

數位系統導論

Introduction to Digital System

Pei-Yin Chen, 陳培殷

Syllabus

- Time and Place

- Tuesday: 9:10 ~ 12:00 Rm.4263

- Contact Information

- 雲平大樓 東棟 5F 501室 (06-2757575 EXT 62547)

- E-mail: pychen@mail.ncku.edu.tw

- Office Hour

- Monday: 9:00~12:00 Friday: 8:00~9:00

- Course Assistants

- 雲平大樓 東棟 3F DIC (Digital IC Design) Lab 葉俊顯

Syllabus (continued)

- **Textbook**

- **M. Morris Mano, “Digital Design,” Prentice Hall, 滄海書局**

- **References**

- 陳培殷, 數位邏輯概論, 滄海書局, 2010
- 陳培殷, 數位IC設計—Verilog, 滄海書局, 2008
- **HDL chip design (Douglas J. Smith), Doone Publications**

- **Grading Policies**

- Mid-term Exam-I: 30% Mid-term Exam-II: 30%
Final Exam: 40~30% Homework: 0~10%

研讀方式: Attention + 上課投影片 + Text book

Goal

Goal:

- 1. Understand the basic concepts of digital circuit.**
- 2. Understand the basic skills for digital circuit design**

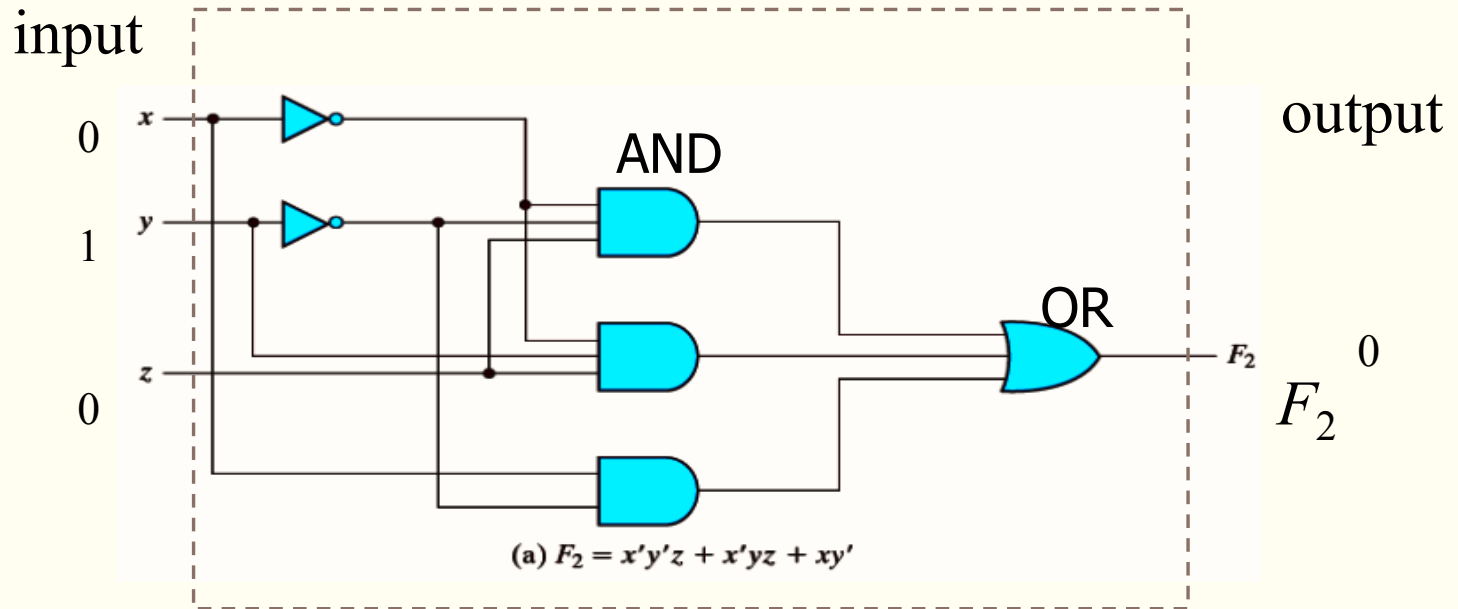
課程概述	介紹數位電路相關的基礎知識，包含：邏輯閘、組合電路、循序電路與數位系統架構設計等。
教學目標	讓學生具備數位電路的基本觀念，並熟悉設計數位電路的相關技巧。

Overview of a Digital Circuit



A digital circuit accepts the input bit-stream (0 and 1), processes it and produces the **proper** output results (0 and 1).

