Panel Discussion on Skills and Theory – How to Keep Up Laboratory Courses for Electrical Engineering

Byung Kook Kim
Dept. of EECS
Korea Advanced Institute of Science and Technology
bkkim@ee.kaist.ac.kr
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Introduction

■ Education
  ■ Flood of information
    ■ Traditional, computer, bio & nano, ...
    ■ Physical and virtual knowledge
  ■ Education to cultivate T engineers
    ■ Width
      ■ Fundamental theoretical knowledge for wide applicability
      ■ Virtual knowledge via Internet
    ■ Depth
      ■ Hands-on experience
      ■ Design capability
Introduction (II)

Requirements for EE laboratory courses

- Assistant to theory
  - Verify theory
  - Enhance understanding

- Design capability
  - Analysis and synthesis
  - Cooperation and teamwork

- Adaptability for the future
II. Lab Courses in EE, KAIST

- **Basic structure**
  - Theoretic courses 3-0-3
  - Lab courses 1-6-3
    - Two omnibus style lab courses for Sophomore
      - Electronics Lab I
      - Electronics Lab II
    - One selective lab course for Junior
      - Applied Electronics Lab
    - Two design lab courses for Senior
      - Electronic Design Lab
      - Project Lab
Lab Courses in EE, KAIST (II)

- Sophomore lab courses
  - EE207 Electronics Lab 1 (1:6:3)
    - Experiments on digital systems and circuit theory
    - Circuit theory:
      - Resistor circuits
      - Oscilloscope and phasor
      - Steady-state response to sinusoidal inputs
      - Transient response and operational amplifiers
      - Three-phase circuits
      - Design of passive/active filters
  - Digital system
    - Logic circuits
    - Design of combinational circuits
    - Flip-flops and counters
    - Application of flip-flops
    - Hardware description language
    - EPLD implementation of finite state machine
  - Design
    - Drawing bit images on oscilloscope
Lab Courses in EE, KAIST (III)

Sophomore lab. Courses (cont’d)

EE208 Electronics Lab 2 (1:6:3)
- Experiments on electronic circuits & signals and systems
- Electronic circuits
  - Operational amplifiers
  - Diode
  - Characteristics of bipolar junction transistors
  - Amplifier using BJT
  - Characteristics of MOSFET
  - DC power supply
  - Power amplifier with bipolar-MOSFET
  - Differential amplifier
- Signals and systems
  - A/D and D/A conversion
  - Frequency response of digital linear systems
  - Design of FIR and IIR filters
- Design
  - Design of audio equalizer
Junior lab course: Selective lab course

EE308 Applied Electronics Lab (1:6:3)
- 8 selective units matched for various theoretical classes
  - VLSI design
  - Digital communication
  - Microwave experiment
  - Control engineering
  - Semiconductor IC
  - Digital signal processing
  - Fiber optics
  - Power electronics
- Each student selects 3 units
  - 4 weeks experiment for each unit
- 4 units in the first period and second period
  - 8 units in the last period
Lab Courses in EE, KAIST (V)

- Senior lab courses: Design lab courses
  - EE405 Electronic Design Lab (1:6:3)
    - Design of a specific predefined system – Analog/digital AM radio
    - Analog AM radio
      - Crystal oscillator and PLL
      - Frequency tuning and demodulation
      - IF amplifier and baseband amplifier
      - Antenna design
      - Analog AM radio
    - Digital AM radio
      - Microprocessors and parallel input/output
      - Timer interface
      - Serial interface
      - Analog interface
      - Design of digital AM radio
Senior lab courses (cont’d)

EE406 Project Lab (1:6:3)

- Group forming
  - Students form a group of two
- Selection of project topic
  - Professors suggest topics that can be supported in each graduate research lab
  - Each group of students select a specific topic – suggested or their own
- Presentation of proposal
- Specification and design
- Presentation of interim progress
- Implementation and testing
- Presentation of final result of the project
III. Future Improvements

- Restructuring and enhancing sophomore/junior lab courses
  - Digital electronics lab
    - More design oriented
    - Sequential circuit design project – Coffee vending machine
    - Simple CPU design using AHPL
  - Analog electronics lab
    - Practice vs. theory
    - Noise
  - System programming lab
    - Embedded system programming
      - Embedded Linux
      - Introduction to device drivers
      - Embedded system interfacing
IV. Conclusion

- Appreciate any comments
  - Philosophy
  - Lab course sequence
  - Lab experiment contents
  - Other ...