JOINT INSTITUTE

交大密西根学院

Introduction

VE311 Electronic Circuits (Fall 2020)

Dr. Chang-Ching Tu

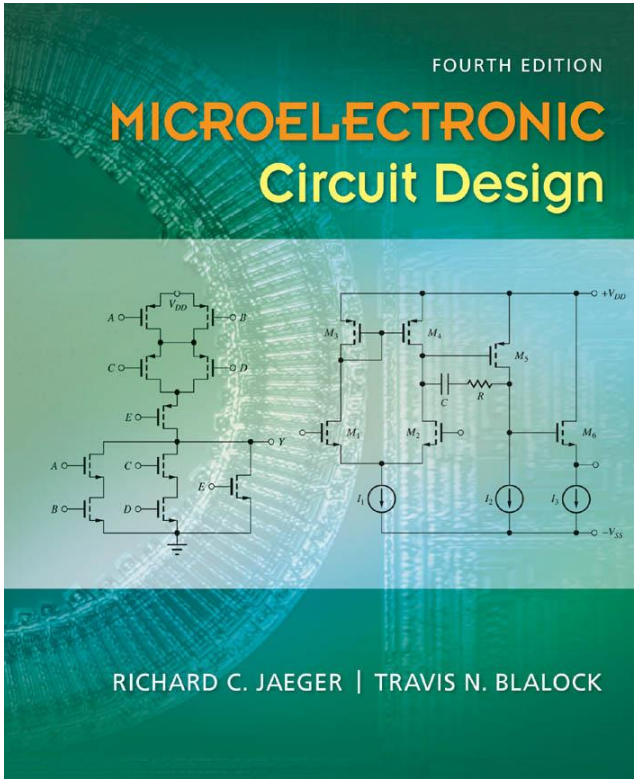
Last Updated on **September 6, 2020**

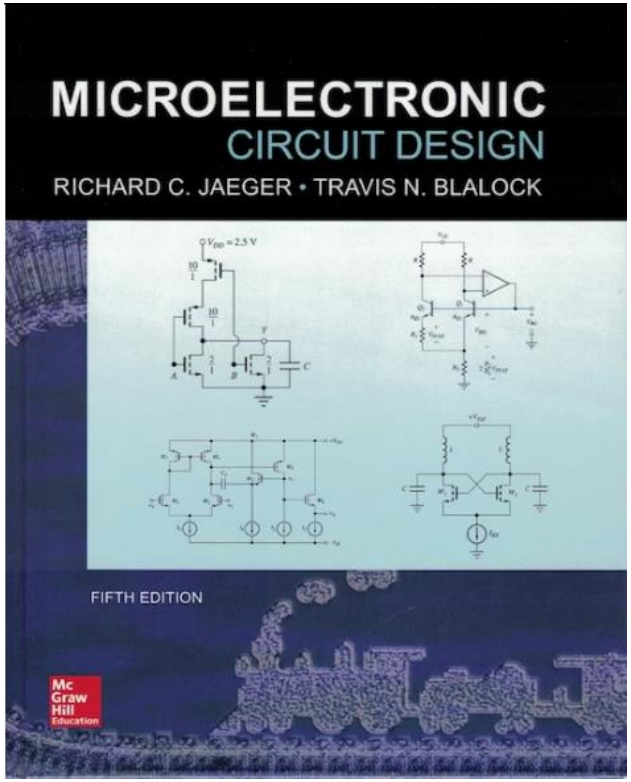
Instructor Short Biography

- **台湾交通大学** (1998 – 2002)
  电子工程学系 B.S.
- **台湾交通大学** (2002 – 2004)
  电子工程学系 M.S.
- **University of Washington, Seattle** (2006 – 2011)
  Electrical Engineering, Ph.D.

- **UW MSE Postdoc** (2011 – 2012)
- **LumiSands, Inc. Co-Founder / CEO** (2013 – 2017)
- **NCTU Applied Chemistry Postdoc** (2014 – 2017)
- **UM-SJTU JI Assistant Professor** (2017 –)

