



**T-738-EMBE**

**EMBEDDED SYSTEM PROGRAMMING**

**8 ECTS**

<b>Year of study:</b>	3 <sup>rd</sup> or 4 <sup>th</sup> year (final year BSc / first year MSc).
<b>Semester:</b>	Fall.
<b>Level of course:</b>	3. First cycle, advanced / 4. Second cycle, introductory.
<b>Type of course:</b>	Core for MSc Mechatronics Engineering, elective for other programs.
<b>Prerequisites:</b>	Programming (T-201-FOR1 or T-111-PROG). <b>Additional recommended prerequisites:</b> Mechatronics I (T-411-MECH).
<b>Schedule:</b>	Runs for 12 weeks – 6 teaching hours a week. A combination of lectures and on-line labs.
<b>Supervisor:</b>	Torfi Þórhallsson.
<b>Lecturer:</b>	Torfi Þórhallsson.

**Learning outcomes:**

- Write embedded programs in C++ and execute them on microcontrollers
- Explain the important features of the C++ programming language
  - Basic control structures (if, while, collections, etc.)
  - Memory management (representations, data structures, and dynamic memory allocation)
  - Object oriented programming (classes, abstract data types)
  - Generic programming (templates, inheritance)
  - Scheduling
- Testing and debugging embedded code
- Explain the importance of real-time operating systems
- How to choose data structures and algorithms

**Content:**

Learning the basics of programming in resource limited systems such as that found in microcontrollers. The course teaches embedded software development using the C++ programming language. Basic programming skills are assumed. The course covers the following six main topics: memory management, object oriented programming, generic programming, embedded software design, performance validation, and code optimization. Each topic is accompanied by a software project using C++ and open software tool chains.

**Reading material:** *Real-Time C++: Efficient Object-Oriented and Template Microcontroller Programming* by Christopher Kormanyos. Alternatively, the following three on-line texts used together:

- *Discovering Modern C++: An Intensive Course for Scientists, Engineers, and Programmers* by Peter Gottschling. Addison-Wesley Professional, 2015.
- *Software Engineering for Embedded Systems, 2nd Edition* by Mark Kraeling; Robert Oshana. Newnes, 2019.
- *Hands-On Embedded Programming with C++17* by Maya Posch. Packt Publishing, 2019.

**Teaching and learning activities:** Six two-week project sprints, supported by lectures.

**Assessment methods:** Practical online exam. Grades given on lab assignments are part of the final grade. Late assignments are not accepted.

**Language of instruction:** English.

**All course descriptions may be subject to change.** Revised information on the course schedule, reading material, teaching and learning activities, and assessment methods will be introduced in the learning management system Canvas at the beginning of the semester.