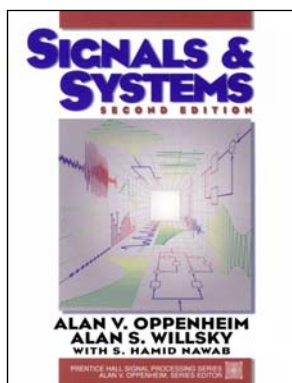


Spring 2015

# 信號與系統 Signals and Systems

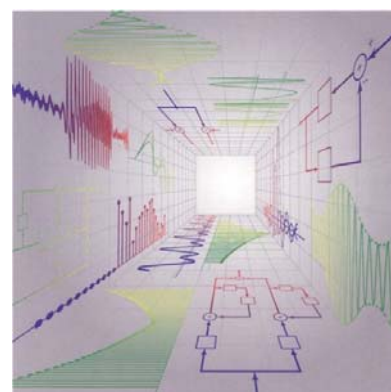
## Chapter SS-0 Introduction



Feng-Li Lian

NTU-EE

Feb15 – Jun15

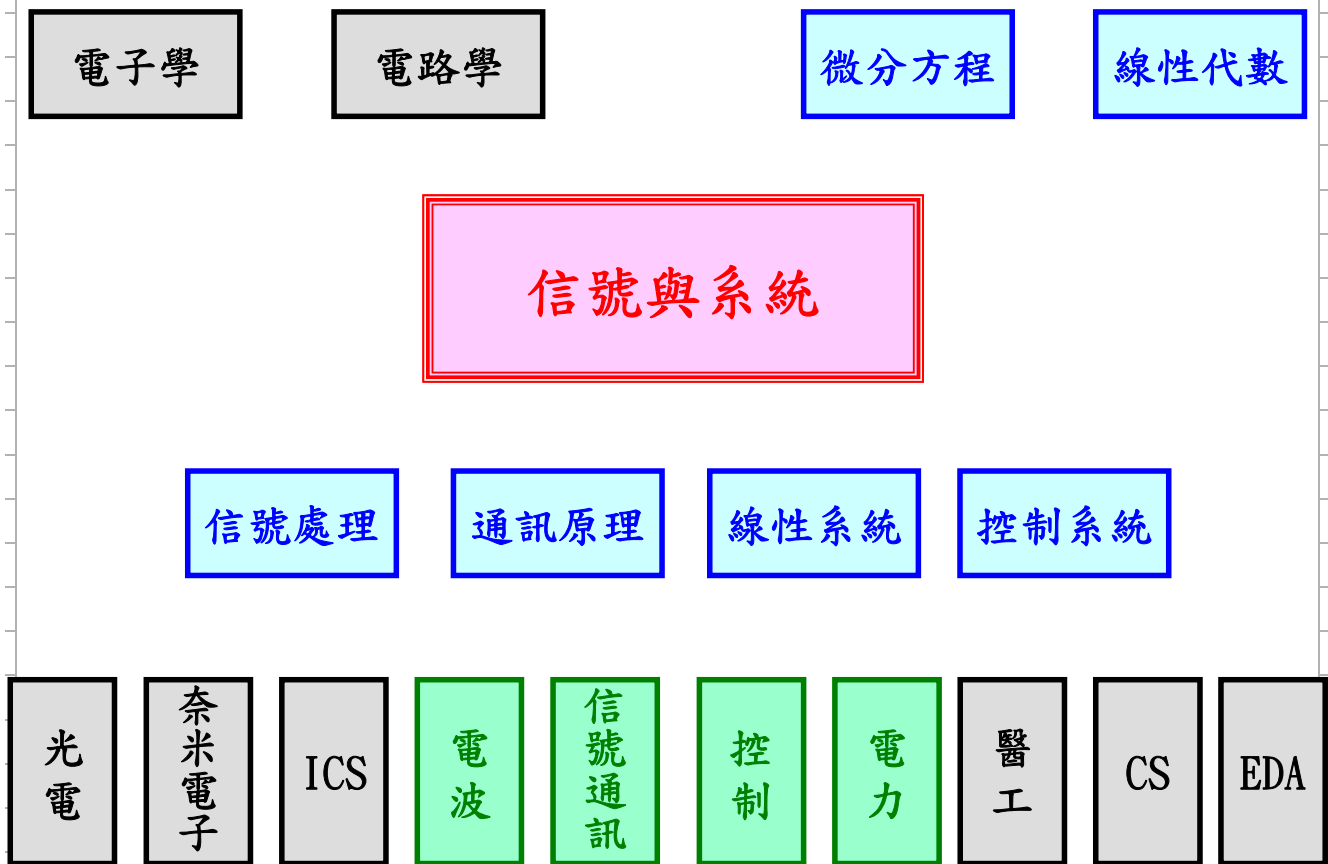


Figures and images used in these lecture notes are adopted from  
“Signals & Systems” by Alan V. Oppenheim and Alan S. Willsky, 1997