Textbook I

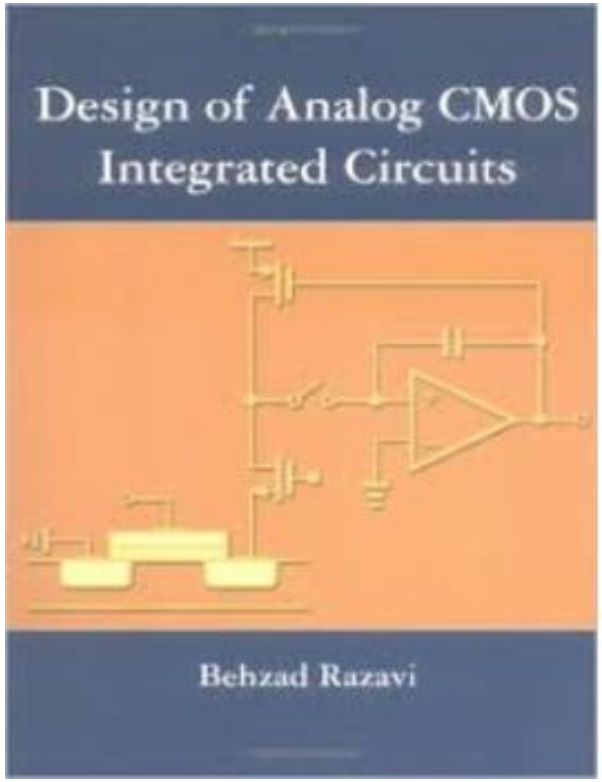


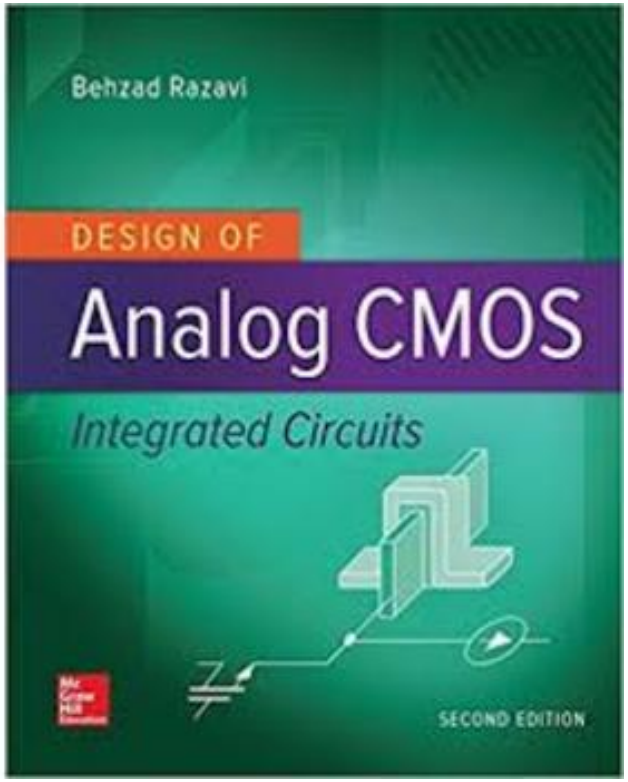


Richard C. Jaeger
Distinguished University Professor Emeritus
ECE Department
Auburn University

Travis N. Blalock
Visiting Associate Professor
ECE Department
University of Virginia

Textbook II





Behzad Razavi
ECE Department
UCLA

Lectures

Midterm Exam

- **Diode**
- **Diode Circuit**
- **BJT**
- **BJT Circuit**
- **MOSFET**
- **MOSFET Single Stage Amplifiers**
- **MOSFET Current Mirrors**
- **MOSFET Differential Amplifiers** (If time allows)

Final Exam

Labs

Lab 1

Diode Circuit (Rectifier)

Lab 2

BJT Circuit (Single-stage amplifier)

Lab 3

MOSFET Circuit (Single-stage amplifier)

Lab 4

MOSFET Circuit (Differential pair amplifier + Feedback)

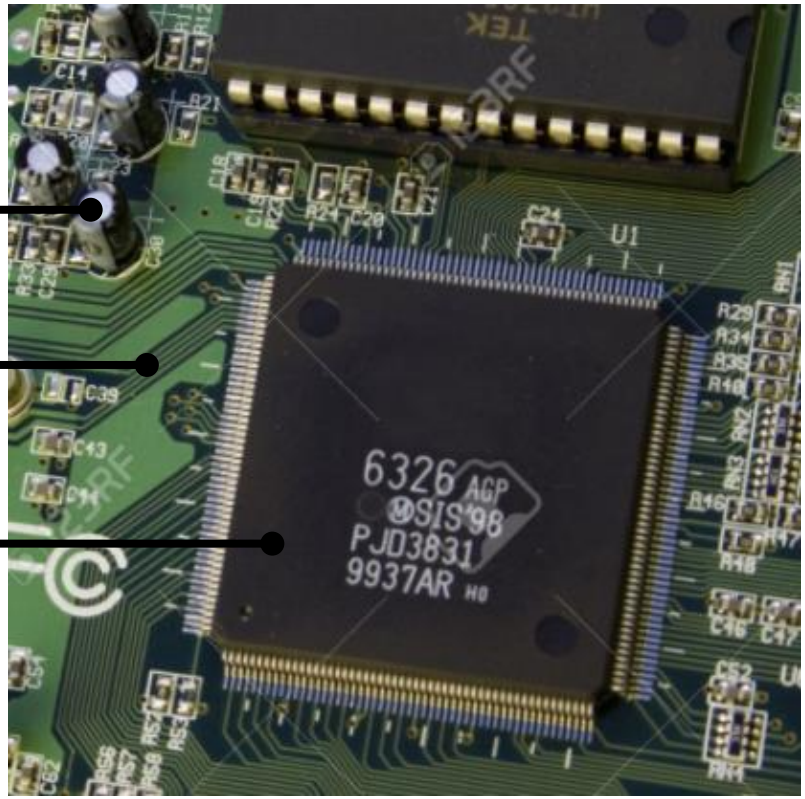
Grading Policy

- **8 × Assignments (with Pspice) (12%)**
- **4 × Lab Reports (Proteus + Lab) (12%)**
- **4 × Quizzes (4%)**
- **1 × Midterm Exam (32%)**
- **1 × Final Exam (40%)**

