SYLLABUS

for the exam of
"Microprocessor Technics"
(Faculty of Mechanical Engineering)

---------1st question---------
1. Introduction to embedded systems.
2. Parallel interfaces. GPIO modules.
3. Asynchronous serial interfaces – RS232.
---------2nd question---------
4. Timers.
5. Embedded systems and analog signals.
6. Displays and indication in embedded systems.

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INSTRUCTIONS

*Examples with source code and circuit diagrams of real devices are not included in the exam.

*Subtopics marked with † are optional, but at least one must be answered and described in the exam.

*The exam lasts 2 astronomical hours.

*The student answers 2 questions from the syllabus - the teacher chooses one question from 1 - 3, and one question from 4 - 6. To successfully graduate from the course, the student must have a minimum grade (on both questions) Average (3). If the grades of the first and second questions differ, the arithmetic mean of the two is taken, with rounding in favor of the student. The final grade also depends on the laboratory and seminar exercises.

*Only part of the lecture material is included in the exam's syllabus - detailed structure is given on the following pages. The student can use the syllabus during the exam, but not the lecture presentations.

*Communication with other people during the exam is prohibited.

1. Introduction to embedded systems.
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Introduction. Areas of application. General block diagram of a microprocessor system. Von Neumann and Harvard architecture - advantages and disadvantages. RISC and CISC microprocessors. Classification of processor elements - standard logic elements (7400, 4000), field-programmable logic arrays (FPGA), microprocessors (uPU).

2. Parallel interfaces. GPIO modules.
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Types of interfaces. Input stages - requirements, pull-up resistors, voltage protections. Output stages - requirements, output stages with a bias resistor, output stages with open-collector/drain. Input/Output stages organization (= General Purpose Input/Output modules). Formation of signal names. GPIO control registers - input, output, direction, interrupt flags, interrupt enable flags, select interrupt type, level, edge, enable pull-up resistors, select pull-up resistor type, function multiplex.

3. Asynchronous serial interfaces – RS232.
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Converting parallel to serial information and vice versa. Difference between asynchronous and synchronous interface. RS232 interface. Signals RxD, TxD. Amplitude of logic levels. UART module – block diagram and data format. UART module registers – input, output, control, status. Data buffering. Generator clock stability.

4. Timers.
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Building blocks of timers. Block diagram of a pre- and post-scaler (divider) in a timer. Modes of operation of the timers - free running (counter), measuring (capture), generating (compare), PWM (PWM). Detailed description and block diagrams of the four modes. Watchdog - definition. Real Time Clocks (RTC) - internal structure and registers. QEI (Quadrature encoder interface).

5. Embedded systems and analog signals.
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Classification of signals - analog, digital, time-discrete, amplitude-discrete. Obtaining analog voltage from digital code and vice-versa - formula. DACs and ADCs characteristics. Sample and hold amplifiers. Transfer functions and errors. ADCs integrated into microcontrollers - example.

6. Displays and indication in embedded systems.
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Control of LEDs – a single LED. Control of 7-segment indicators. Static and dynamic indication. Types of alphanumeric LCD displays. Alphanumeric LCD – block diagram. Inner LCD registers. LCD instructions. Setting of the LCD contrast. LED backlight. LCD signals.