



Development of Embodied System
Courses with implementation of
Innovative Virtual approaches for
integration of Research, Education and
Production in UA, GE, AM

- The two-semester course with next structural parts:
 - digital electronics
 - microprocessors





- **The course features:**
 - it positioned in 3rd and 4th semester
 - it is first circuit design courses
 - training goes along with learning the basics of electronics and circuit theory
 - consist from lectures and laboratory practicum
 - 4 modules with 6 weeks each

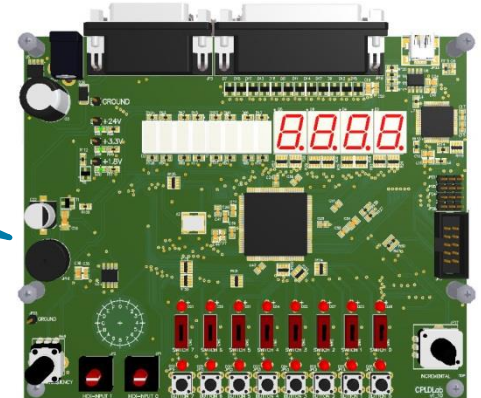
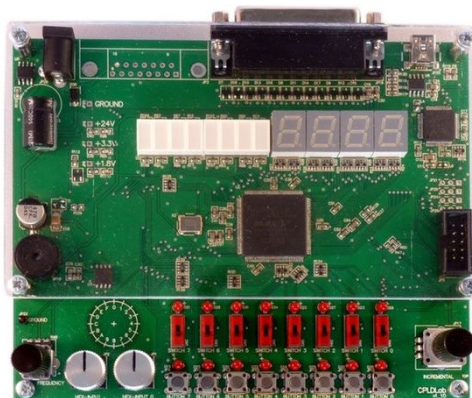


- **The problems:**

- at an initial point, students know nothing about electronics, but at the end they should be able to develop digital devices
- no enough time for a consistent study of discrete electronics, further transition to PLD and then to the microcontrollers as this would required a study of diverse approaches, EDA and simulation tools, etc.
- no funds for the purchase of the licensed program products and well-known sets to study digital electronics

- **Idea**

- It is proposed to use PLD as a linkage for all parts of the course and freely distributed EDA tools as a major environment for development and simulation on real and virtual devices



- **Digital electronics module covers**

- Lectures

1. Combinational devices

- » Boolean arithmetic as basis for digital electronics
- » The basic and universal logic units
- » Adders and digital comparators
- » Codes and coding in digital electronics
- » Coders, decoders
- » Multiplexors, demultiplexors
- » Arithmetic-logic units



- **Digital electronics module covers**
 - Lectures
 - 2. Sequential devices
 - » Simplest triggers
 - » Triggers with static and dynamic (flip-flops) sync
 - » Counters and divider of frequency
 - » Registers, shifter registers
 - » RAM, ROM, bus conditioners and other parts of Microprocessor systems
 - » CPLD, FPGA
 - » The main technologies of digital ICs and their features



- **Digital electronics module covers**
 - Laboratory works
 1. Combinational devices
 - » Logical elements
 - » Coders, decoders
 - » Multiplexors, demultiplexors
 - » Arithmetic-logic units





- **Digital electronics module covers**
 - Laboratory works
 - 2. Sequential devices
 - » Triggers with static sync (latches)
 - » Triggers with dynamic sync (flip-flops)
 - » Counters and divider
 - » Registers, shifters

- **Microprocessors module covers**

- Lectures

- Review of PIC microcontrollers

- » Microcontrollers basics: architectures, features, etc. Memory organization for program and data, addressing, instruction organization and set for PIC16. Basic peripherals for PIC16

- Review of AVR microcontrollers

- » The AVR RISC Microcontroller architecture. Memory organization for program and data, addressing, instruction organization and set for AVR. Basic peripherals of AVR MCU family.



- **Microprocessors module covers**

- Laboratory works

- Review of PIC microcontrollers

- » The first program for PIC16.
 - » Using the main instructions
 - » Using ports for the input/output

- Review of AVR microcontrollers

- » Writing “hello World” program for AVR.
 - » Learning the basic instruction
 - » Using IO on AVR



Step by step example of the laboratory work

Triggers with static sync (latches)



- ...to be continued
 - my courses:
 - » Programming of MCU (eq. Embedded Software)
 - » MCU in Electronic System (eq. Embedded System)
 - colleagues courses:
 - » Digital Signal Processing
 - » Computers and MCU in Telecommunication



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