IT Hardware Industry Ecosystem

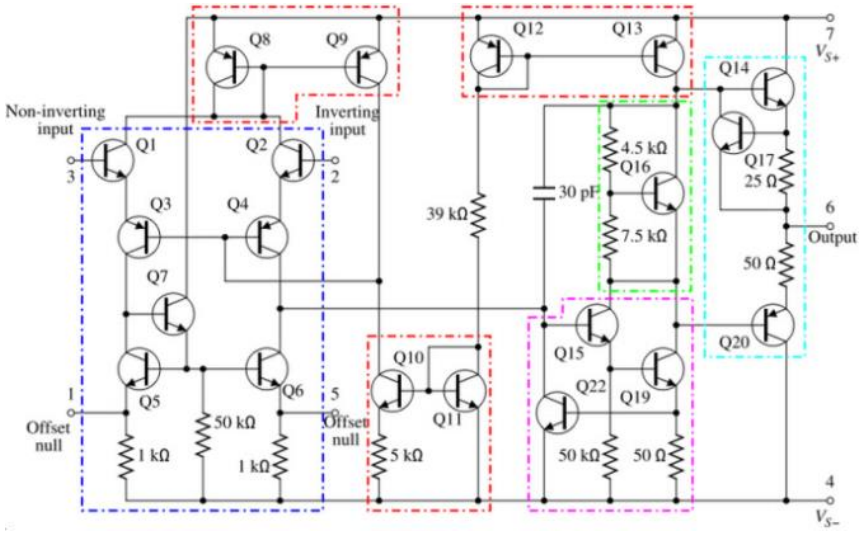
Apple
HP
Sony
Huawei
Samsung

Apple
Microsoft
Google
Amazon
腾讯
百度
阿里巴巴

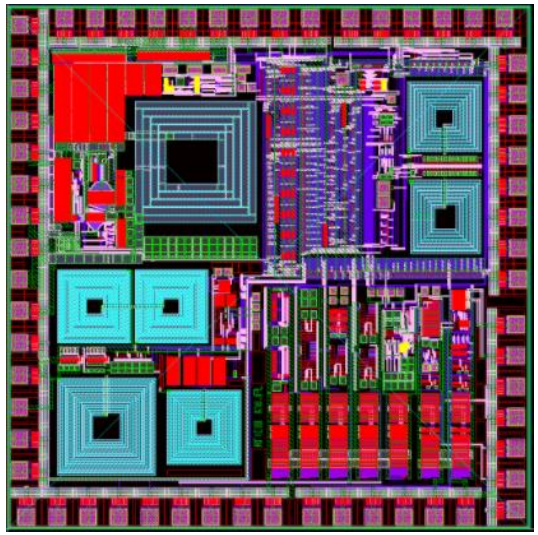


Foxconn
Huawei
Samsung

Qualcomm
Broadcom
MediaTek
NVIDIA
Marvell
Apple
Intel
Huawei (海思)
Samsung



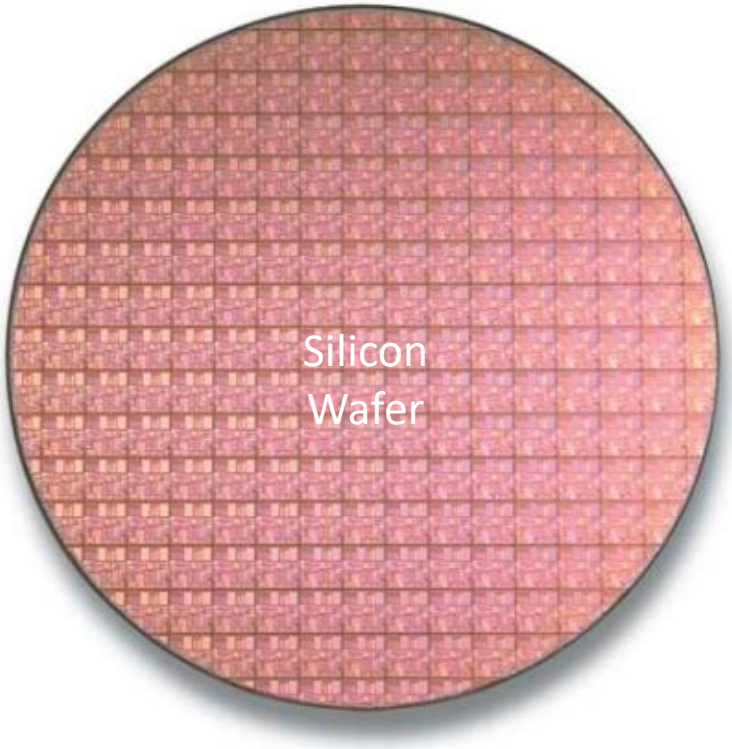
Schematic
(Spice)