Inside a Digital Circuit



A lot of logic gates which use the input bitstream to produce the output bitstream.

Half Adder

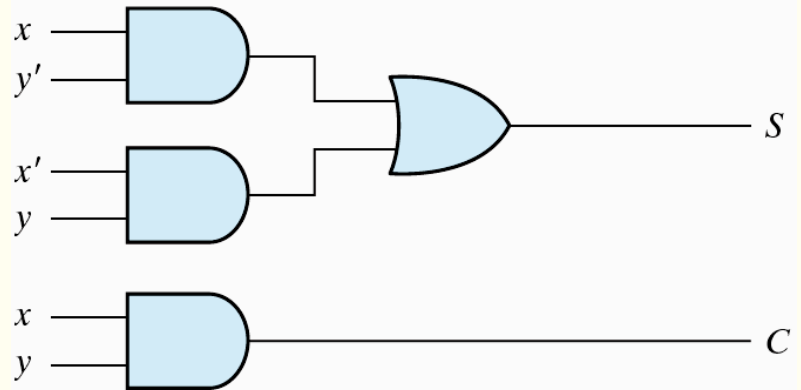
$$\begin{array}{r} \text{x} \quad 0 \quad 0 \quad 1 \quad 1 \\ + \text{y} \quad 0 \quad 1 \quad 0 \quad 1 \\ \hline \end{array}$$

