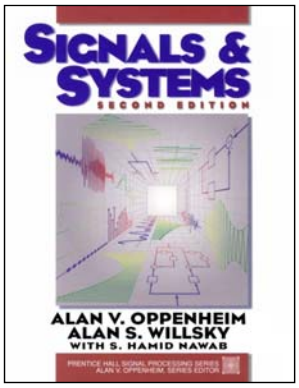
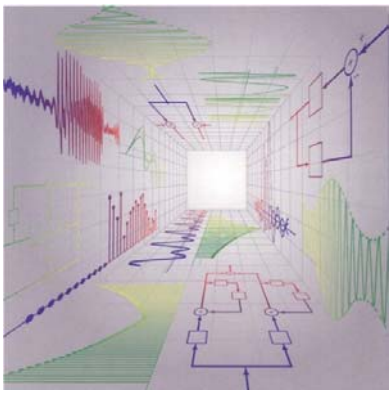
Spring 2013

信號與系統
Signals and Systems

Chapter SS-0
Introduction



Feng-Li Lian
NTU-EE
Feb13 – Jun13

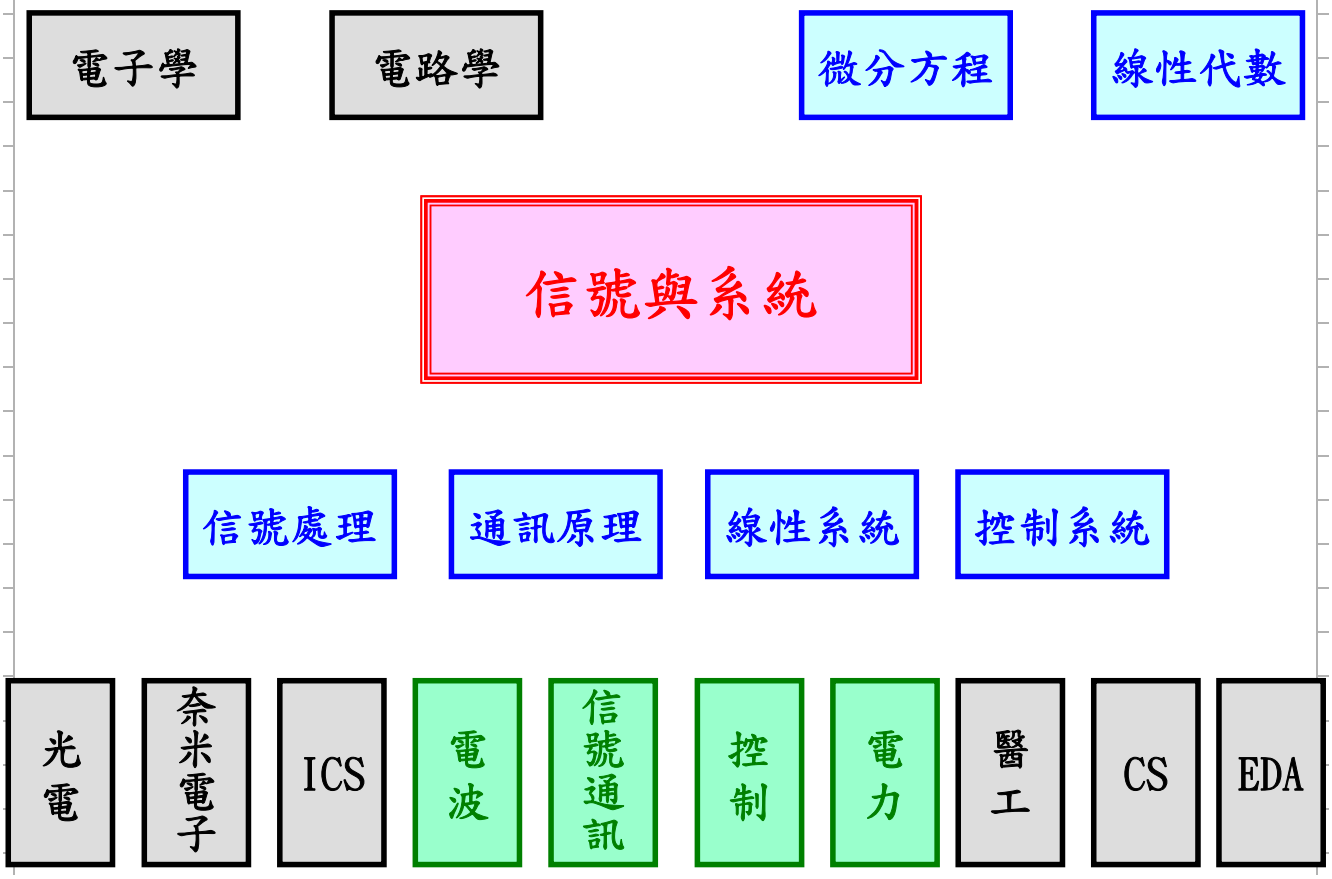


Figures and images used in these lecture notes are adopted from "Signals & Systems" by Alan V. Oppenheim and Alan S. Willsky, 1997

Basic Course Information

課程概述	重點為信號處理與系統分析。 與其他三個班比較來說， 本班會比較強調系統分析。
課程目標	瞭解信號處理與系統分析的 *基本定義*，*理論原理*，*操作方式*，與*工程應用*等。
