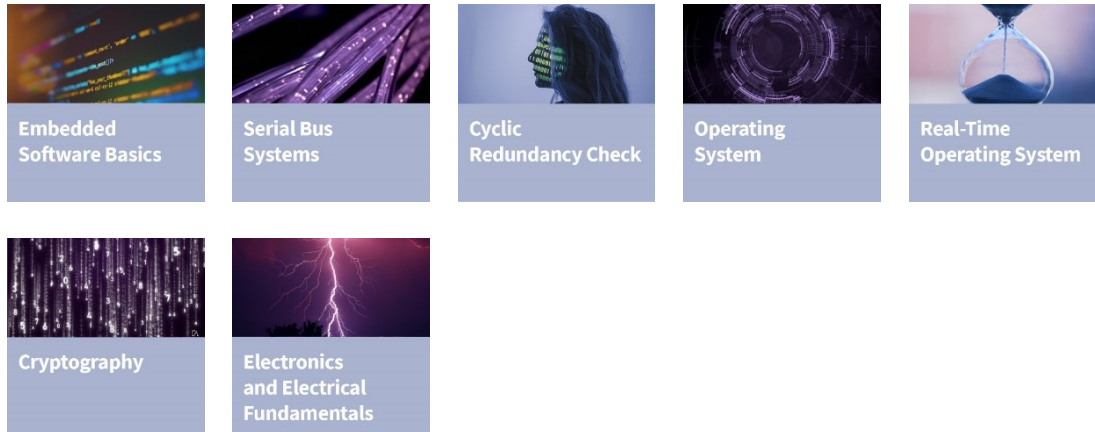# E-Learning for Embedded Software Developer

February 2024

The combination of courses is perfect for getting into or learning more about Embedded Software Development

Courses within the e-learning package

Embedded Software Basics	Serial Bus Systems	Cyclic Redundancy Check	Operating System	Real-Time Operating System

Cryptography	Electronics and Electrical Fundamentals

The "**Embedded Software Developer**" e-learning package is a comprehensive program that equips learners with essential knowledge and skills in the field of embedded software development. This package covers a wide range of topics to provide a well-rounded understanding of the subject.
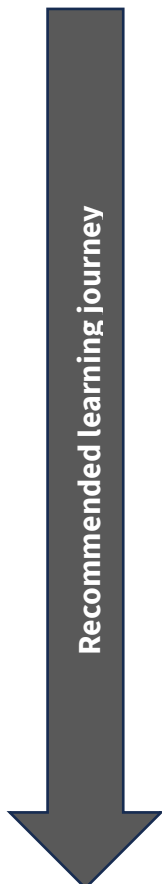
Moving on to the **fundamentals of embedded software**, the course dives into fixed-point arithmetic and floating-point arithmetic, essential for understanding numerical representation and calculations in embedded systems.

Serial bus systems are a critical component of embedded systems, and learners will gain insights into their architecture, protocols, and components. The OSI model is also covered, providing an understanding of layered communication systems.

The **cyclic redundancy check CRC** provides important further details which are often needed in bus communication.

Operating systems, including real-time operating systems, are explored in-depth, focusing on kernel operations, multitasking, safety considerations, and common challenges in embedded OS development.

The operating system in an embedded application has real-time requirements and thus a **Real-Time Operating System** is needed. We cover different real-time requirements, time and event-based tasks and more.

In the realm of **cryptography**, learners will explore both classical and modern cryptography, including encryption techniques such as the Caesar Cipher, Vigenère Cipher, DES (Data Encryption Standard), AES (Advanced Encryption Standard), Diffie-Hellman Key Exchange, and RSA. This knowledge is vital for securing embedded systems and data.

Lastly, the course delves into **electronics and electrical fundamentals**, encompassing topics like electronics and magnetism, circuitry, alternating current circuits, and the basics of power electronics, which are crucial for embedded system developers.