### Basic Course Information

Feng-Li Lian © 2015  
NTUEE-SS0-Intro-2

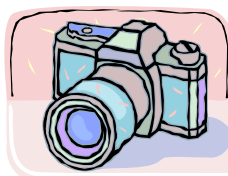
|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 課程概述 | 重點為 <u>信號處理</u> 與 <u>系統分析</u> 。<br>與其他三個班比較來說，<br>本班會比較強調 <u>系統分析</u> 。                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 課程目標 | 瞭解 <u>信號處理</u> 與 <u>系統分析</u> 的<br><u>基本定義</u> ， <u>理論原理</u> ， <u>操作方式</u> ，與 <u>工程應用</u> 等。                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 說明   | <ol style="list-style-type: none"><li>課程的進行模式為：<ul style="list-style-type: none"><li>學生於課前，先自行上網研讀課程內容。</li><li>然後，在上課時間，針對該週進度，進行討論。</li><li>也就是，在上課時間，並不會依照課本內容順序逐一進行講解。</li><li>課後：練習手寫與Matlab作業，繳交作業，準備考試。</li></ul></li><li>課前上網研讀，建議如下：<ul style="list-style-type: none"><li>觀看上課內容之影片：登入 lknow.net 使用。</li><li>觀看影片之時，於網站上記錄重點與回答問題。</li></ul></li><li>四個班級：<ul style="list-style-type: none"><li><u>統一課本</u>，<u>統一進度</u>，<u>統一作業</u>，<u>統一考試</u>，</li><li>但教學內容與方式<u>不一定一樣</u>。</li><li>所以，請選擇適合自己上課方式的班級。</li></ul></li></ol> |



## Introduction: Smart Phone with Camera, GPS etc.

### Smart Phone

From <http://www.iphone.com/>



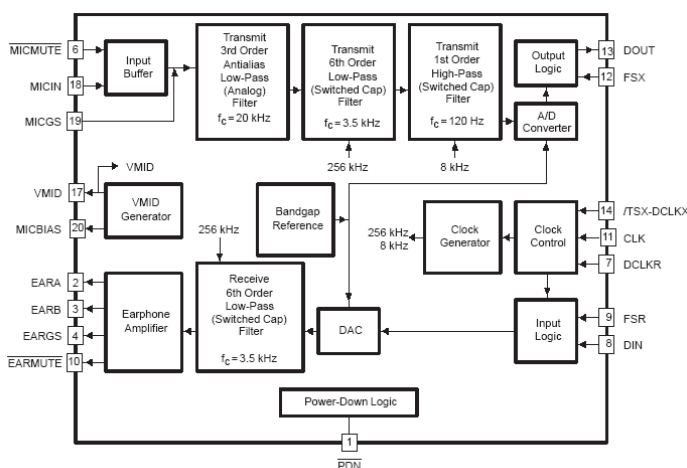
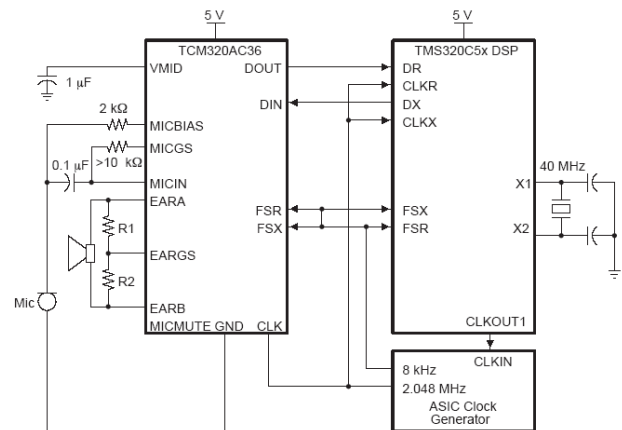
## ■ iPhone 6:

