E-Learning for
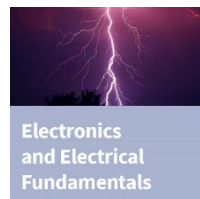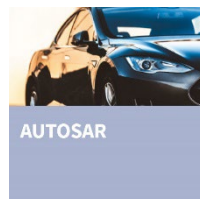# Automotive Basic Software Developer

June 2024

The combination of courses is perfect for a software developer within the automotive domain.

Courses within the e-learning package

The "**Automotive Basic Software Developer**" e-learning package is a comprehensive program that equips learners with essential knowledge and skills in the field of embedded software development and in addition to important automotive knowledge. This package covers a wide range of topics to provide a well-rounded understanding of the subject.

This first part is providing you with know-how to become proficient in embedded software development.

Embedded Software Basics

Serial Bus Systems

Cyclic Redundancy Check

Automotive Bus Systems

Operating System OS

Real-Time Operating System RTOS

AUTOSAR

Electronics and Electrical Fundamentals

Recommended learning journey

Fundamentals of embedded software, 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.

Automotive bus systems provide you with extra automotive know-how in this context.

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

AUTOSAR provides you with a general understanding of the this Automotive standard which will help you to navigate through the extensive set of specifications.

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.

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.

In this second part the focus lies on Automotive specific processes and cybersecurity surrounded by some extra e-learning courses connected to the topic.

Automotive SPICE is structured into several courses. We recommend to start with **ASPICE Overview**, then to take the **ASPICE engineering processes**, and finally to learn all about **ASPICE supporting processes**. The access will also give you the opportunity to learn about the ASPICE management processes as well as acquisition and supply.

Information security is the first e-learning course dealing with IT-security and introduces you to all the basic terms in this field.

Based on this the next e-learning is going into the details and specific requirements and process required by **automotive cybersecurity.**

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.