00 01 01 10

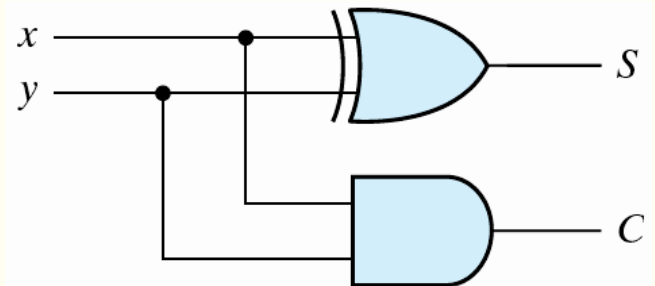
Table 4.3

Half Adder

		carry	sum
x	y	C	S
0	0	0	0
0	1	0	1
1	0	0	1
1	1	1	0

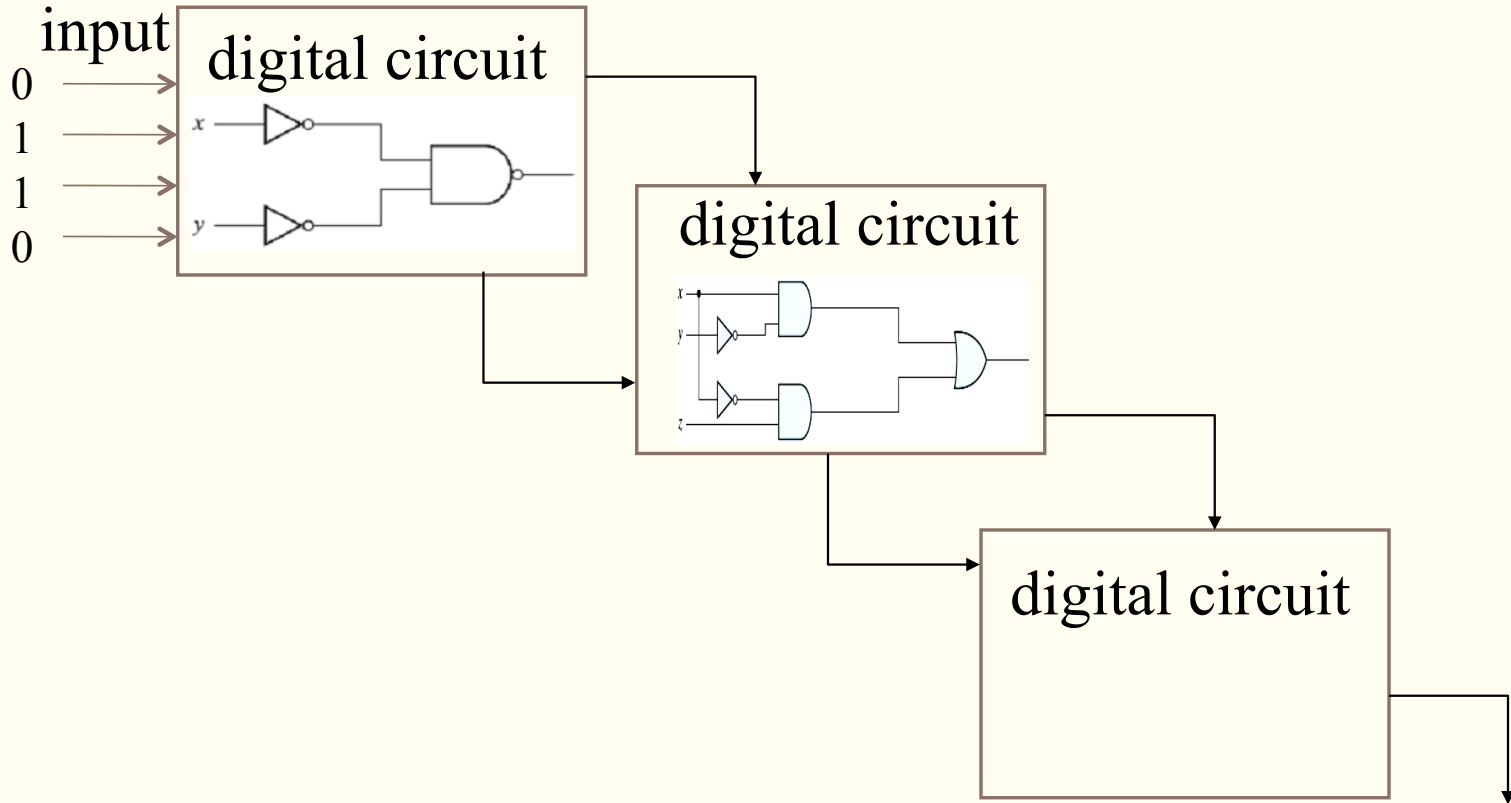


$$\begin{aligned} \text{(a)} \quad S &= xy' + x'y \\ C &= xy \end{aligned}$$



$$\begin{aligned} \text{(b)} \quad S &= x \oplus y \\ C &= xy \end{aligned}$$

Digital System

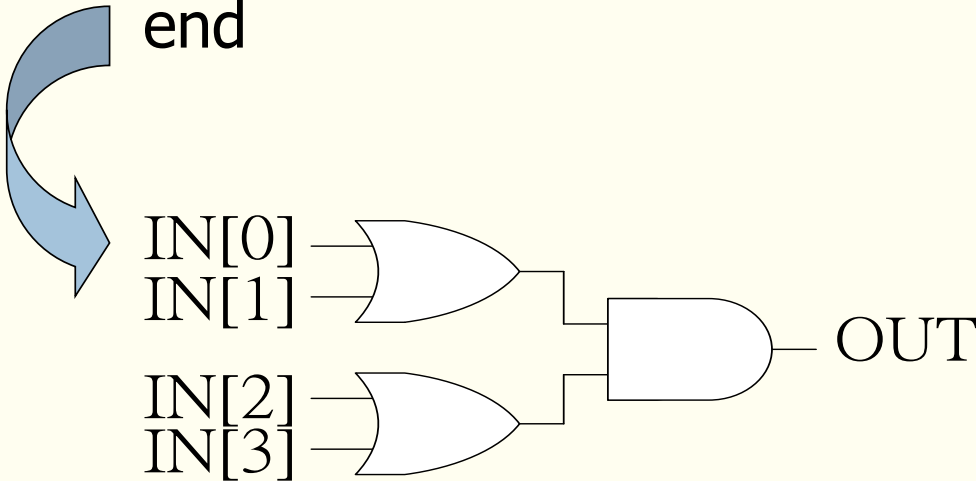


digital circuit === IC (integrated circuit) semiconductor

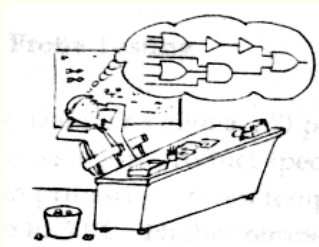
Digital IC Design

Example:

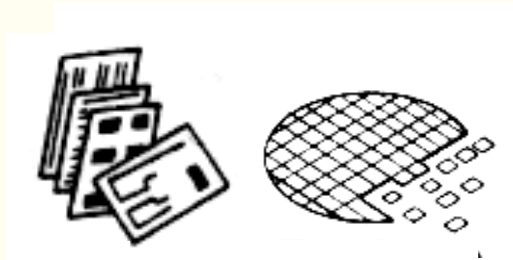
```
always @(IN)
begin
    OUT = (IN[0] | IN[1]) & (IN[2] | IN[3]);
end
```