說　明	1. 課程的進行模式為： • 學生於課前，先自行上網研讀課程內容。 • 然後，在上課時間，針對該週進度，進行討論。 • 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。 2. 課前上網研讀，建議如下： • 以四位同學為一個小組一起共同進行。 • 四位同學的組成，建議參考微方、線代與電路三科平均成績， • 以"兩位同學為70分以上，兩位為70分以下"為最佳組合。 3. 四個班級： • 統一課本，統一進度，統一作業，統一考試， • 但教學內容與方式不一定一樣。 • 所以，請選擇適合自己上課方式的班級。

Course Flowchart in NTU-EE



Introduction: Smart Phone with Camera, GPS etc.

- iPhone

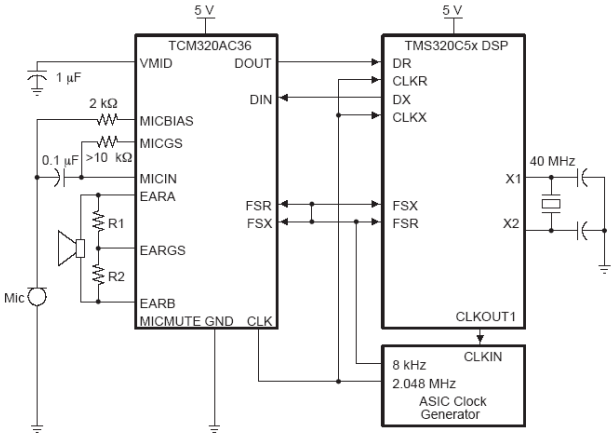
From http://www.htc.com/tw/

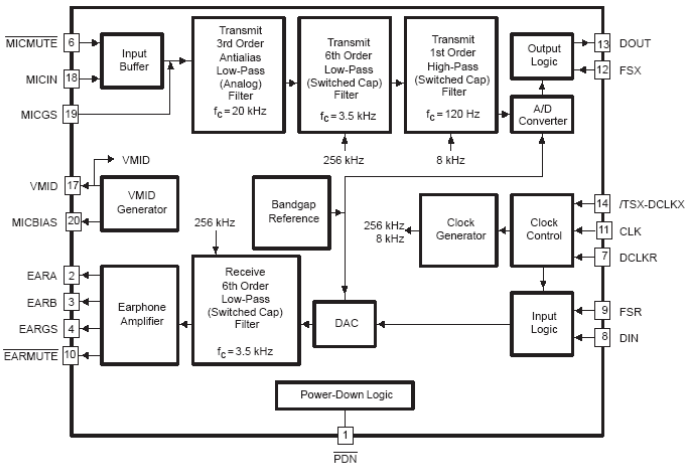
Introduction: Cellular Phone with Digital Camera

