Hardware for software engineers

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***Training description****: The training aims to teach some electrical engineering basics related mostly to embedded systems.*

***Training scope****: Embedded software students and non-EE professionals, hobbyists.*

# Basic circuits and electrical signals (1/3 of 2h – theory)

* + Voltage, resistance and current - Ohm's law
  + Basic circuits
    - Voltage divider
    - RC circuits
    - Transistor switch
    - Digital circuits – inverter etc.
  + Basic theory of signals
    - Discrete and analog signals
    - Pulsed signal parameters - timing and slew rates
    - Pulse width modulation (PWM)

# Electronic components (2/3 of 2h – theory)

* + Passive components
  + R,L,C,XT etc.
  + Semiconductor devices
    - Diodes and LEDs
    - Transistors BJT and FET
    - Integrated circuits

# Electrical machines (3/3 of 2h – theory)

* + Motors - DC, Stepper
  + Solenoids

# Microcontrollers and microprocessors (2h – theory)

* + Definition, parameters, classification and structure
  + Functional blocks of a MCU. Internal structure, ports and types of ports
    - fuses and special registers
    - Interrupts
    - WDT, BOR, POR
    - Programming interfaces JTAG & ICSP
    - Timers and counters
  + Memory units
    - DRAM & ROM
    - Flash – NAND & NOR, EEPROM
  + Typical operating circuits.
    - Power supply domains.
    - Oscillators, frequency domains & PLLs

# Interfaces & Peripheral devices (2h – theory)

* + Interfaces
    - Differential and single ended signal lines
    - Serial asynchronous - UART (TTL&RS232,RS485)
    - Serial synchronous - SPI , I2C
    - Display types and interfaces - RGB parallel, LVDS, 8080, serial
    - Audio interfaces - PWM, PCM, I2S
    - ~~Ethernet - MII & RMII~~
    - Automotive communications - CAN LIN MOST APIX Flex Ray
    - ~~USB~~
  + Peripheral devices
    - Capture, Compare, PWM
    - ADC/DAC
    - Communication line transceivers
    - smart LED drivers
    - RTC - real time clocks
    - SD Card

# Practical Exercises (2h + 2h/4h – practice)

* + Using electronics workbench tools
    - Basic electrical safety - introduction.
    - Benchtop power supply.
    - Measurement of voltage & current.
    - Using an oscilloscope?
    - Using a functional generator?
    - Soldering.
  + Circuit exercises
    - Simple LED circuit, LED biasing.
    - Button circuit - digital input handling.
    - Measurement of temperature - analog sampling
    - Driving an automotive speed pointer - driving a bipolar stepper motor.
    - Inverted pendulum