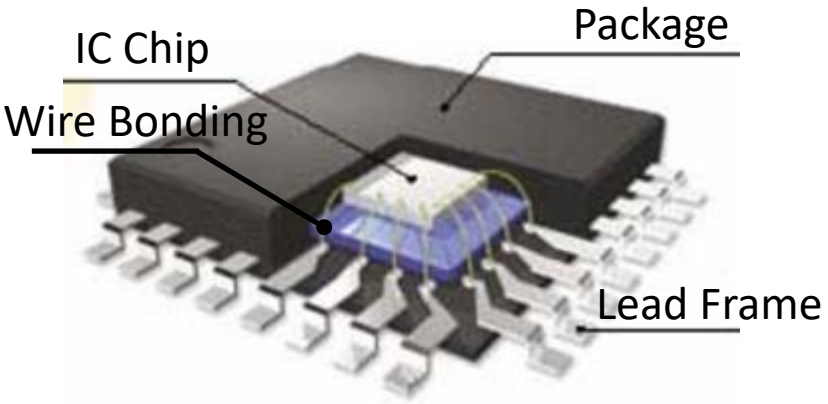


Layout
(Cadence)

VE215: Introduction to Circuits
VE311: Electronic Circuits
VE312: Digital Integrated Circuits
VE413: Monolithic Amplifier Circuits

TSMC
Intel
GlobalFoundries
Samsung
中芯半导体





VE320: Introduction to Semiconductor Devices
VE421: Properties of Transistors

Top IC Design Companies

Table: 2019 Revenue Ranking of Top 10 IC Design Companies (Unit: Million USD)

Ranking	Company	2019 Revenue	2018 Revenue	YoY
1	Broadcom	17,246	18,547	-7.0%
2	Qualcomm	14,518	16,370	-11.3%
3	NVIDIA	10,125	11,163	-9.3%
4	MediaTek	7,962	7,882	1.0%
5	AMD	6,731	6,475	4.0%
6	Xilinx	3,236	2,868	12.8%
7	Marvell	2,708	2,823	-4.1%
8	Novatek	2,085	1,813	15.0%
9	Realtek	1,965	1,518	29.4%
10	Dialog	1,421	1,442	-1.5%
Top 10 Total		**67,997**	**70,901**	**-4.1%**

