Embedded Software Development in C/C++

Course Information

Course Objective: to provide basic theoretical knowledge and practical skills necessary for developing embedded software in C/C++.

Target Group: This course is designed for those who want to gain both theoretical and practical skills in developing software for microcontrollers in C/C++.

The training is conducted in a classroom format, in a practical lab at Tartu mnt. 18, Tallinn. Group size up to 6 people. All study materials are included in the course price. **A laptop can be provided for the duration of the course if needed.**

Requirements for Participants:

- Confident PC user
- Basic level of English (approximate A1/A2 level)
- **Preferably with your own laptop (Windows / Mac, 8 GB RAM, screen size > 13.3"); a laptop can be provided if needed.**

Learning Outcomes:

After completing the course, participants will:

- Understand how popular microcontrollers such as STM32, ESP32, RP2040, and Teensy work
- Be able to write software for microcontrollers using C/C++
- Know how to connect sensors and actuators to microcontrollers
- Use debugging tools, logic analyzers, and oscilloscopes
- Understand the principles of building autonomous devices (robots, drones, IoT)

Learning Methods:

Total course volume: 180 academic hours, including 100 academic hours in the classroom (42 hours of practical work and 2 seminars totaling 8 hours)

Assessment Criteria:

Learning outcomes are assessed based on independently completed practical work.

Assessment Methods:

Successful completion of practical and homework tasks is marked as "passed".

Course Completion Requirements:

To complete the course and receive a certificate, at least 75% of homework must be completed and passed.

Additional Information:

General rules for organizing studies (in Estonian) (/oppekorralduse_alused.php)
Rules for ensuring study quality (in Estonian) (/oppekvaliteedi_tagamine.php)

Course program

Module	Main topics	Volume
1. Introduction to Microcontrollers and Electronics	• Basic concepts of microcontrollers and their applications in robotics and drones. • Comparison of STM32, ESP32, RP2040, and Teensy. • Fundamentals of electrical circuits and prototyping. • ractical skills: simple circuits assembling, working with a multimeter and an oscilloscope.	8 ac/h
2. Fundamentals of Programming in C	• Data types, variables, arithmetic • Loops, conditions, functions, pointers • Working with arrays and strings • Practice: writing and debugging simple programs	16 acad. hrs
3. Fundamentals of C++ for Microcontrollers	• Classes, objects, encapsulation • Inheritance, templates, data structures • RAII, memory handling, standard libraries • Creating peripheral control libraries	14 acad. hrs
4. Working with STM32, ESP32, RP2040, Teensy	• Using STM32CubeIDE, ESP-IDF, Pico SDK, Arduino Core • GPIO, timers, PWM, ADC, interrupts, DMA • Communication: UART, I2C, SPI, BLE, Wi-Fi • Working with sensors and motors, real-world integration	30 acad. hrs
5. Debugging and Testing Embedded Systems	• Using ST-Link, J-Link, UART, SWD/JTAG • Using logic analyzers and oscilloscopes • Debugging and troubleshooting techniques • Bug tracking and hardware debugging	14 acad. hrs

6. Final Project	• Selecting a project: drone, mobile robot, or IoT device • Designing circuit and software architecture • Integrating sensors, motors, communication, and control • Project presentation and defense	16 acad. hrs

Course Details

Course Schedule:
23.02.2026 - 25.04.2026
Class Time:
Mon, Wed, Fri 17:45 - 21:00

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Course Duration: 2 months

Format and Location:
Address: Tartu mnt. 18-53, Tallinn.

In-person training at our lab located at Tartu mnt. 18-53, Tallinn. Group size up to 6 people.

Language of Instruction: English

Cost: 1967.21 EUR + VAT

Total Course Volume: 180 acad. hrs
Includes:
- Classroom sessions: 100 acad. hrs (including 42 practical hrs and 2 seminars – 8 acad. hrs)
- Independent work: 80 acad. hrs

Instructors

Nikolai Barbanov

Qualification: Over 10 years of experience managing physical systems and automation — from manufacturing (Ericsson) to logistics and e-commerce. A hands-on practitioner and hobbyist in robotics and programming.

Specialization: Design of controllable systems, automation of physical and virtual processes, orchestration of distributed components.

Teaching Experience: 10+ years in corporate operations, training, and consulting. Speaker at technical conferences, including PyCon Estonia (https://pycon.ee/).

Education: Master of Science in Physics, Lomonosov Moscow State University, 2015. Thesis focused on signal analysis from bottom pressure recorders used in the DART (Deep-ocean Assessment and Reporting of Tsunamis) system for early tsunami detection. The topic is directly related to sensor data processing and the architecture of distributed systems — the core foundation of this course..
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