IC Industry in Taiwan

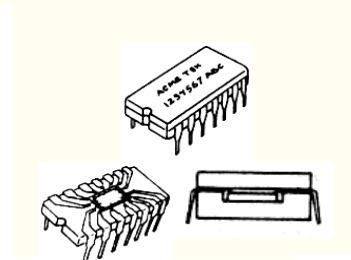


邏輯設計



光罩設計

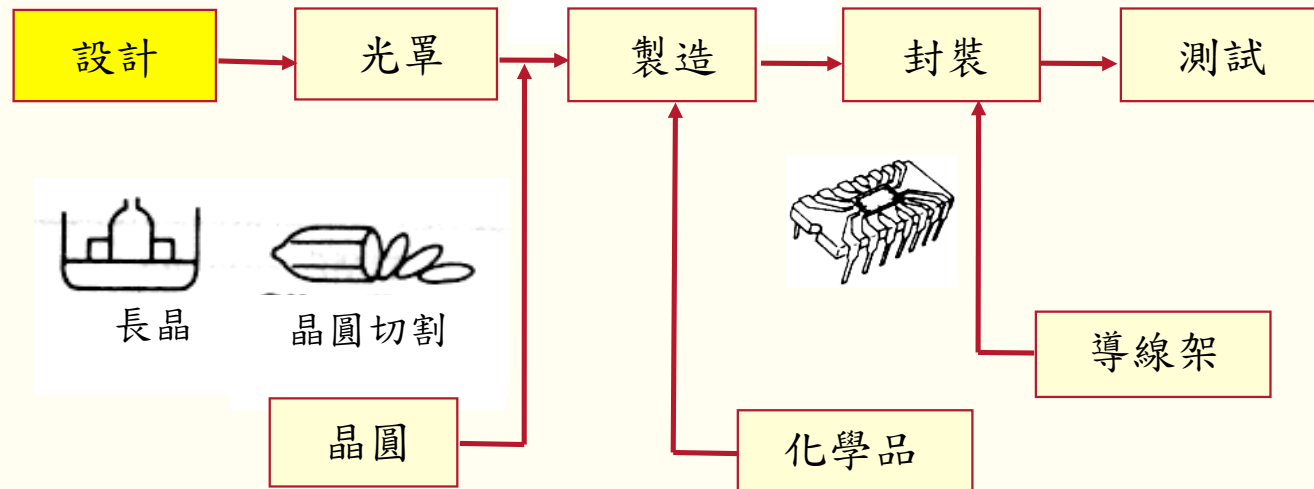
晶粒測試及切割



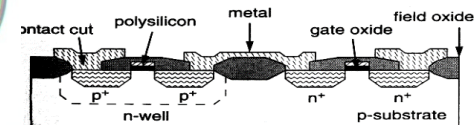
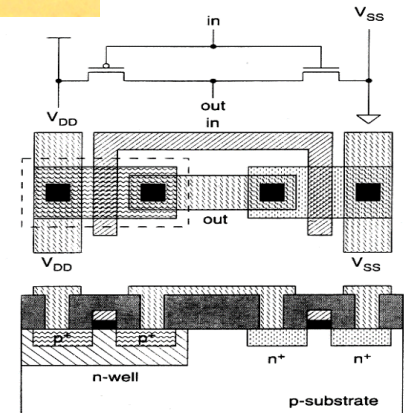
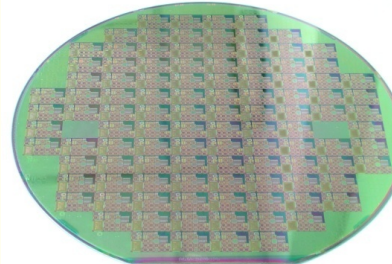
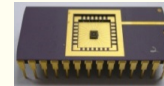
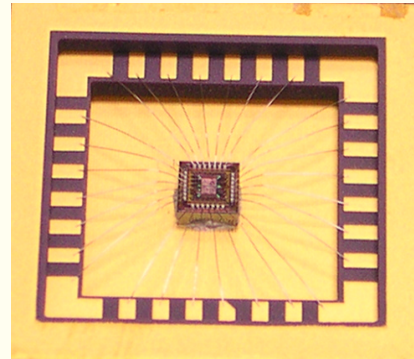
封裝



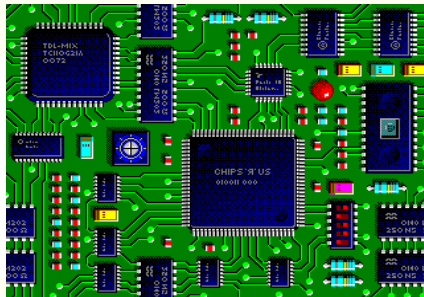
成品測試



Chip/Circuit Everywhere!