联发科

联詠

瑞昱

Source: TrendForce, March, 2020

Top IC Manufacturers

台积电

联电

中芯

力晶

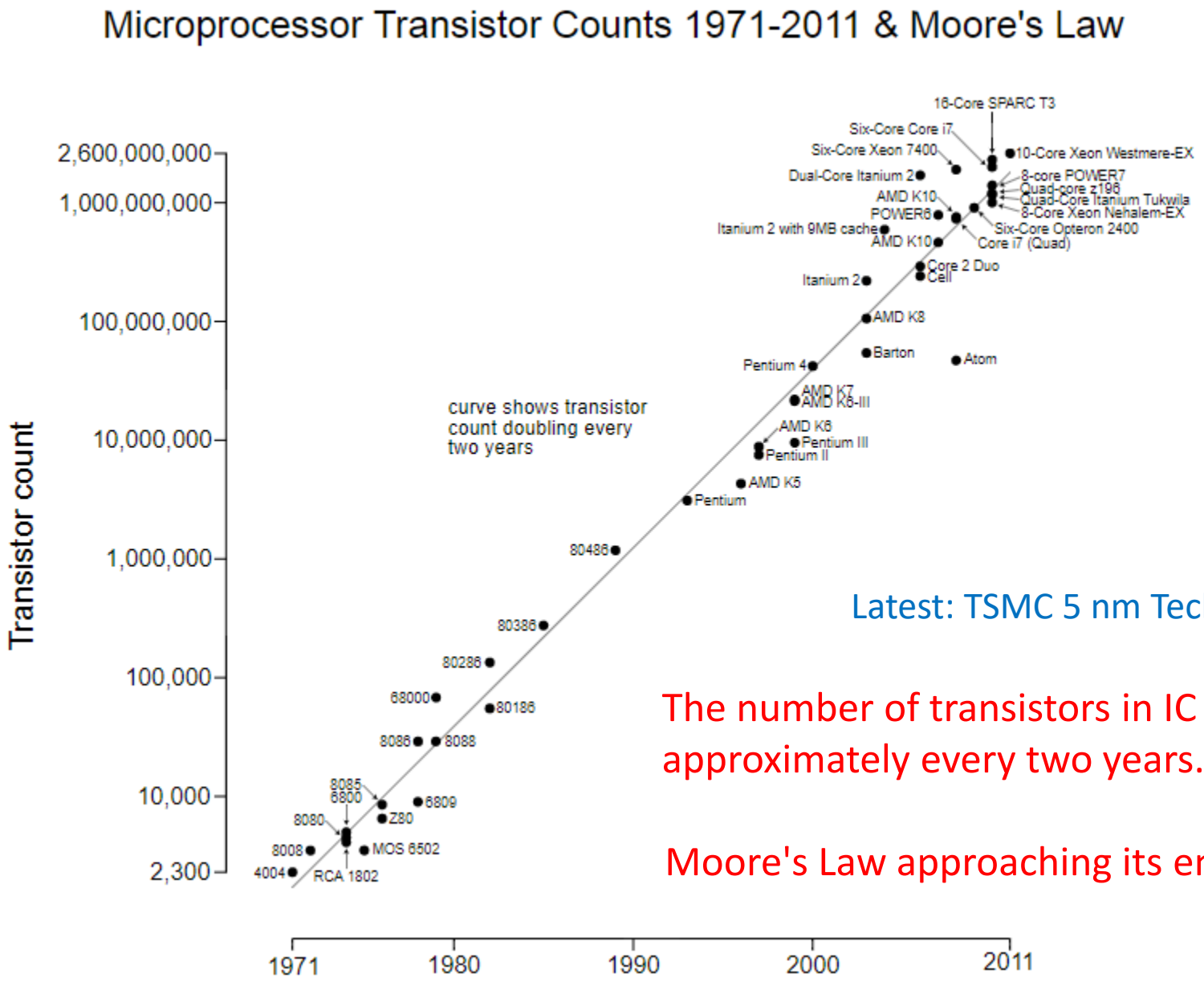
华虹

Table: Ranking of the Global Top 10 Foundries by Revenue, 1Q20 (Unit: Million USD)

Ranking	Company	1Q20E	1Q19	YoY	M/S
1	TSMC	10,200	7,096	43.7%	54.1%
2	Samsung	2,996	2,586	15.9%	15.9%
3	GlobalFoundries	1,452	1,256	15.6%	7.7%
4	UMC	1,397	1,057	32.2%	7.4%
5	SMIC	848	669	26.8%	4.5%
6	TowerJazz	300	310	-3.3%	1.6%
7	VIS	258	224	14.9%	1.4%
8	PSMC	251	178	41.2%	1.3%
9	Hua Hong	200	221	-9.4%	1.1%
10	DB HiTek	158	139	13.8%	0.8%
Top 10 Total		**18,060**	**13,737**	**31.5%**	**95.7%**

Source: TrendForce, March, 2020

Moore's Law

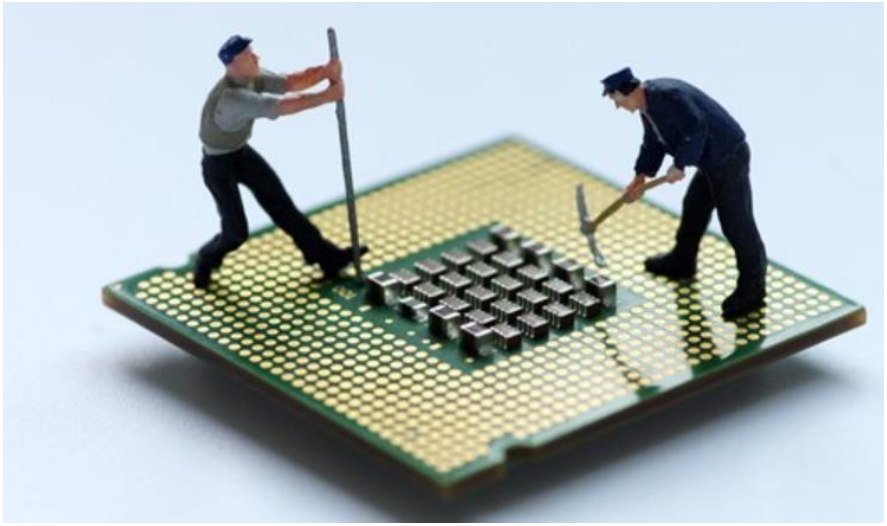


Latest: TSMC 5 nm Technology

The number of transistors in IC doubles approximately every two years.

Moore's Law approaching its end now?

