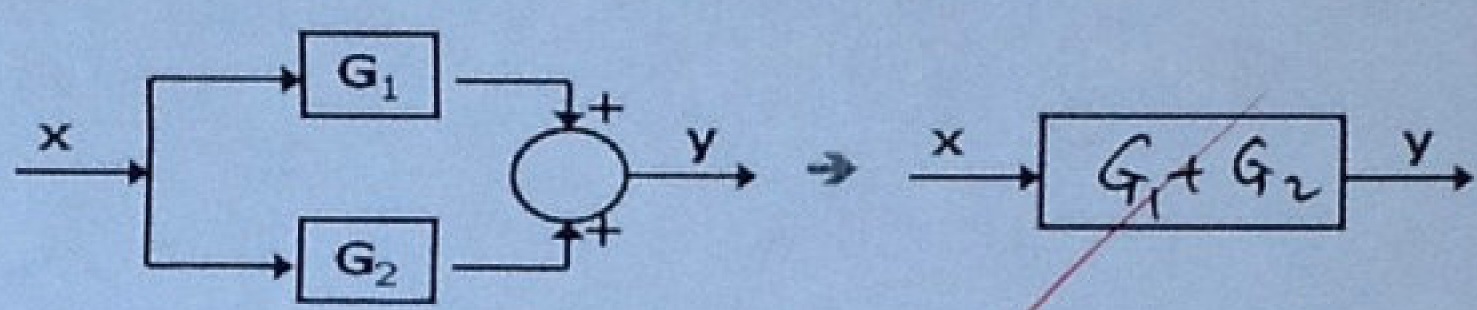
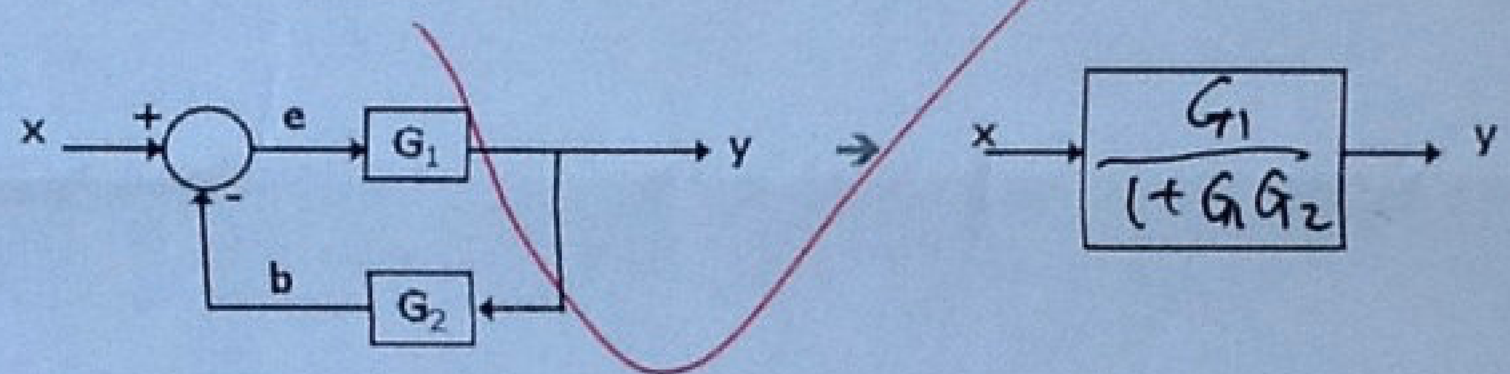
EE 475 Fall 2011 Quiz #1