<http://www.iphone.com/>



- **Voice:**
  - 頻率響應範圍：20Hz 至 20,000Hz ???
- **Image:**
  - 全新 800 萬像素 iSight 攝錄鏡頭, Face Time: 120 萬像素照片 (1280 x 960)
  - 1080p HD 錄影功能 (每秒 30 影格或 60 影格)
- **Communication:**
  - UMTS/HSPA+/DC-HSDPA (850、900、1700/2100、1900、2100 MHz)
  - GSM/EDGE (850、900、1800、1900 MHz)
  - LTE (波段 1、2、3、4、5、7、8、13、17、18、19、20、25、26、28、29)
  - 802.11a/b/g/n/ac Wi-Fi (2.4GHz), 藍牙 4.0 無線技術 (2.4GHz), NFC
- **Computation:**
  - 64 位元架構的 A8 晶片
- **Memory:**
  - 16GB – 128GB of memory
- **Multimedia:**
  - 支援的音訊格式:  
AAC (8 至 320 Kbps)、HE-AAC、MP3 (8 至 320 Kbps)、MP3 VBR、Audible (格式 2、3、4、Audible Enhanced Audio、AAX 及 AAX+)、Apple Lossless、AIFF 以及 WAV
  - 支援的影片格式:  
H.264 High Profile level 4.2 編碼的 .m4v、.mp4 與 .mov 檔案格式, 最高可達 1080p、每秒 60 影格, 音訊為 AAC-LC 立體聲, 可達 160 Kbps、48kHz; 使用 MPEG-4 Simple Profile 編碼的 .m4v、.mp4 及 .mov 檔案格式, 可達 2.5 Mbps、640 x 480 像素, 每秒 30 影格, 音訊為 AAC-LC 立體聲, 每聲道可達 160 Kbps、48kHz; 使用 Motion JPEG (M-JPEG) 編碼的 .avi 檔案格式, 可達 35 Mbps、1280 x 720 像素, 每秒 30 影格, 音訊為 ulaw、PCM 立體聲

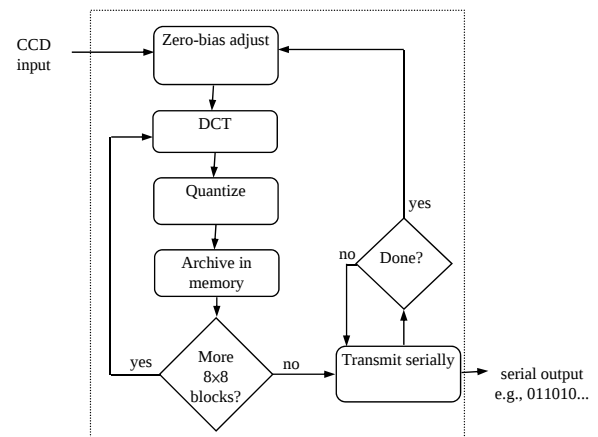
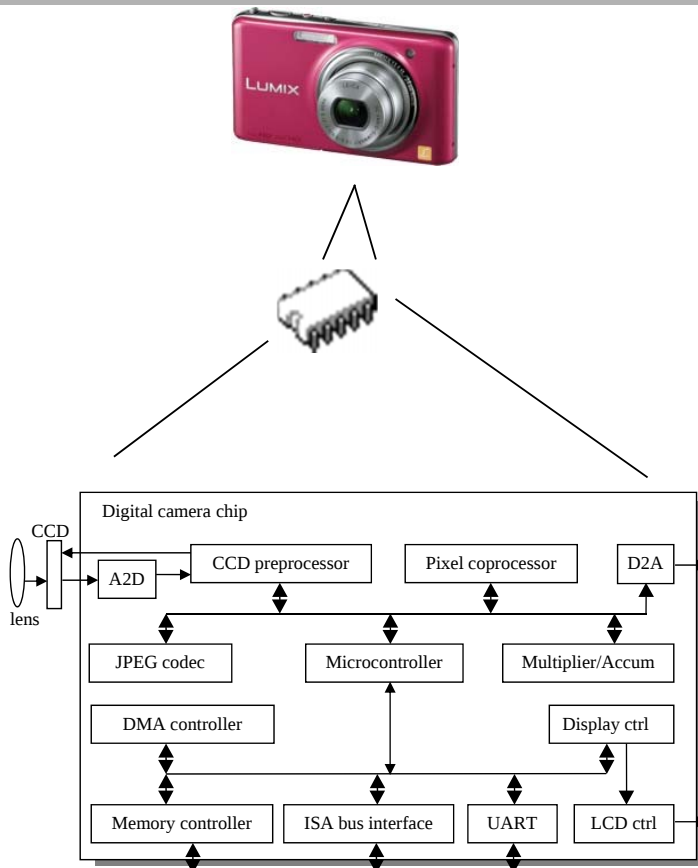
# Introduction: Voice Signal Processing