http://www.htc.com/tw/

- HTC Butterfly:
  - Voice:
    - 頻率響應範圍：20Hz 至 20,000Hz
    - 音質效果：Beats Audio™
  - Image:
    - 800 萬像素彩色相機
    - 錄影功能可錄製 1080p HD 高解析影像
    - 210萬畫素前鏡頭，視訊通話時支援1080p高解析影像
  - Communication:
    - HSPA/WCDMA (850、2100 MHz)
    - GSM/GPRS/EDGE (850、900、1800、1900 MHz)
    - 802.11a/b/g/n Wi-Fi (僅限 802.11n 2.4GHz)
    - Bluetooth 4.0 無線技術
  - Computation:
    - 1.5GHz 四核心
  - Memory:
    - 16GB of memory
  - Multimedia:
    - 支援的音訊格式: .aac, .amr, .ogg, .m4a, .mid, .mp3, .wav, .wma (Windows Media Audio 9)
    - 支援的影片格式: .3gp, .3g2, .mp4, .wmv (Windows Media Video 9), .avi (MP4 ASP and MP3)

Introduction: Voice Signal Processing

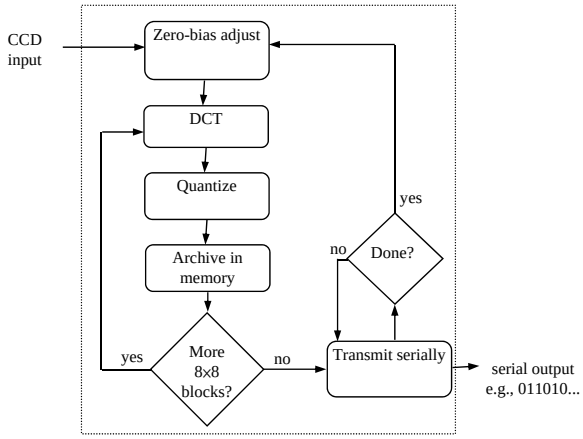


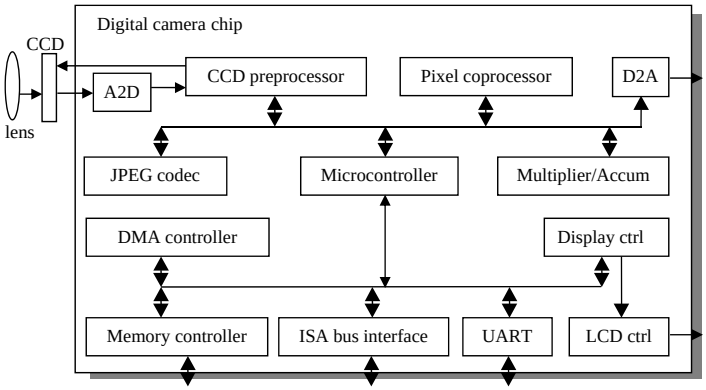


NOTE: f_c is the –3-dB cutoff frequency.