This e-learning package is tailored for those aspiring to, 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 automotive software development.
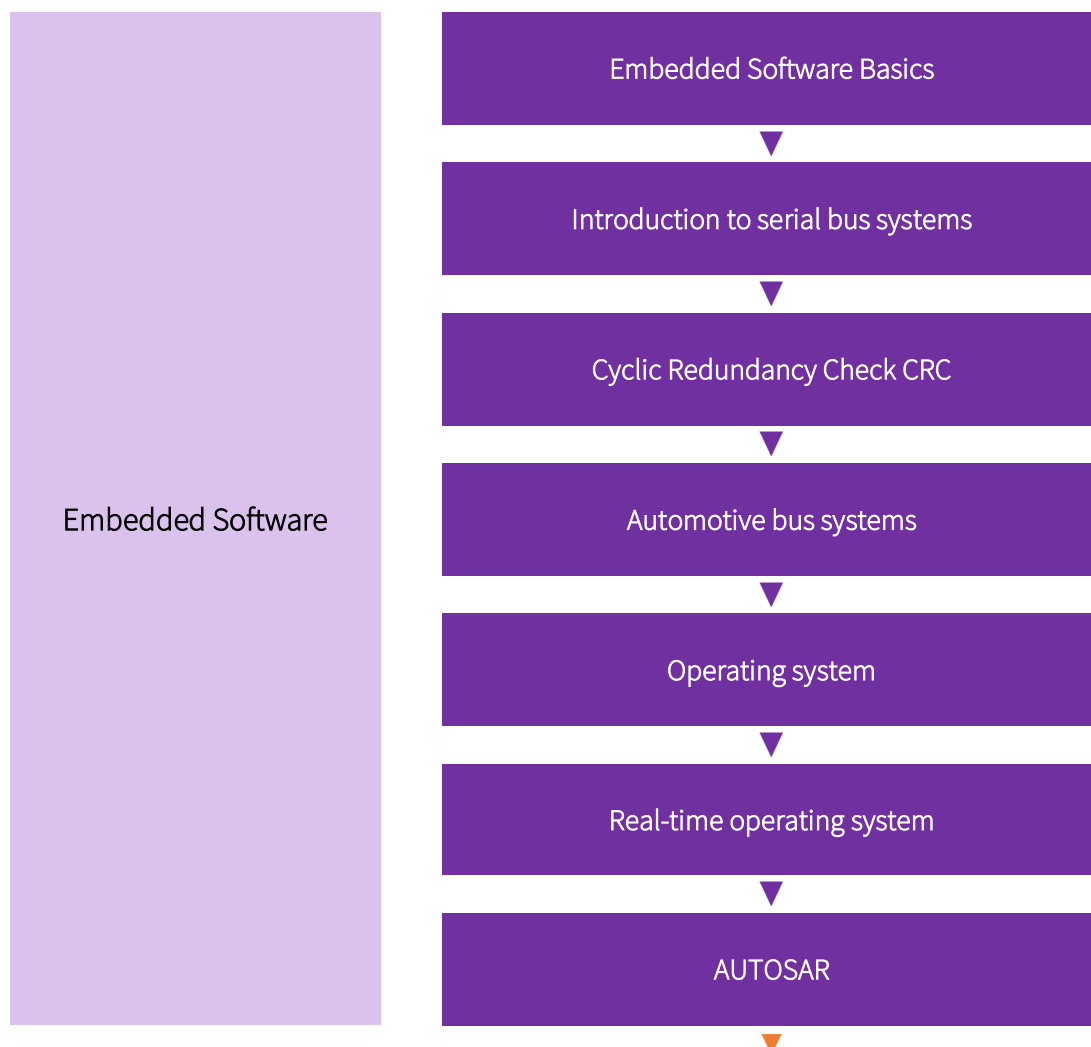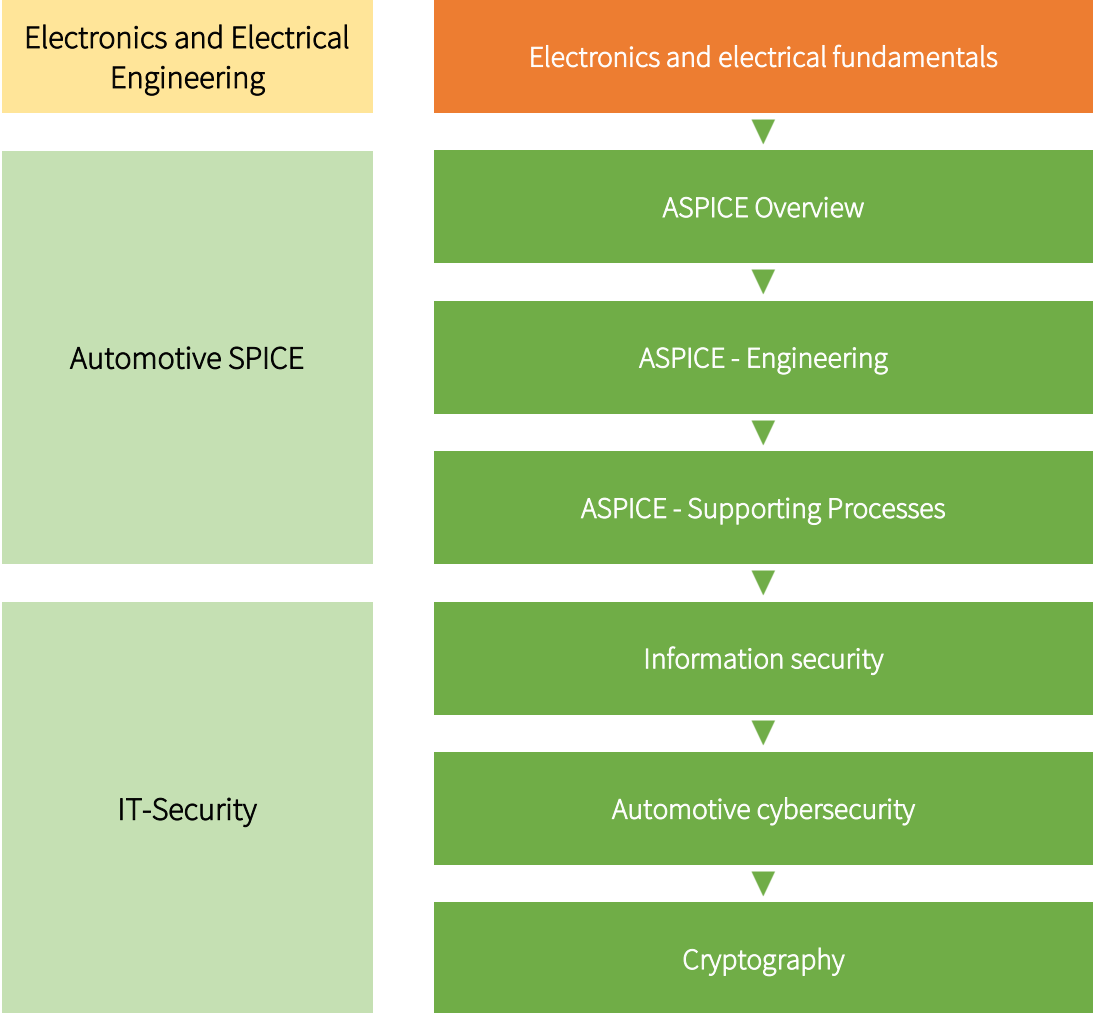
Delivery Content