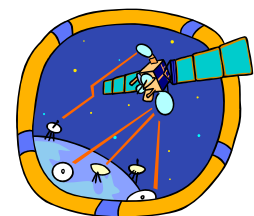
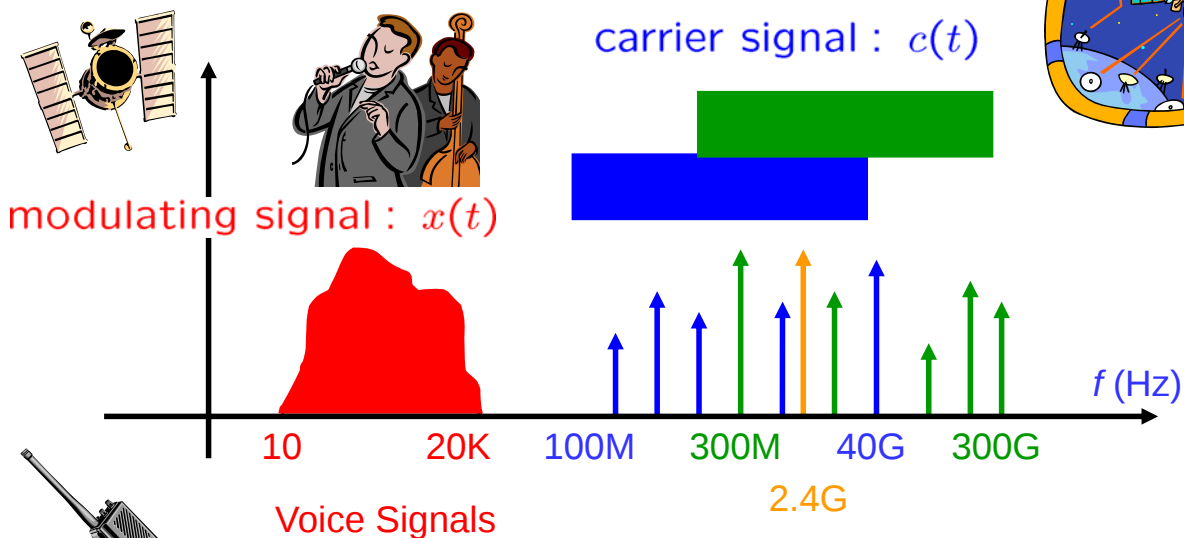
NOTE:  $f_c$  is the -3-dB cutoff frequency.



TCM320AC2x/4x Voice-Band Audio Processors  
SPRA146, Oct 1994, [www.ti.com](http://www.ti.com)



