

- When turn in your homework, please write down: 作業次別, 姓名, 學號, 系級, 日期
- Assigned: 12/3/08, Due on 12/10/08

• (Controllability and Observability)

Consider the systems studied in [Problems 3, 5, 6 of HW1](#) and use the solution provided for their respective **A, B, C, D**.

Use the following additional assumptions to discuss the controllability and observability of these systems in terms of values of these parameters used to model the systems.

Furthermore, if possible, provide your the reason why different values of these parameters cause different system characteristics.

3 (A parallel electrical circuit)

30 points

- If $L_1 = L_2, C_1 = C_2, R_1 = R_2$, the system is controllable or un-controllable?
- If $c = [0, 0, 0, 1]$ as given in the solution, the system is observable or un-observable?
If $c = [0, 1, 0, 1]$, the system is observable or un-observable?

5 (A 3-tank system)

50 points

- Let $B = \begin{bmatrix} b_1 & 0 & 0 \\ 0 & b_2 & 0 \\ 0 & 0 & b_3 \end{bmatrix}$ and discuss the controllability of the following three cases.
 - 1 Only input u_1 is applied, i.e., $b_1 = 1, b_2 = b_3 = 0$.
 - 2 Only input u_2 is applied, i.e., $b_2 = 1, b_1 = b_3 = 0$.
 - 3 Only input u_3 is applied, i.e., $b_3 = 1, b_1 = b_2 = 0$.
- Let $C = c_1 = [1 \ 0 \ 0]$ or $C = c_2 = [0 \ 1 \ 0]$ and discuss the observability of the two cases.

6 (A bicycle-rider system)

40 points

- Discuss the controllability when $F \neq 0$ and $F = 0$.
- Discuss the observability when $V \neq 0$ and $V = 0$.