Semiconductor Talent Gap in China



China faces talent gap in chips

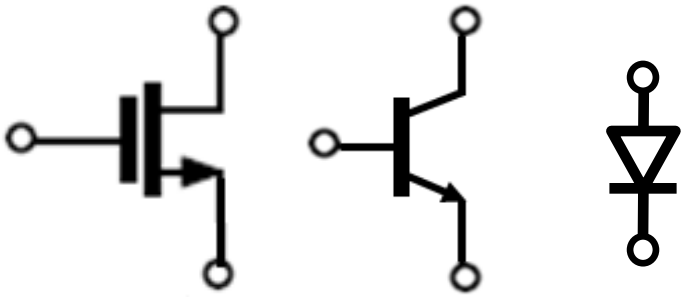
- *环球时报*, May 20th, 2019

There are only 400,000 semiconductor professionals in China, which needs more than 720,000 by 2020, leading to a gap of 320,000 in the talent pool, according to an industry white paper released last year by research firm CCIDC Consulting.

Active vs Passive Components

Active Components

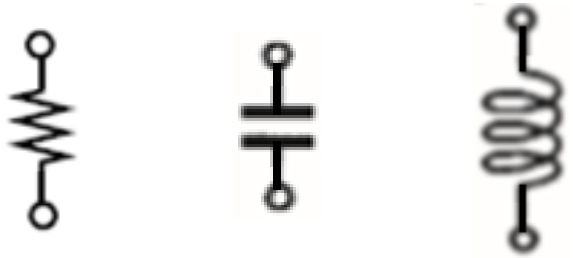
MOSFET BJT Diode



VE 311

Passive Components

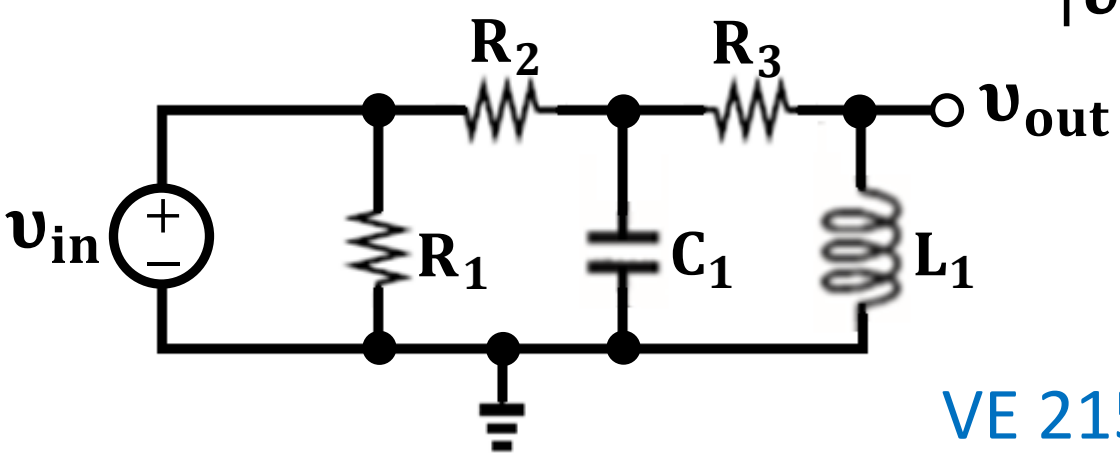
Resistor Capacitor Inductor

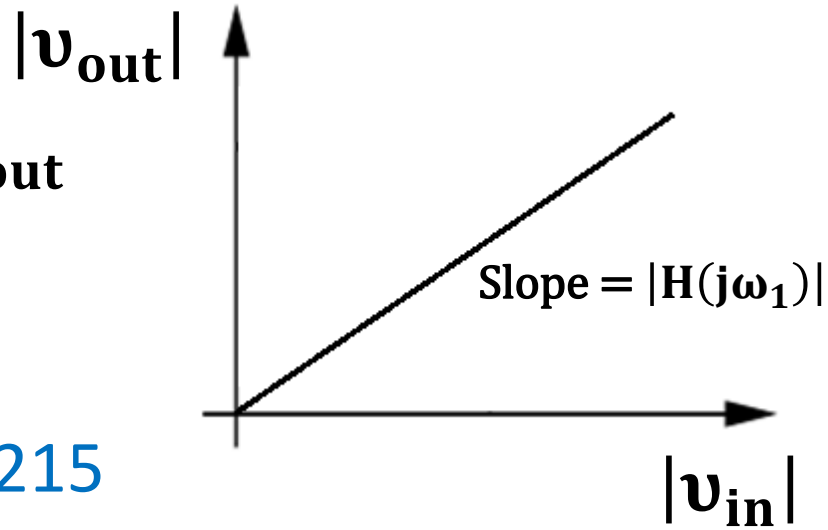


VE 215

Linear vs Nonlinear Circuit

