ECE 322 Winter 2017

Please work on Quiz 0

Action Items

• Timesheet for office hours and help sessions
  – Please mark ‘x’ if not available

• Anonymous feedback on class webpage
  (http://web.engr.oregonstate.edu/~karti/ec322.html)

• Review
  – Circuit analysis: ENGR 201/202/203
Organization and Policies

- Class website (lecture notes, HW, etc.)
  - http://web.engr.oregonstate.edu/~karti/ece322.html
- You can work on HWs from HW#2 onwards individually or in groups of 2 (Form groups by Friday Jan 13)
  - HW#1 (individual assignment) Due Fri Jan 13 (class webpage). Read Chaps 3 & 4 of ENGR201-3 textbook
- No laptops allowed in class
- No late HWs accepted
- No makeup exam/quiz
  - Exception: medical emergency

Electronic Gadgets and Devices
This Course is on Microelectronics

Focus on Analog Circuits

• Integrated circuit (IC) technology capable of producing circuits containing billions of components in a small piece of silicon, the chip

• A brief history
  – 1926: Lilienfield – “Method and apparatus for controlling electric currents”
  – Dec. 1947: Bardeen, Shockley, & Brattain at AT&T Bell Labs create the first point-contact germanium transistor
  – 1950: Shockley invents the Bipolar Junction Transistor (BJT)
  – Late 1950’s: Silicon BJTs
  – 1958/59: Invention of the IC
  – 1962: Hofstein and Heiman at RCA research labs invent the Metal Oxide Semiconductor Field-Effect Transistor (MOSFET)
  – Today: MOSFETs with typical feature size 14nm (Intel 6th gen core i7 processor)

The First ICs

• 1958: Jack Kilby at TI demonstrates first integration in Germanium
  – Files patent in 1959
• 1959: Robert Noyce of Fairchild files patent for the IC in July 1959
  – Forms the basis of modern day ICs
• 1960’s early part – legal battle over who invented the IC first
  – Fairchild started in 1957 by Noyce
  – Noyce, Gordon Moore, & Andrew Grove started a company in 1968 called Integrated Electronics Corp. - the modern day Intel
• Intel builds microprocessors
  – 1972: Intel 4004 – 2300 transistors, 10μm feature size
  – 1974: Intel 8080 – 4500 transistors, 6μm feature size
  – 2000: Intel Pentium 4 – 42M transistors, 0.18μm feature size
  – 2007: Intel Core i7 – 731M transistors, 45nm feature size
  – 2012: Intel 62-Core Xeon Phi – 5B transistors, 22nm feature size
  – 2015: Intel Core i7 (6th gen) – ? transistors, 14nm feature size
Moore’s Law
# of transistors on ICs doubles every 2 years

Analog Integrated Circuits
Why analog circuits in the digital VLSI era?

Digitized music on a Compact Disc (CD)

From: Prof. Mark Fowler
Why Analog Circuits in the Digital VLSI Era?

• Physical world is analog in nature
  – Audio signal, video signal
• Digital systems cannot operate in a vacuum

Sensing/Actuation Example

• Automobile air bag
  – Sense acceleration
  – Deploy airbag if acceleration exceeds a threshold
Any Sensing and Control Application

- Analog sensor (continuous time information)
- Digitize analog information using an Analog to Digital Converter (ADC)
- Process signal in digital domain using a processor (DSP)
- Convert back to analog domain using a Digital to Analog Converter (DAC) for control

Course Content

- Semiconductor devices
  - Diode
  - Bipolar junction transistor (BJT)
  - Metal oxide semiconductor field effect transistor (MOSFET)
- Applications in the design of analog circuits
  - Rectifiers
  - Amplifiers