



Development of Embbeded 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

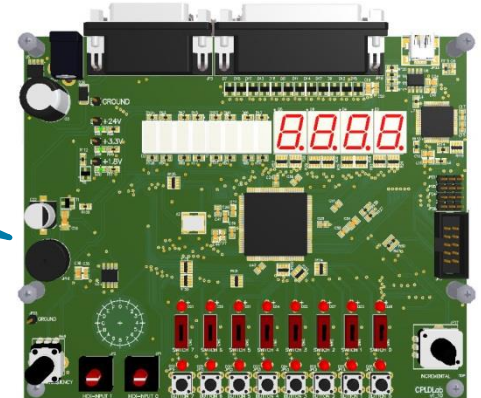
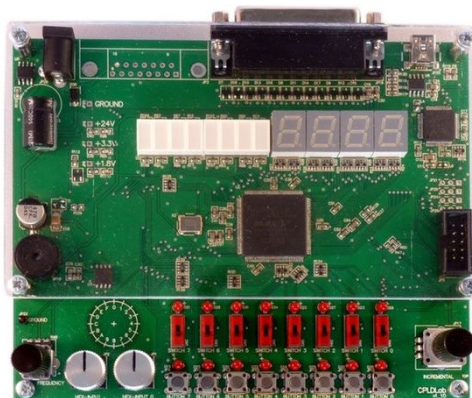


- **The problems:**

- 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



Morshchavka Sergii PhD. Eng.
Assoc. Prof. on Radio Electronics
and Telecommunication Dept

Faculty of Radio Electronics
and Telecommunication

Zaporizhzhya National
Technical University

Zhukovskogo str, 64
69063 Zaporizhzhya
Ukraine

Tel. + 38 061 764 3281

Gsm + 38 050 501 4569

svmorsh@zntu.edu.ua

www.zntu.edu.ua