Applications



2011 Top 20 Fabless IC Suppliers

2011 rank	2010 rank	Company	HQ	2011 (\$M)	2011 rank	2010 rank	Company	HQ	(\$M)
1	1	Qualcomm	US	9910	11	13	MStar 晨星	Taiwan	1220
2	2	Broadcom	US	7160	12	11	Novatek	Taiwan	1198
3	3	AMD	US	6568	13	15	CSR 聯詠	Europe	845
4	6	Nvidia	US	3939	14	12	ST-Ericsson	Europe	825
5	4	Marvell	US	3445	15	16	Realtek	Taiwan	742
6	5	MediaTek 聯發科	Taiwan	2969	16	17	HiSilicon 瑞昱	China	710
7	7	Xilinx	US	2269	17	27	Spreadtrum	China	674
8	8	Altera	US	2064			PMC-Sierra	US	654
9	9	LSI Corp	US	2042	18	19			
10	10	Avago	Singapore	1341	19	18	Himax 奇景	Taiwan	633
					20	21	Lantiq	Europe	540

2011台灣IC設計公司營收

表二 2011 年台灣 IC 設計產業前 10 大廠商營收及成長率

2010 排名	2011 排名	公司	2011 年營收 (億新台幣/百萬美元)	年成長率 (台幣/美元)
1	1	聯發科	933/3167	-17.8%/-11.7%
3	2	晨星	357/1212	6.3%/14.1%
2	3	聯詠	351/1190	-3.5%/3.7%
4	4	群聯	323/1098	1.7%/9.2%
5	5	瑞昱	219/743	-1.7%/5.5%
6	6	奇景	182/617	-10.6%/-4.0%
7	7	立錡	110/373	-9.4%/-2.7%
8	8	創意	91.5/310	-10.9%/-4.4%
16	9	奕力	90.6/307	55.7%/67.2%
9	10	瑞鼎	90.6/307	-1.3%/6.0%

1. 強健的體魄
2. 優異的自制力
3. 高超的耐壓性

Outline

Chapter 1: Binary System

Chapter 2: Boolean Algebra and Logic Gates

Chapter 3: Gate-Level Minimization

Chapter 4: Combinational Logic

Chapter 5: Synchronous Sequential Logic

Chapter 6: Registers and Counters

Chapter 7: Memory and Programmable Logic

Chapter 8: Register Transfer Level

Chapter 9: Asynchronous Sequential Logic

Chapter 10: Digital Integrated Circuits



系上教育目標(工程認證)

● 課程成績評量參考指標

<input checked="" type="checkbox"/> 紙筆測驗	<input checked="" type="checkbox"/> 書面報告	<input type="checkbox"/> 口頭報告
<input type="checkbox"/> 課堂問答	<input type="checkbox"/> 實作表現	<input checked="" type="checkbox"/> 上課表現
<input checked="" type="checkbox"/> 指定作業	<input type="checkbox"/> 專題研究	<input checked="" type="checkbox"/> 課堂出席

● 修習本課程後，學生可獲得以下核心能力

- | |
|--|
| <input checked="" type="checkbox"/> 1.1 具備基礎專業數學及資訊理論知識之基本能力 |
| <input checked="" type="checkbox"/> 1.2 具備理論推導及實驗數據分析歸納之能力 |
| <input type="checkbox"/> 1.3 具備終身學習之能力 |
| <input checked="" type="checkbox"/> 2.1 具備發掘、分析及解決資訊應用問題之能力 |
| <input checked="" type="checkbox"/> 2.2 具備資訊工程設計、創新、測試及驗證之能力 |
| <input checked="" type="checkbox"/> 2.3 具備系統整合之能力 |
| <input type="checkbox"/> 3.1 具備科技人文素養及資訊工程倫理之精神 |
| <input type="checkbox"/> 3.2 具備良好溝通技巧及國際觀 |
| <input type="checkbox"/> 3.3 具備負責之工作態度及團隊合作之能力 |