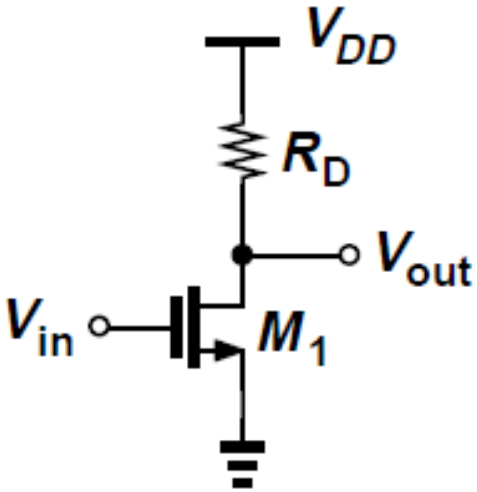
Linear Circuit

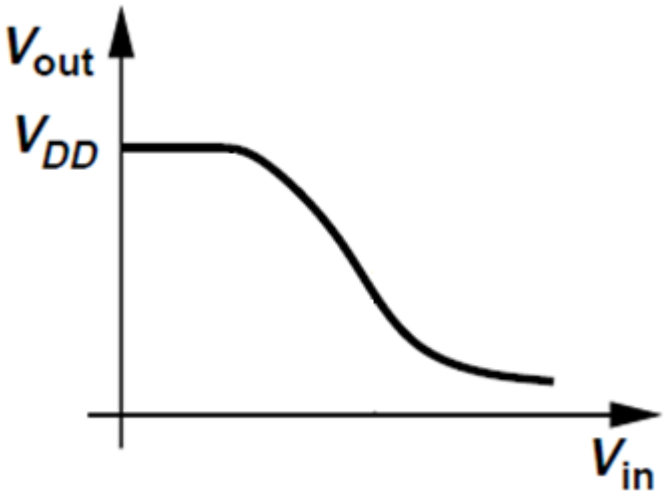




VE 215

Nonlinear Circuit

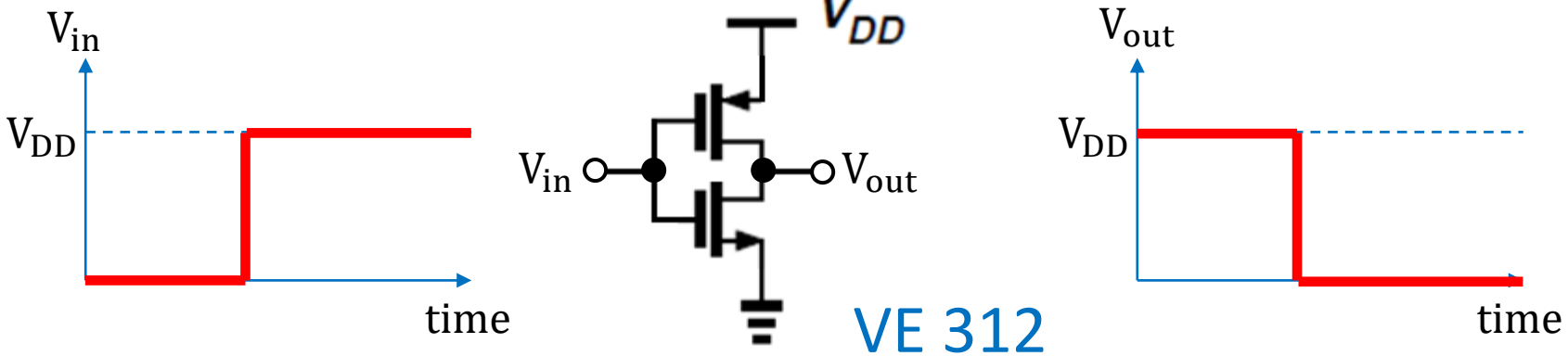




VE 311

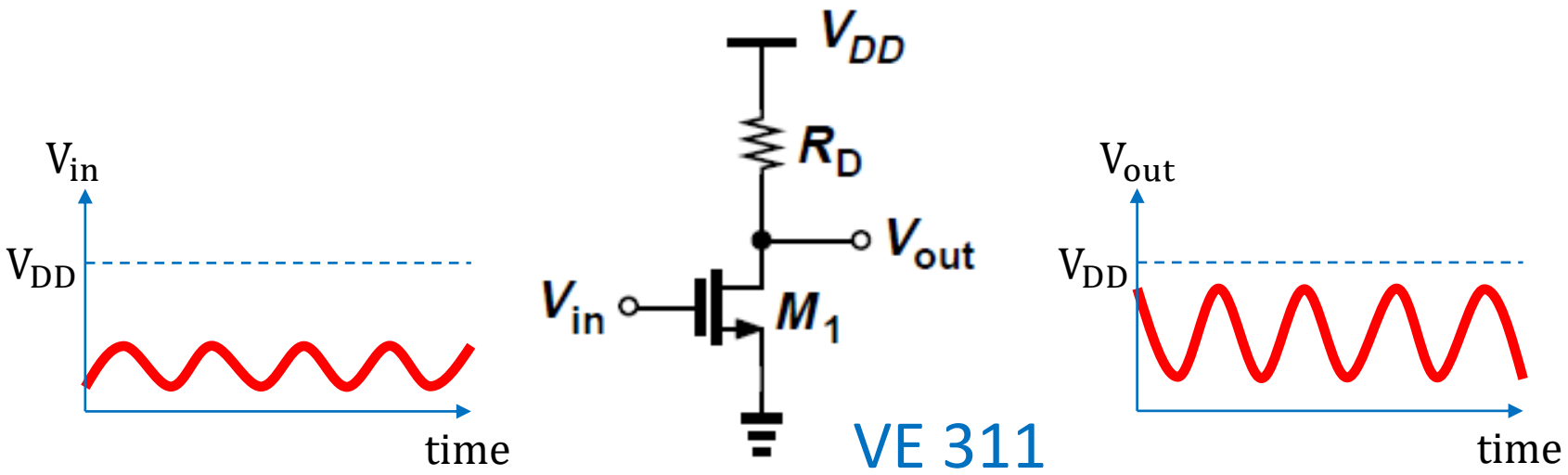
Analog vs Digital

Digital



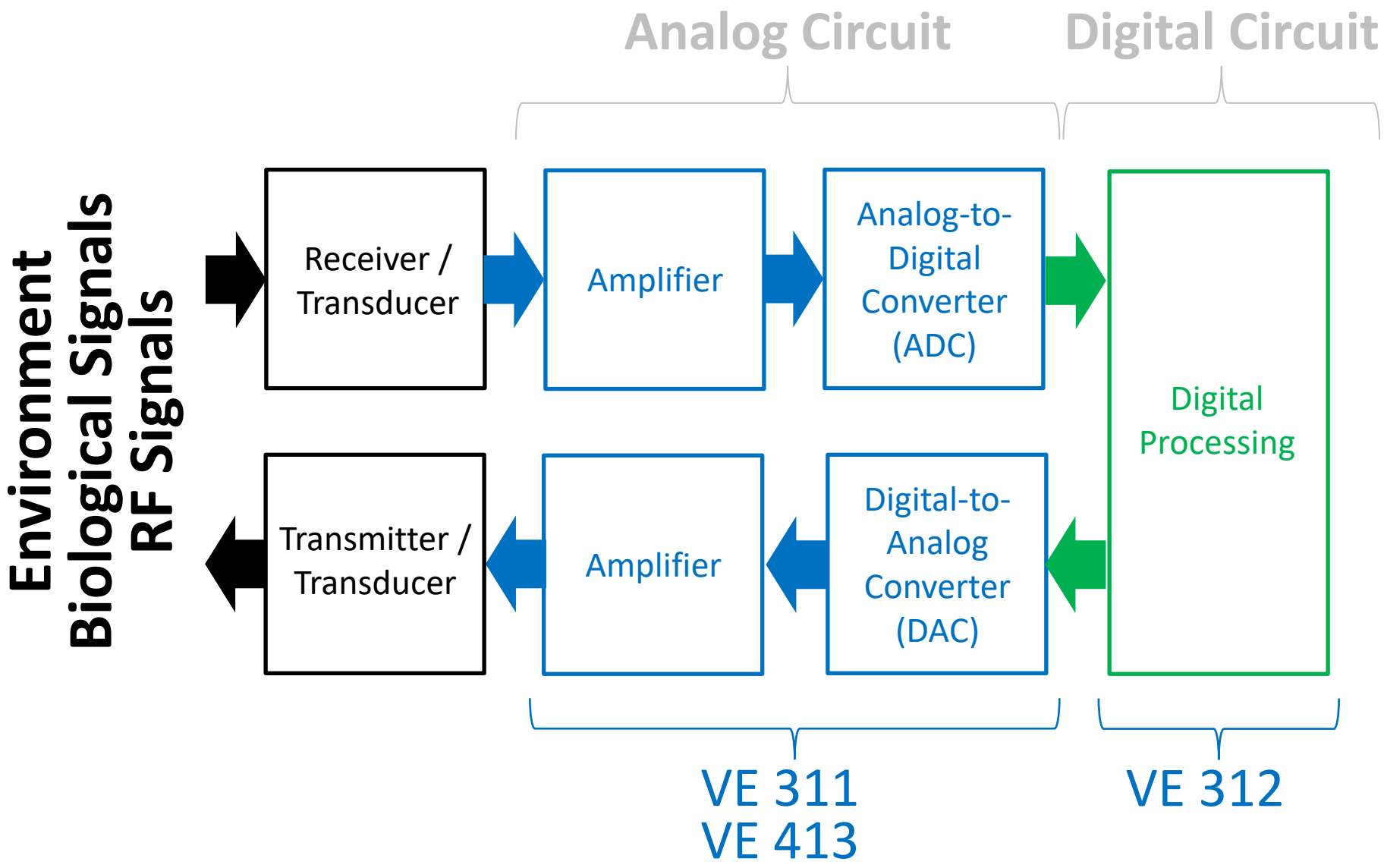
VE 312

Analog



VE 311

Analog Circuit in IC



IC Design Process