TCM320AC2x/4x Voice-Band Audio Processors
SPRA146, Oct 1994, www.ti.com

Introduction: Image Processing in Digital Camera

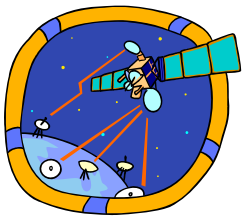


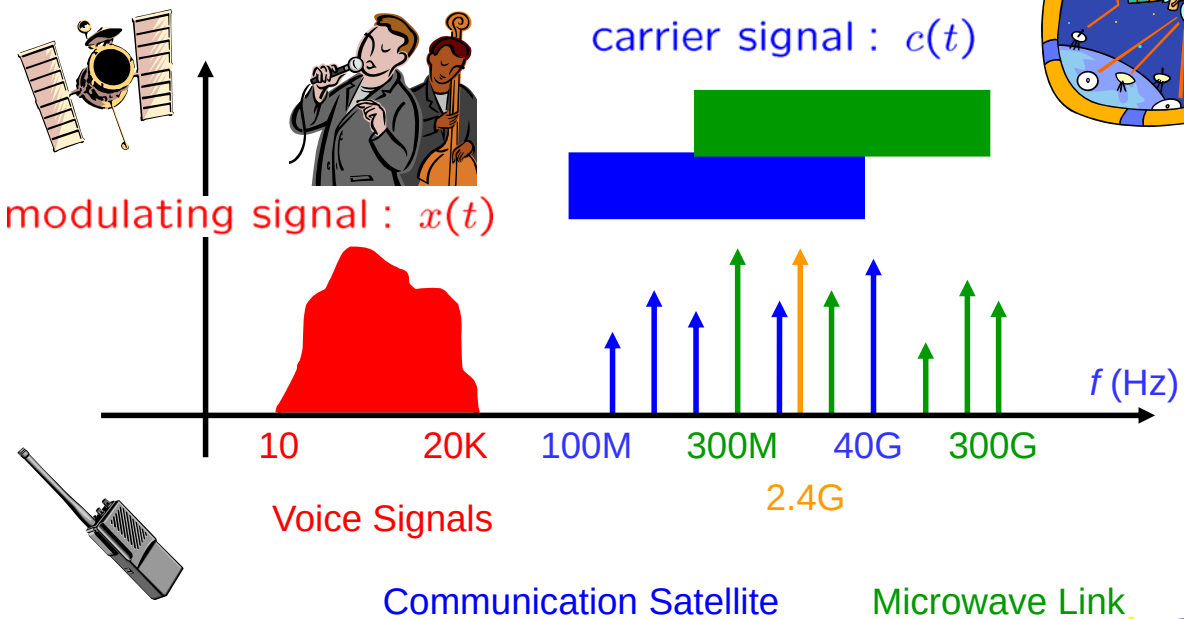


Embedded Systems Design: A Unified Hardware/Software Introduction, (c) 2000 Vahid/Givargis

Introduction: Modulation & Demodulation in Communication

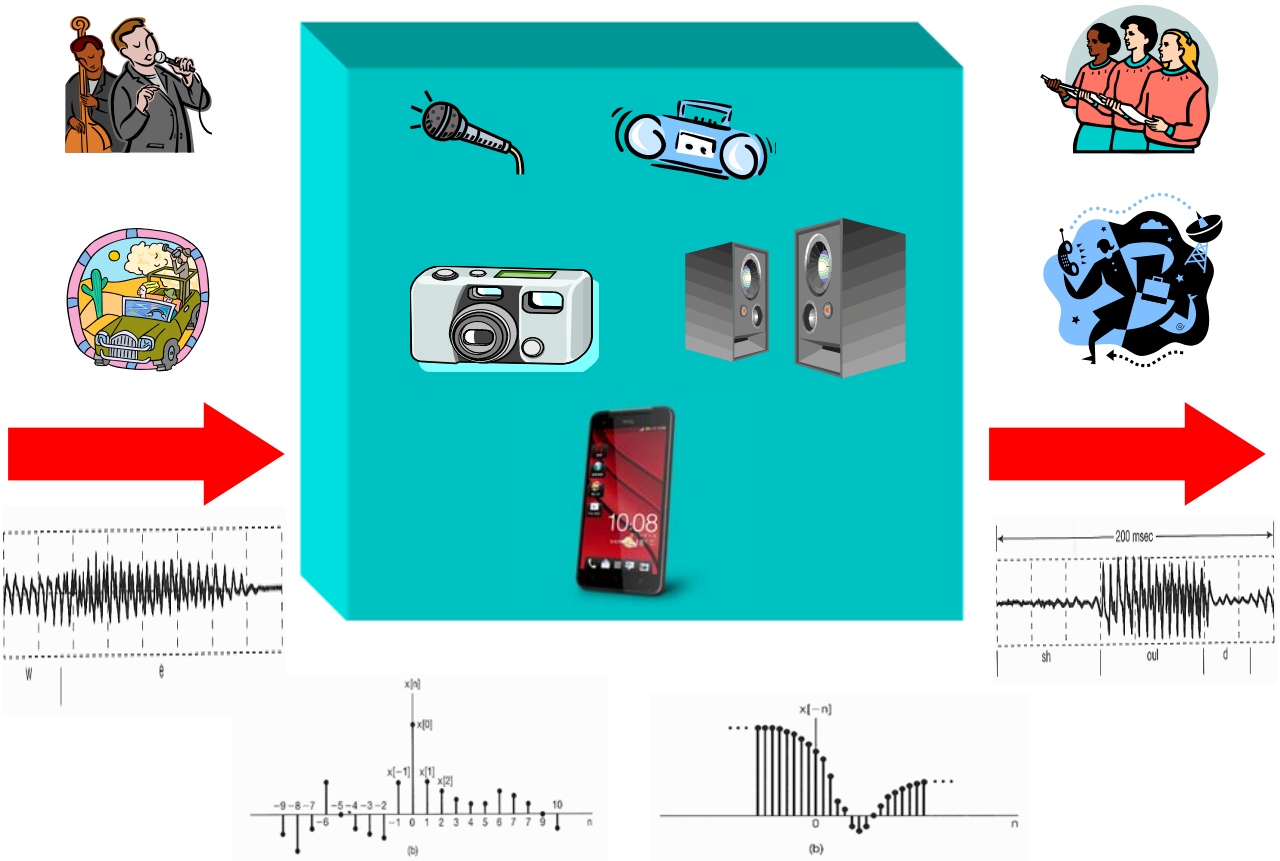
- Signal Frequency Characteristics:



