

EE2019: Analog Systems & Lab.

Introduction

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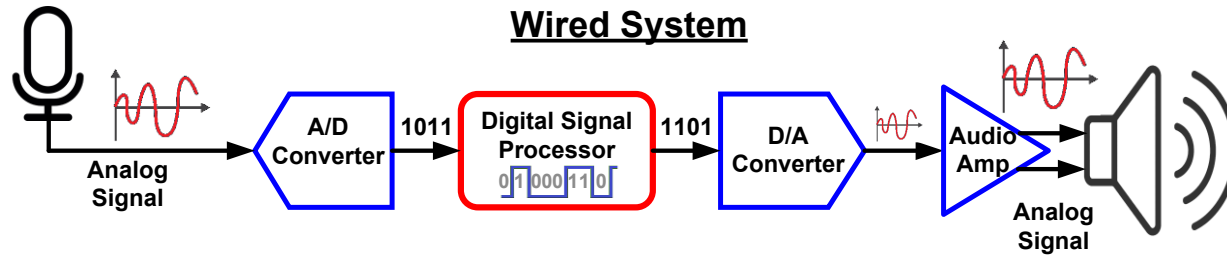
Why Analog?

- ❑ **The world is analog !!!**

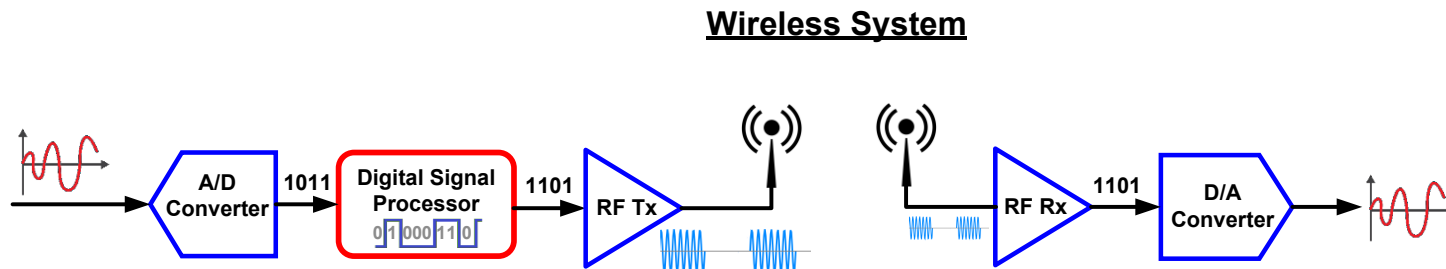
- ❑ **In real world, input and output signal are analog**
 - We speak in analog and we hear in analog

- ❑ **Signals can be processed either in analog or digital**
 - Digital processing requires A/D converter which is again an analog system
 - Clock generators or oscillators are analog
 - Voltage regulators are analog
 - Before signals are processed in digital, may also require pre-amplification and pre-filtering which is done in analog
 - Wireless signals are analog

Example of Real World Systems



Blue → Analog
Red → Digital



Inside a Mobile System

Analog/Mixed Signal

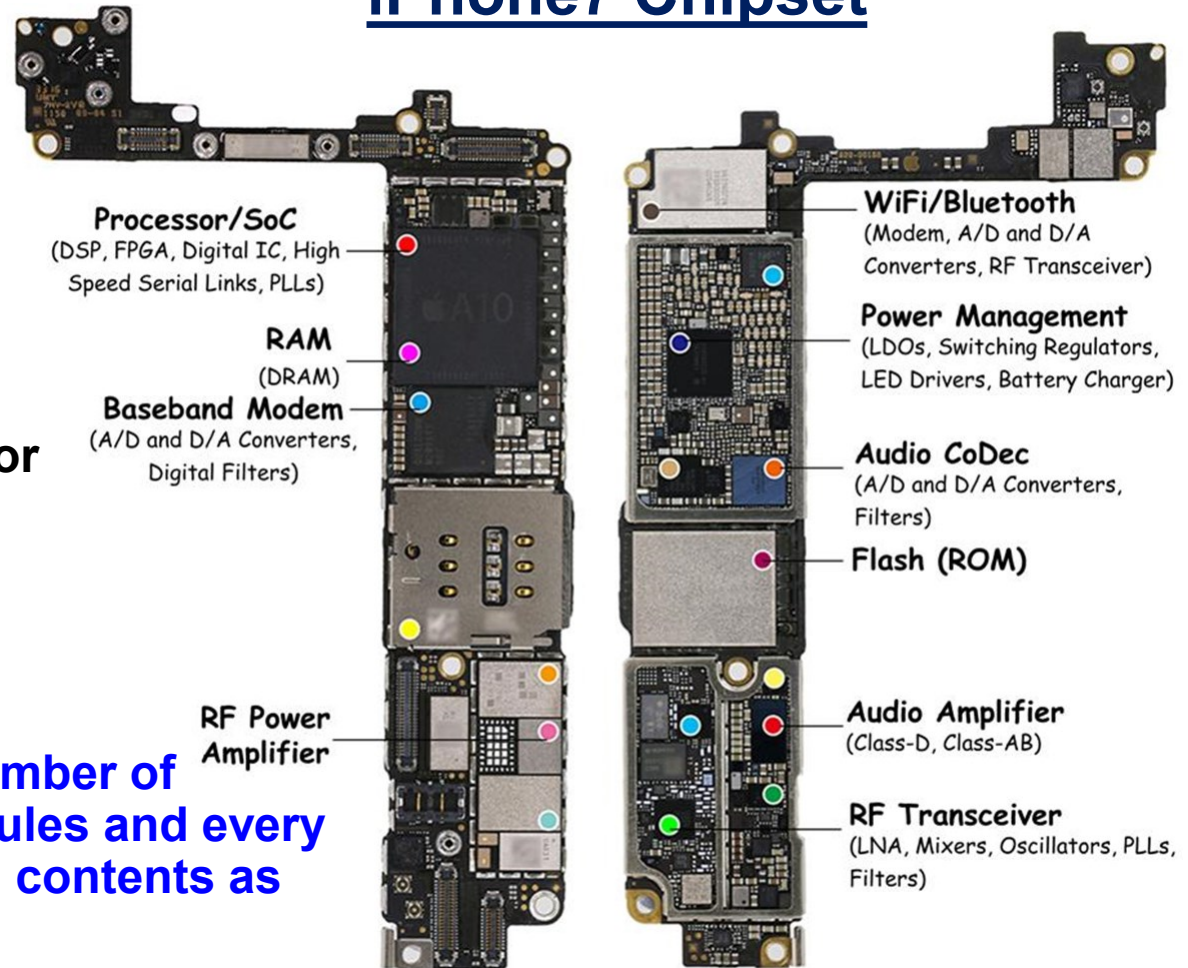
- A/D and D/A
- Oscillators, PLLs
- Audio Amplifier
- RF Transceiver
- Power Management