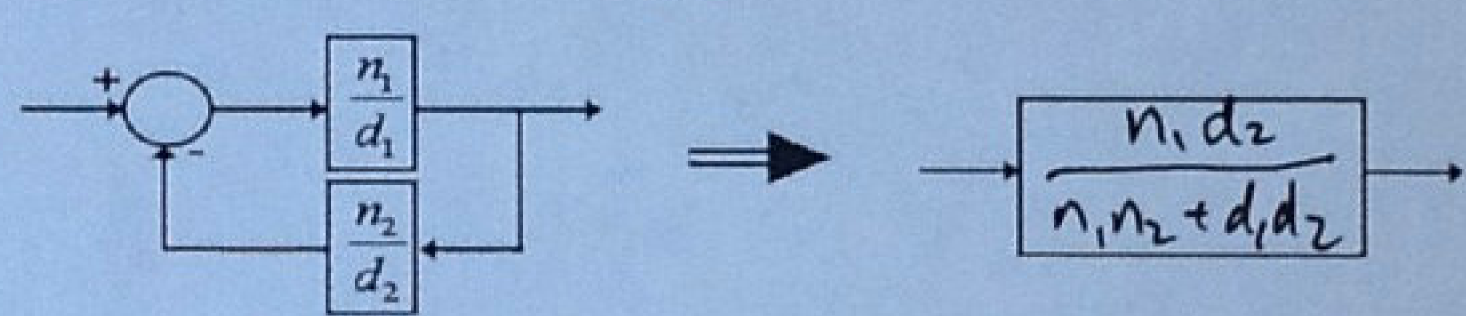
Name: Key

1. $\mathcal{L}(\delta(t))=$ 1, where δ (t) is the unit impulse function
2. $\mathcal{L}(u(t))=$ 1/s, where u(t) is the unit step function.
3. A system has transfer function H(s),
   a. then its impulse response is given by $h(t) = \mathcal{L}^{-1}(H(s))$
   b. and its step response is given by $y_s(t) = \mathcal{L}^{-1}(\frac{1}{s}H(s))$

4. 

5. 

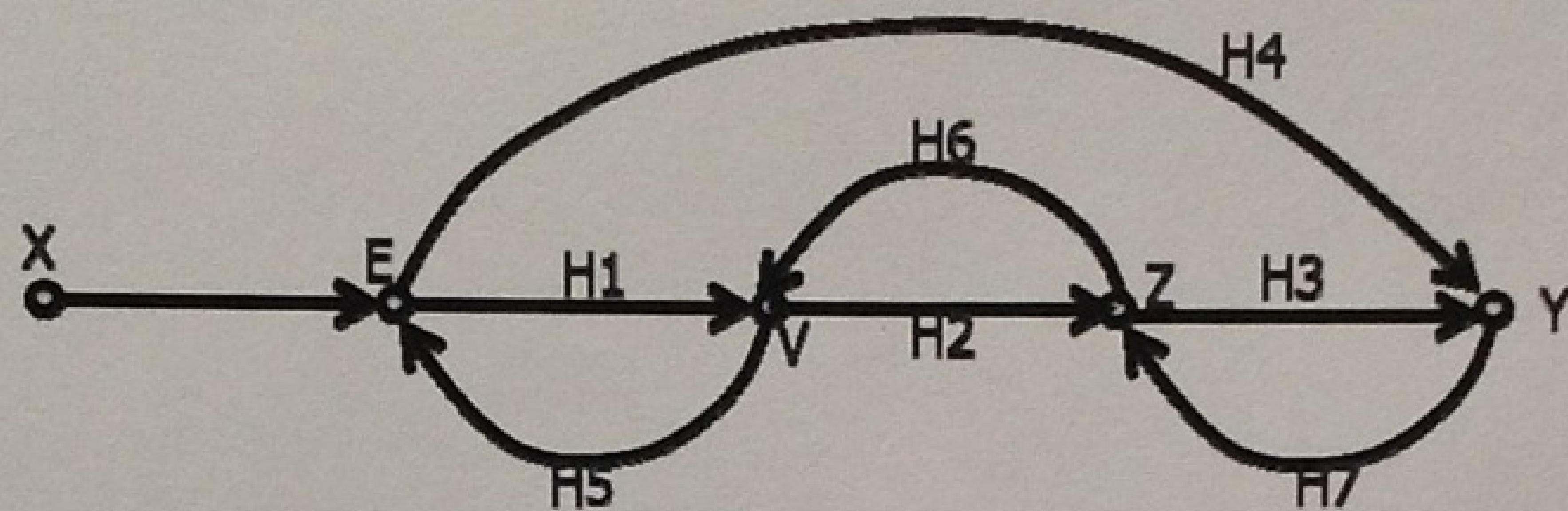
6. 

7. 