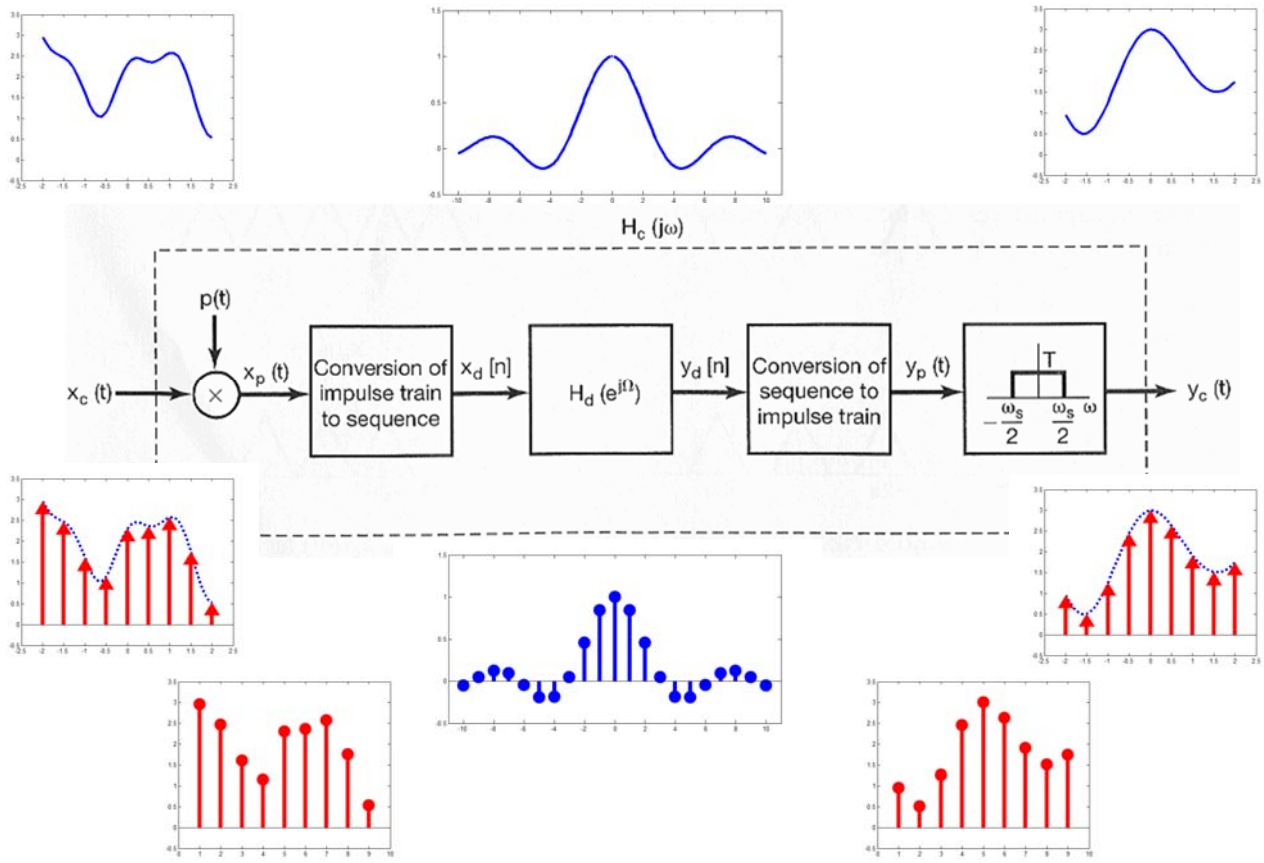


modulated signal : $y(t) = x(t)\ c(t)$

Introduction: Signal Processing



Introduction: Digital Signal Processing



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

AND

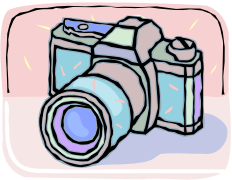
An extremely powerfully set of tools
for analyzing them

- 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

Introduction: Smart Phone with Camera, GPS etc.