Access

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

 of the Embedded Academy.

Recommended Learning Journey

The Automotive Application Software Developer e-learning package is composed of several e-learning courses. We recommend the following order for learning.

Embedded Software

Embedded Software Basics

▼

Introduction to serial bus systems

▼

Cyclic Redundancy Check CRC

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Automotive bus systems

▼

Operating system

▼

Real-time operating system

▼

AUTOSAR

▼

Electronics and Electrical Engineering	Electronics and electrical fundamentals
	▼
	ASPICE Overview
	▼
Automotive SPICE	ASPICE - Engineering
	▼
	ASPICE - Supporting Processes
	▼
	Information security
	▼
IT-Security	Automotive cybersecurity
	▼
	Cryptography

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

4) Automotive Bus Systems

- Language: English, German
- Course objective: This course is aimed at all developers who already use automotive bus systems, want to use them or want to learn how they are structured.
- Course content: In this course you will learn about different bus systems that are mainly used in the automotive environment.
- Duration: 45 minutes
- Study time: 3 hours, 45 minutes
- Further insights:
  https://embedded-academy.com/en/courses/automotive-bus-systems-en/

5) 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: 55 minutes
- Study time: 4 hours, 40 minutes
- Further insights: https://embedded-academy.com/en/courses/operating-system/

6) 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/

7) AUTOSAR

- Language: English
- Course objective: The aim of this course is to understand what AUTOSAR™ is so that you are able to develop software related to AUTOSAR™.
- Course content: The course introduces AUTOSAR™ as an organization, explains the standard it defines and addresses the methodology as well as the classic platform from the release R19-11.
  Learners can start with the **overview** e-learning, which introduces AUTOSAR™ as an organization and explains the standard it defines. In particular, there will be details about the different standards AUTOSAR™ contains.
  Another e-learning addresses the **classic platform** from the release R19-11. There we take a look at the methodology as well as the software architecture. The methodology describes how one proceeds when developing a system with AUTOSAR™ and the software architecture describes the different layers of the layered software architecture.
  The e-learnings about the **virtual functional bus** explain the main communication concept of the classic platform.

And we also offer an e-learning about the **operating system** of AUTOSAR Classic Platform.

- Duration: 3 hours, 50 minutes
- Study time: 19 hours, 10 minutes
- Further insights: https://embedded-academy.com/en/courses/autosar-en/

8) 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/

9) V3.1 ASPICE - 1 – Overview

- Language: English, German
- Course objective: The aim of this course is to understand ASPICE and to get to know the purpose of this standard.
- Course content: The course "V3.1 ASPICE – Overview" is divided into two e-learning units and provides basic knowledge about Automotive SPICE. The first E-Learning provides reasons that speak for **Automotive SPICE** and introduces further standards that are relevant to the topic of Automotive SPICE. The second E-Learning provides an overview of the contents of

the **process model**. The Process Reference Model (PRM) and the Process Assessment Model (PAM) are explained in detail. The concept of the standard is explained using an example process.