EE 475 Quiz #2

Name: key

1. For the signal flow graph below



a) List the two forward paths from X to Y and their gains: M1= (XEVZY) $H_1H_2H_3$

M2= (XEY) H_4.

b) Find the determinant for each forward path: D1= 1

D2= $1 - H_2H_6$.

c) List the 4 loop gains: L1= H_2H_6 L2= $H_4H_7H_6H_5$

L3= H_3H_7 L4= H_1H_5.

d) List the non-touching loop pair's total gain: $H_1H_5H_3H_7$.

e) The determinant of the graph is Δ= $1 - H_2H_6 - H_1H_5 - H_3H_7 - H_4H_7H_6H_5 + H_1H_3H_5H_7$.

f) The transfer function from X to Y =

$$\frac{H_1H_2H_3 + H_4(1 - H_2H_6)}{1 - H_2H_6 - H_1H_5 - H_3H_7 - H_4H_5H_6H_7 + H_1H_3H_5H_7}$$

EE 475 Quiz #3

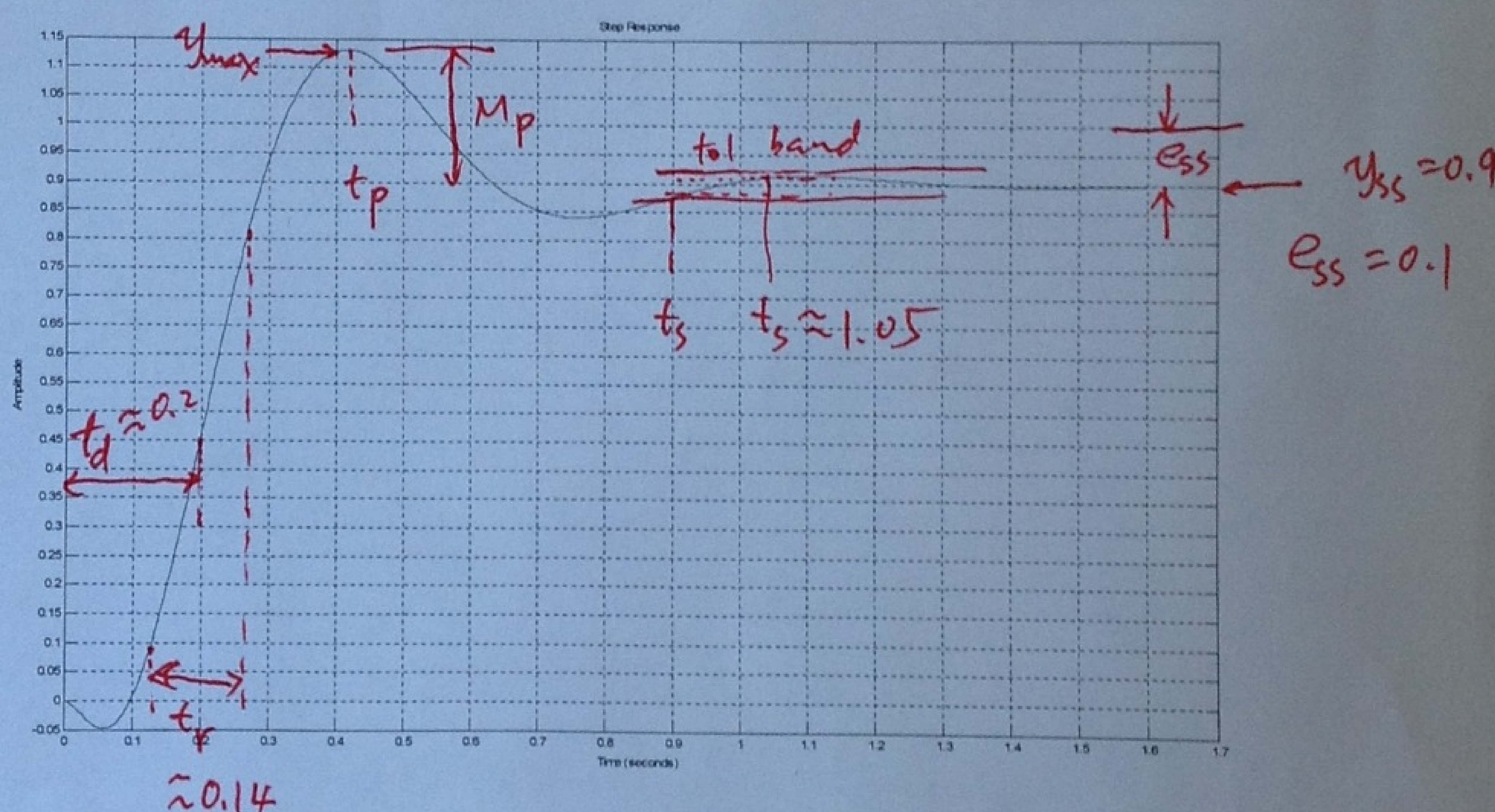
Name: key

1. For an ideal op amp, its
   a. Vp – Vn = 0
   b. Ip = In = 0
   c. Rin = ∞
   d. Ro = 0
   e. DC gain = ∞
2. In control system modeling, your key equations must be based on: physical laws
3. In modeling electric circuits, name two most important physical laws: KCL, KVL
   Ohm's law
4. In modeling mechanical motions, name two most important physical laws: Newton's
   Euler's, Hooke's law, Law

EE 475 Quiz #4

Name: Key

1. The closed-loop unit step response of a system is given below. Find the following time-domain specifications, and mark them on the graph also.
   a. yss = 0.9
   b. ymax = 1.13
   c. ess = 0.1
   d. ts = 0.9 or 1.1
   e. tp = 0.42
   f. tr = 0.14
   g. td = 0.2
   h. Mp = $= \frac{1.13-0.9}{0.9} = \frac{0.23}{0.9} \simeq 0.25 = 25\%$



EE475 Quiz05

Name: Key

1. For an under-damped prototype 2nd order system, if one of its poles is given by p,
   a. Then ω_n = $|p|$, ζ = $180° -$ angle(p).
   b. And σ = $-Re(p)$, ω_d = imag(p).
2. If ω_n and ζ are given,
   a. Then σ = $\zeta\omega_n$, ω_d = $\omega_n\sqrt{1-\zeta^2}$.