Recommended learning journey

This e-learning package is tailored for those aspiring to become proficient in embedded software development, whether you are a beginner or seeking to enhance your existing skills. Upon completion, you will possess the knowledge and capabilities required to excel in this dynamic and vital field of technology.
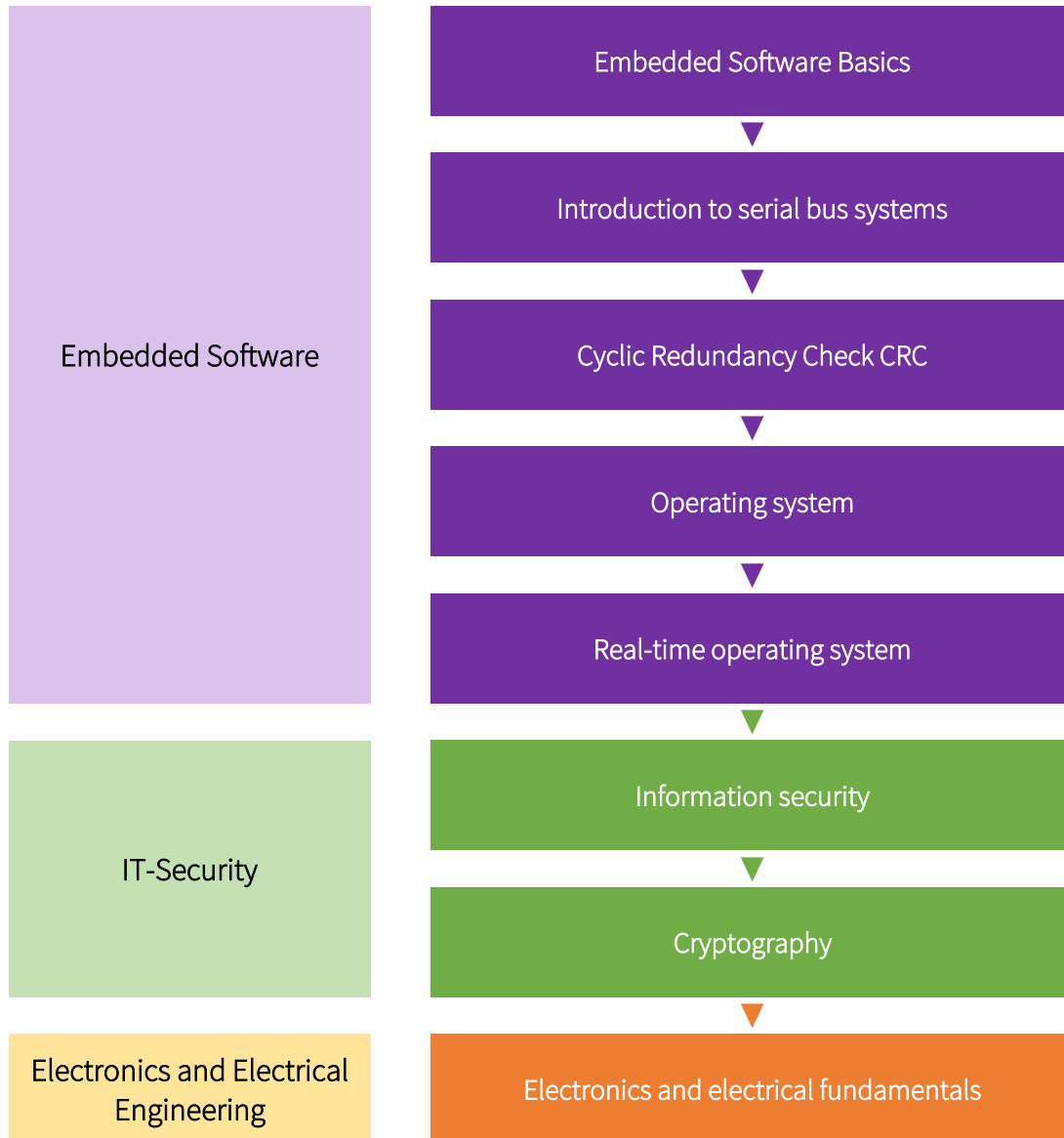
Delivery Content

Access

- for one user
- to all e-learning courses
- for the purchased time period

of the Embedded Academy.