Digital

- Application Processor
- Baseband Modem
- DSP
- Memories

There are significant number of standalone analog modules and every digital has some analog contents as well

iPhone7 Chipset



Applications of Analog in Real World

Real World: Sensors & Actuators



Environment



Health



Industry



Security



Wireless Communication



Wireline Comm.

- End of row aggregation
Faster XSR/VSR
- Same rack
Direct copper cables (LR)

DDR4:	3.2Gb/s
Mipi-MPHY:	5Gb/s
GPI:	7.4Gb/s
USB 3.1:	10Gb/s
PCIe 4.0:	16Gb/s
HDMI 2.0:	18Gb/s
Infiniband:	25Gb/s
IEEE 802.3b:	25 Gb/s

Motherboard

Wireline Communication

<https://www.google.com/about/datacenters/gallery/#/tech/20>

- ❑ Sensors & actuators
- ❑ Analog to Digital Conv.
- ❑ Digital to Analog Conv.
- ❑ RF wireless transceiver
- ❑ Wireline communication
- ❑ Power management of ICs
- ❑ Digital signal processing

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❑ Power management of ICs

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Analog

&

Mixed Signal

Circuits

Analog IC Design in India

- ❑ Many companies starting analog centers**
- ❑ Multinationals and Indian start ups**
- ❑ Big demand for skilled designers**
- ❑ Interesting and profitable activity**

Course Goals

Theory & Lab

- ❑ Negative feedback at system & block level
- ❑ Stabilization of feedback circuits
- ❑ Applications
 - Opamp based amplifiers with precise gain
 - Opamp based active filters
 - Low Dropout Regulators (LDOs)
 - LC oscillators
 - Analog-to-digital / digital-to-analog converters
 - DC-DC buck converter

Course Prerequisites

- Circuit analysis**
 - **Mesh, nodal analyses**
 - **RLC, linear dependent sources**
- Laplace transforms, frequency response**
- Differential equations**
- Basic digital logic gates**

- EE1101: Signals and Systems**
- EE2015: Electric Circuits and Networks**
- EE2001: Digital Systems and Lab**

Follow Up

- EE3002: Analog circuits**
- EE5390: Analog IC design**
- EE5320: Advanced Electrical Networks**
- EE534: Active Filter Design**

- EE6320: RF Integrated Circuits**
- EE6321: VLSI Data Conversion Circuits**
- EE6322: VLSI Broadband Comm. Circuits**
- EE6323: Wireless System Design**
- EE6324: Phase-Locked Loops**
- EE5325: Power Management Integrated Circuits**

Resources

Course homepage

- IITM moodle: <https://courses.iitm.ac.in/>
- http://www.ee.iitm.ac.in/vlsi/ee2019_2021/start

Recorded lectures

- <http://www.ee.iitm.ac.in/nagendra/videolectures/>

Text book

- None

Resources

□ References

- A. S. Sedra and K. C. Smith, *Microelectronic Circuits*, 5ed, Oxford University Press, 2004.
- Sergio Franco, *Design with operational amplifiers and analog ICs*, Tata McGraw Hill.
- Hayt and Kemmerly, *Engineering Circuit Analysis*, McGraw Hill, 6/e.
- B. P. Lathi, *Linear Systems and Signals*, Oxford University Press, 2nd edition, 2004.

Logistics

E slot

Odd roll numbers: Google Meet

Even roll numbers: Google Meet

Extended tutorial: Saturday, 9am-12pm, IE labs

Etiquette and expectations

- 85% attendance (includes tutorial sessions, excludes quizzes)**
- Must solve problems given in classes**

Must Know or Refresh

- Basic circuit analysis (nodal/mesh analysis)**
- Bode plots**
- Two port parameters**
- Differential equations and time domain solutions**
- Circuit analysis with Laplace transforms**
- (Links to recorded lectures on the webpage)**

Evaluation

- 4 quizzes-30%**
- End sem-50%**
- Tutorials-20%**
 - **Must attend**
 - **Marks based on number of problems solved completely**

Teaching Assistants

- Post any questions related to the course on the moodle forum**
- Office hours will be announced**

For More Curious Students

- ❑ **Simulate the circuits you see in class**
 - <http://www.ee.iitm.ac.in/nagendra/cadinfo.html>
 - **Online spice simulator at**
<http://www.ngspice.com/index.php>
- ❑ **Build the circuits**