## Signal Frequency Characteristics:

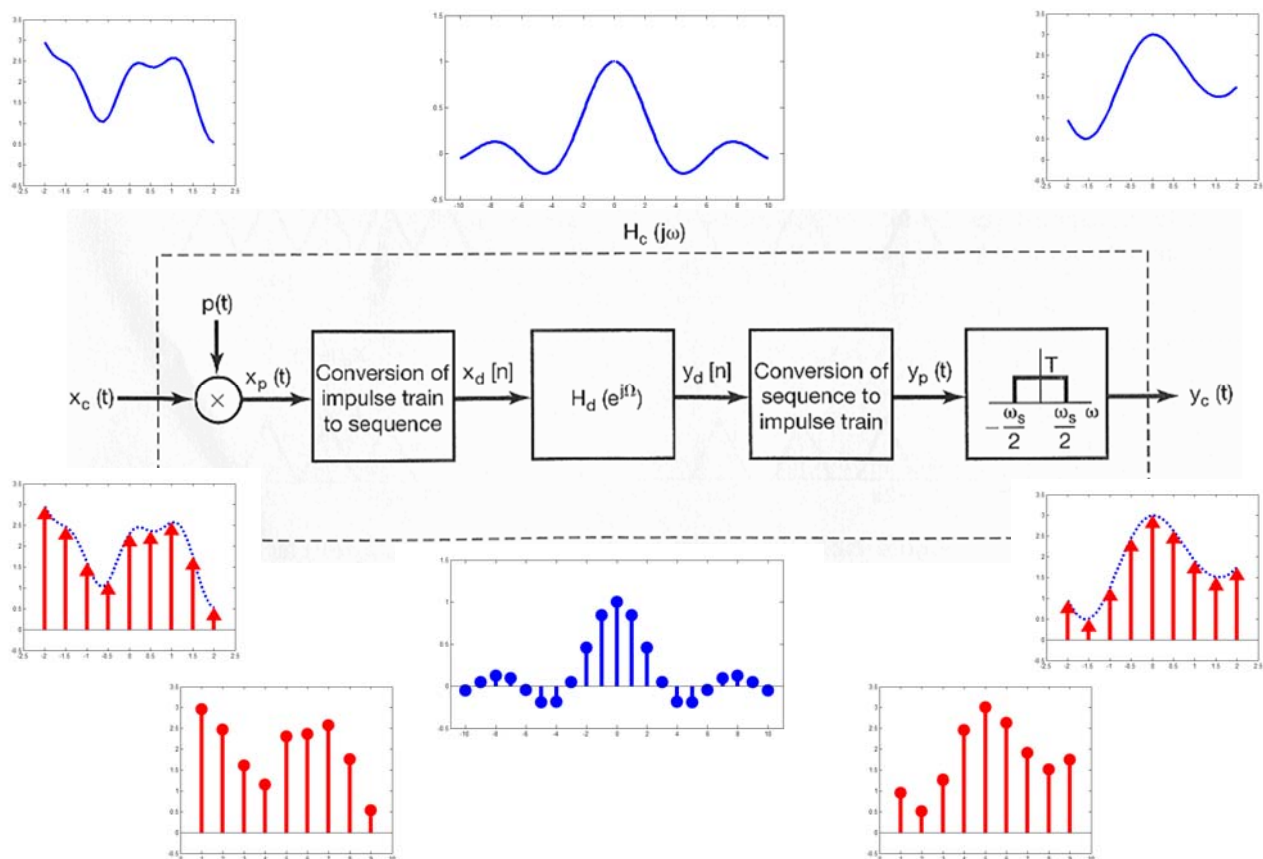


modulated signal :  $y(t) = x(t) c(t)$

Communication Satellite      Microwave Link

802.11 & Bluetooth





A (mathematical and engineering) **language**  
for describing **signals** and **systems**

AND

An extremely **powerfully** set of **tools**  
for **analyzing** them

- Examples of **Signals & Systems**:
  - **Circuit**
    - **Voltages** & **currents**
  - **Automobile**
    - **Pressure** on accelerator & automobile **speed**
  - **Electrocardiograms:**
    - Digitalized **electrocardiogram** & **heart rate**
  - **Camera:**
    - **Light** & **photograph**
  - **Robot arm:**
    - **Movement** & **motor speed**

### Lecture Information:

- Required for Sophomore:
  - Mondays, 9:30-11:00
  - Thursday, 1:30-3:00
  - MD231

<http://cc.ee.ntu.edu.tw/~fengli/Teaching/SignalsSystems>

### Instructor:

- 連豐力 (Feng-Li Lian)
- Office: MD717
- Email: fengli AT ntu DOT edu DOT tw
- Phone: 02-3366-3606

### Grading:

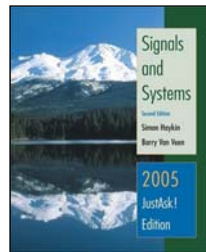
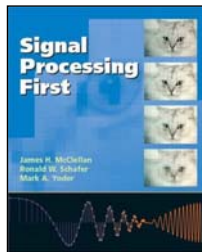
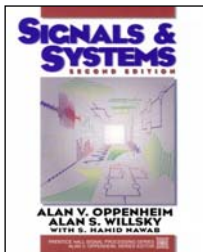
- Homework and Program (30%)
- Midterm Exam (35%)
- Final Exam (35%)

### Course Outline:

1. Signals and Systems
2. Linear Time-Invariant Systems
3. Fourier Series Representation of Periodic Signals
4. The Continuous-Time Fourier Transform
5. The Discrete-Time Fourier Transform
9. The Laplace Transform
10. The z-Transform
6. Time and Frequency Characterization
7. Sampling
8. Communication Systems
9. Linear Feedback Systems (optional)

### Textbooks:

1. **Signals and Systems**, 1997 by Oppenheim, Willsky & Nawab (Required)
2. **Signal Processing First**, 2003 by McClellan, Schafer & Yoder (Reference book with CD-ROM)
3. **Signals & Systems**, 2003, 2nd Ed. by Haykin & Van Veen, John Wiley & Sons (Reference book)



02/08/14

## Course Flowchart

Signals &amp; Systems (Chap 1)

LTI &amp; Convolution (Chap 2)

### Bounded/Convergent

#### Periodic

FS

(Chap 3)

- CT
- DT

#### Aperiodic

FT

- CT (Chap 4)
- DT (Chap 5)

### Unbounded/Non-convergent

LT

- CT (Chap 9)

zT

- DT (Chap 10)

CT-DT (Chap 7)

Communication (Chap 8)

Time-Frequency (Chap 6)

Control (Chap 11)