Recommended Learning Journey

The Embedded Software Developer learning package is composed of 7 e-learning courses. We recommend the following order for learning.

Embedded Software	Embedded Software Basics
	▼
	Introduction to serial bus systems
	▼
	Cyclic Redundancy Check CRC
	▼
	Operating system
	▼
	Real-time operating system
	▼
IT-Security	Information security
	▼
	Cryptography
	▼
Electronics and Electrical Engineering	Electronics and electrical fundamentals

E-Learning Content

1) **Embedded Software Basics**

- <u>Language</u>: English, German

- <u>Course objective</u>: The aim of this course is to provide a sound basic knowledge on which other topics, such as AUTOSAR, can build.

- <u>Course content</u>: This course provides an e-learning on **fixed point arithmetic** and on **floating point arithmetic**. Two ways of storing binary numbers are described, and limitations and typical errors of the methods are explained. This helps to avoid beginner mistakes and enables a quick introduction to the basics of embedded software.

- <u>Duration:</u> 1 hours, 15 minutes

- <u>Study time:</u> 6 hours, 15 minutes

- <u>Further insights:</u> https://embedded-academy.com/en/courses/embedded-software-basics/

2) **Introduction to Serial Bus Systems**

- <u>Language</u>: English, German
- <u>Course objective</u>: The aim of this course is to introduce learners to all the important basic terms for the topic of serial bus systems.
- <u>Course content</u>: This course is designed to introduce you to important basic terms related to serial bus systems. Terms concerning hardware and software are explained.
  The focus of the first e-learning lies on very **general basic terms** that are relevant to most bus systems. For example, the terms bit rate, baud rate, latency, clock signal and router are explained, or what a protocol and a protocol stack actually are. At the beginning of the e-Learning, typical application areas of serial bus systems and their advantages over other systems are described.
  The second e-learning deals with the **OSI model**, which is a reference model for communication systems and protocols. Two components of this model are particularly relevant for bus systems: the so-called physical layer and the data link layer.
  The last two e-learning courses are based on these mentioned layers. One of them covers basic terms of the **physical layer**, the other one those of the **data link layer**.
- <u>Duration:</u> 2 hours, 50 minutes
- <u>Study time:</u> 14 hours, 10 minutes
- <u>Further insights:</u>
  https://embedded-academy.com/en/courses/introduction-to-serial-bus-systems-en/

3) **Cyclic Redundancy Check CRC**

- <u>Language</u>: German, English

- Course objective: The aim of this course is to understand how to calculate various CRC checksums

- Course content: The e-learning course consists of three e-learning units:

"CRC Definition," "CRC-8," and "CRC-16." In this course, you will acquire the necessary knowledge to understand the calculation of CRC checksums. The first module imparts the definition and function of the CRC checksum. The modules are organized in ascending order of CRC sums, and the calculations are always explained using examples.

In the "**CRC Definition**" module, we uncover its significance, explore various CRC lengths, and delve into its principles, including functionality, polynomial representation, and generator polynomial.

In "E-Learning **CRC-8**," we delve deeper into CRC-8 calculation, explaining steps with examples. Explore how the sender generates the CRC-8 checksum and how the receiver verifies message accuracy.

Continuing the journey, "**CRC-16**" explores CRC-16 calculation through detailed examples. Learn how CRC-16 is generated and verified, addressing diverse message lengths. Whether new to CRC or seeking a deep dive, this course empowers your understanding.