   b. And p = $-\zeta\omega_n \pm j\omega_n\sqrt{1-\zeta^2}$, in terms of ω_n and ζ.
3. If σ and ω_d are given,
   a. Then ω_n = $\sqrt{\sigma^2+\omega_d^2}$, ζ = $\frac{\sigma}{\sqrt{\sigma^2+\omega_d^2}}$.
   b. And p = $-\sigma \pm j\omega_d$, in terms of σ and ω_d.
4. Given a closed-loop transfer function $H(s) = \dfrac{10(s+0.01)}{(s+0.001)(s^2+10s+100)(0.0001s+1)}$.
   a. Find its poles: -0.001, -10000, $-5 \pm 5\sqrt{3}j$.
   b. Find its zeros: -0.01.
   c. The dominant pole(s) is/are: $-5 \pm 5\sqrt{3}j$.
   d. For estimating the system's performance, we would use ω_n = 10 and ζ = 0.5.

EE475 Quiz06

Name: Key

1. For an under-damped prototype 2nd order system with closed-loop transfer function

   $$H(s) = \frac{\omega_n^2}{s^2 + 2\zeta\omega_n s + \omega_n^2}$$, its step response specifications can be approximately

   computed by the following formulas:

   a. yss = 1

   b. ess = 0

   c. tp = $\frac{\pi}{\omega_n\sqrt{1-\zeta^2}}$

   d. tr = $\frac{4.5(\zeta-0.12)}{\omega_n} = \frac{2}{\omega_n}$

   e. td = $\frac{0.8+0.9\zeta}{\omega_n} = \frac{1.4}{\omega_n}$

   f. ts = $\frac{-\ln(tol)}{\sigma} = \frac{3, 4 \text{ or } 5}{\sigma}$ $(\sigma = \zeta\omega_n)$

   g. Mp = $e^{-\pi\zeta/\sqrt{1-\zeta^2}} \cdot 100\%$

2. Base on the Routh criterion, for second order system, the closed-loop system is stable if and only all coeff have same sign. for denominator.

3. Base on the Routh criterion, for third order system, the closed-loop system is stable if and only a) a, b, c, d all have same sign for denominator

   and b) $bc > ad$.

   (assuming $d(s) = as^3 + bs^2 + cs + d$)

Routh criterion: $d(s)$ is A.S. iff. 1st col have sam sign.

Don't confuse this with 2 and 3, Routh criterion is general, which includes 2 & 3