- iPhone

From http://www.htc.com/tw/

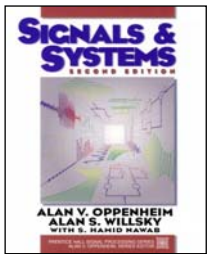


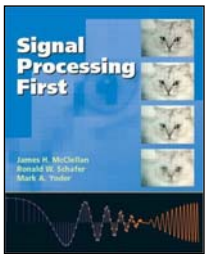
Introduction: Humanoid Robot - ROBOSAPIEN V3

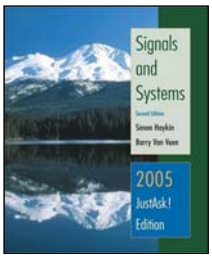
- ROBOSAPIEN V3

Syllabus

- Lecture Information:
  - Required for Sophomore:
    - Mondays, 9:30-10:10, 10:20-11:00
    - Thursday, 1:30-2:10, 2:20-3:00
    - MD231
- http://cc.ee.ntu.edu.tw/~fengli/Teaching/SignalsSystems
- Instructor:
  - 連豊力(Feng-Li Lian)
  - Office: MD717
  - Email: fengli AT ntu DOT edu DOT tw
  - Phone: 02-3366-3606
- Grading:
  - MATLAB Homework (20%)
  - Written Homework (10%)
  - 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 Willey & Sons
     (Reference book)

Course Flowchart

Course Flowchart

Signals & Systems (Chap 1) LTI & Convolution (Chap 2)

Course Flowchart

Signals & Systems (Chap 1) LTI & Convolution (Chap 2)

Bounded/Convergent

Course Flowchart

Signals & Systems (Chap 1) LTI & Convolution (Chap 2)

Bounded/Convergent

Periodic **Aperiodic**

Course Flowchart

Signals & Systems (Chap 1) LTI & Convolution (Chap 2)

Bounded/Convergent

Periodic

– CT

– DT

(Chap 3)

Aperiodic

– CT (Chap 4)

– DT (Chap 5)

Course Flowchart

Signals & Systems (Chap 1) LTI & Convolution (Chap 2)

Bounded/Convergent

Periodic

FS (Chap 3)
– CT
– DT

FT

Aperiodic

– CT (Chap 4)
– DT (Chap 5)

Course Flowchart

Signals & Systems (Chap 1) LTI & Convolution (Chap 2)

Bounded/Convergent

Periodic

FS (Chap 3)
– CT
– DT

FT

Aperiodic

– CT (Chap 4)
– DT (Chap 5)

Unbounded/Non-convergent

Course Flowchart

Signals & Systems (Chap 1) LTI & Convolution (Chap 2)

Bounded/Convergent

Periodic

FS (Chap 3)

– CT

– DT

Aperiodic

FT

– CT (Chap 4)

– DT (Chap 5)

Unbounded/Non-convergent

– CT (Chap 9)

– DT (Chap 10)

Course Flowchart

Signals & Systems (Chap 1) LTI & Convolution (Chap 2)

Bounded/Convergent

Periodic

FS (Chap 3)

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Course Flowchart

Signals & Systems (Chap 1)

LTI & Convolution (Chap 2)

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Periodic

FS (Chap 3)
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LT – CT (Chap 9)

zT – DT (Chap 10)

Course Flowchart

Signals & Systems (Chap 1)

LTI & Convolution (Chap 2)

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FS (Chap 3)
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Aperiodic

FT
– CT (Chap 4)
– DT (Chap 5)

Unbounded/Non-convergent

LT – CT (Chap 9)

zT – DT (Chap 10)

CT-DT (Chap 7)

Time-Frequency (Chap 6)

Course Flowchart

Signals & Systems (Chap 1)

LTI & Convolution (Chap 2)

Bounded/Convergent

Periodic

FS (Chap 3)
– CT
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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)