- Duration: 1 hour, 20 minutes

- Study time: 6 hours, 40 minutes

- Further insights:
https://embedded-academy.com/en/courses/cyclic-redundancy-check-crc/

4) Operating System

- Language: English
- Course objective: The aim of this course is to provide a basic knowledge of operating systems and the various components and functions they contain.
- Course content: In this course, you learn what an operating system is. Therefore, you are familiarized with the kernel, which holds the core functionality of the operating system and you get to know the scheduler, which controls the execution of multiple tasks and allocates resources to them. This is covered in greater detail in the chapter "Multitasking". To complete this course, safety and other advanced aspects are covered as well as the characteristics of embedded operating systems.
- Duration: 50 minutes
- Study time: 4 hours, 40 minutes
- Further insights: https://embedded-academy.com/en/courses/operating-system/

5) Real-Time Operating System

- Language: English

- Course objective: The aim of this course is to provide a basic knowledge of real-time operating systems. The learner will understand what a real-time operating system is and how it works.
- Course content: You will learn when real-time operating systems are needed and which requirements they have. In particular, we cover the difference between soft real-time requirements and hard real-time requirements. You will also encounter the term "timing analysis" and learn about the difference between time-based tasks and event-based tasks. At the end you will be familiarized with three scheduling algorithms, before we cover three typical problems: task starvation, deadlock and race conditions.
- Duration: 1 hour, 5 minutes
- Study time: 5 hours, 25 minutes
- Further insights: https://embedded-academy.com/en/courses/real-time-operating-system-en/

6) Cryptography

- Language: English, German
- Course objective: The aim of this course is to understand the various encryption methods, how they are used, and which mechanisms are most useful for which application during implementation.
- Course content: The course on cryptography is divided into two parts.
  First, the focus is on **classical cryptography**, presented in three e-learnings. We begin with a general introduction to the topic, which is followed by a historical overview. Thereby, we will encounter the most famous classical encryption methods: the Scytale, the Caesar Cipher, the Vigenère Cipher, the One-Time Pad and the Enigma.
  The second part then moves on from this historical encryption to **modern methods**, also divided into three e-learnings. Here, using the example of Alice and Bob, A to B encryption from the sender (A) to receiver (B) is explained for the three basic types (symmetric, asymmetric, and hybrid) and further illuminated using concrete methods such as the DES, AES, RSA and the Diffie-Hellman Key Exchange.
- Duration: 4 hours
- Study time: 20 hours
- Further insights: https://embedded-academy.com/en/courses/cryptography/

7) Electronics and Electrical Fundamentals

- Language: English
- Course objective: The aim of this course is to provide a basic technical understanding of all relevant topics in the area of electricity.
- Course content: The first e-learning unit of this course is called "**Electronics and Magnetism**". It covers the relationship between current, voltage and resistance, which is expressed by

Ohm's law. In addition, electric and magnetic fields are contrasted and different types of magnets are considered.

The second e-learning unit deals with the **important components of a circuit**, the capacitor and the coil, as well as the resulting phenomena and physical laws, the Lorentz Force, the Hall Effect and the principle of induction.

Furthermore, **direct current and alternating current** are analyzed. For the analysis of circuits, Kirchhoff's Laws and the circuit types parallel circuit and series circuit are explained. With regard to alternating current, the Star connection and the Delta connection are considered. The topic of **AC circuits** is covered in greater detail. Therefore, the complex numbers are explained in order to then discuss the complex voltage and the complex current. Furthermore, this chapter covers the impedance and the Root Mean Square.

The last part of the e-learning contains an introduction to **power electronics**, which is based on semiconductor elements. In addition to teaching technical basics, it explains how various components can be constructed using semiconductors. Here, special attention is paid to the diode and the MOSFET. The user is therefore familiarized with the concept of the p-n-junction.

- Duration: 3 hours, 10 minutes

- Study time: 15 hours, 50 minutes

- Further insights:
  https://embedded-academy.com/en/courses/electronics-and-electrical-fundamentals/