- Duration: 1 hour, 5 minutes
- Study time: 5 hours, 25 minutes
- Further insights: https://embedded-academy.com/en/courses/automotive-spice-overview/

10) V3.1 ASPICE – Engineering

- Language: English, German
- Course objective: The aim of this course is to understand ASPICE and to get detailed information about the engineering processes.
- Course content: The course "V3.1 ASPICE – Engineering and Management" is divided into four e-learning units. Each of them explains one or more processes. It covers all processes of the **System Engineering** Process Group SYS and the **Software Engineering** Group SWE.
- Duration: 2 hours, 50 minutes
- Study time: 14 hours, 10 minutes
- Further insights: https://embedded-academy.com/en/courses/automotive-spice-engineering-en/

11) V3.1 ASPICE – Supporting Processes

- Language: English
- Course objective: The aim of this course is to get detailed information about of Supporting Process Group and Supplier Monitoring of V3.1 ASPICE.
- Course content: In this course we focus on the processes which are part of the VDA Scope and thus mandatory for more or less every automotive electronics and software project. For the supporting processes this applies to Quality Assurance **SUP.1**, Configuration Management **SUP.8**, Problem Resolution Management **SUP.9**, and Change Request Management **SUP.10**. The course is divided into several e-learning units. Each of them covers one process and its work products. At the beginning of each e-learning the respective process group is introduced and you get to know the connections between the different processes. The e-learnings highlight connection between different topics. This is particularly helpful for practical application work when processes and relationships need to be understood.
- Duration: 1 hour, 45 minutes
- Study time: 8 hours, 45 minutes
- Further insights: https://embedded-academy.com/en/courses/automotive-spice-supporting-processes-en/

12) V4.0 ASPICE – 1 – Overview

- Language: English
- Course objective: The target of this course is to understand V4.0 ASPICE and to get to know the purpose of this standard.
- Course content: The course "V4.0 ASPICE Overview" is structured into three e-learning units and provides you with a general knowledge about Automotive SPICE.
  The first e-learning presents a motivation for using Automotive SPICE and covers the process dimension of the process assessment model. It focuses in particular on the **measurement framework**. The most important aspects of the measurement framework are the capability levels, the process attributes and NPLF rating scale.
  The second e-learning provides an overview of the contents of the process dimension of process assessment model. In this e-learning, the **process reference model** is explained in detail.
  Finally, the concept of the standard is explained by using the **project management process** an example. This e-learning provides detailed information about the process purpose, the process outcomes, the base practices and the output information items.
- Duration: 1 hour, 40 minutes
- Study time: 8 hours, 20 minutes
- Further insights: https://embedded-academy.com/en/courses/v4-0-aspice-1-overview/

13) Information Security

- Language: English, German
- Course objective: The aim of this course is to provide an overview of information security so that its interrelationships and importance become clear.
- Course content: The course is divided into two topics. First, important terms of **information security** are defined and the underlying goals are explained. Furthermore, it is clarified who is affected by information security and what it is needed for.
  In the second e-learning unit, the **practical implementation of information security** is explained. Here, risks and threats are presented and explained using examples. Afterwards, the **information security management system** is defined and its functioning is explained. The introduction of this system is, among other things, the task of the information security officer. Finally, direct measures are explained on the basis of the 14 reference measure objectives, using ISO 27001 as a source.
- Duration: 1 hour
- Study time: 5 hours
- Further insights: https://embedded-academy.com/en/courses/information-security-en/

14) Automotive Cybersecurity

- Language: English
- Course objective: The aim of this course is to get an overview of what is relevant in the topic of automotive cybersecurity. The learner will be aware why automotive cybersecurity is important and how it is regulated, implemented, and controlled.
- Course content: In the first e-learning unit of this course, you learn why **automotive cybersecurity** matters. You get introduced to the main reasons for the implementation as well as the top attack points. In the following, you get to know the upcoming regulations and standards as well as the role of cybersecurity in the product life cycle. Then, you get to know the cybersecurity threat analysis and risk assessment, also known as TARA. It is explained through an example so it is easy to understand. At the end of this course, you will learn what the cybersecurity controls and requirements are and you will take a closer look at the cybersecurity verification and validation testing.
- Duration: 1 hour
- Study time: 5 hours
- Further insights: https://embedded-academy.com/en/courses/automotive-cybersecurity-en/

15) 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/