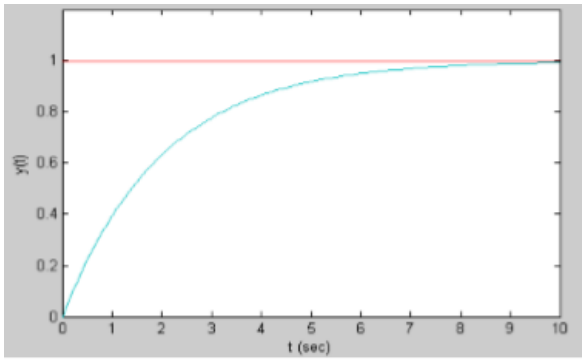
Tutorial Questions 2:

Industrial Process Control

1. Determine the system stability by root value using **s-plan** for following transfer function, then explain why the system is stable or not.
   a. $D(s) = \frac{2}{s^2+5s-8}$
   b. $D(s) = \frac{12}{2s^2+4s+6}$

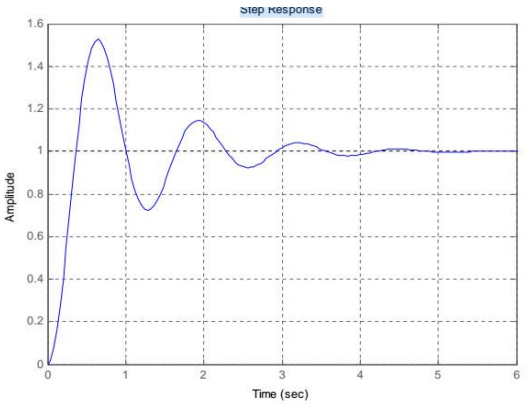
2. Determine the system stability by Routh method (use **Routh table** if necessary) for following function, then explain why the system is stable or not.
   a. $F(s) = \frac{3}{3.5s^2+0.25s+2}$
   b. $F(s) = \frac{8}{4s^2+3s-2}$
   c. $F(s) = \frac{7}{3s+2}$
   d. $4s^3 + 4s^2 + 2 = 0$
   e. $2s^3 + 4s^2 + 3s + 2 = 0$
   f. $3s^3 + 2s^2 + 3s + 8 = 0$

3. From time response first order system
   a. Determine the gain K, time constantτ and settling time t_s
   b. Writer the differential equation, transfer function and time response
      i. $4\dot{y}(t) + 5y(t) = 10u(t)$
      ii. $2\dot{y}(t) + y(t) = 4u(t)$
      iii. From the **graph (1),** find **a** and **b**



graph (1)

4. From time response second order system
   a. Determine $\alpha.\omega_0.\zeta$ and K
   b. What is the type of this system?
   c. Writer the differential equation, transfer function
      i. $3\ddot{y}(t) + 3\dot{y}(t) + 5y(t) = 10u(t)$
      ii. $12\ddot{y}(t) + 6\dot{y}(t) + 15y(t) = 30u(t)$
      iii. $G(s) = \frac{15}{2s^2+3s+8}$
      iv. From the **graph (2),** find:
      Y_{ss},Y_p,M,t_d,t_r,t_p,T_p,f_p and ω_p



graph (2)

5. Examine controllability and observability of the system:

$$A = \begin{bmatrix} 0 & 2 \\ -2 & -3 \end{bmatrix}, \quad B = \begin{bmatrix} 0 \\ 3 \end{bmatrix}, \quad C = \begin{bmatrix} 1 & 0 \end{bmatrix}$$

6. What is the transfer function of P, I, D, PI, PD and PID?
7. What is the **advantage** anddis **advantage** of P, I, D, PI, PD and PID?