HOCHSCHULE
ESSLINGEN

System Design

1	Module Number 3902	Study Programme ASM	Semester 1	Offered in ☒WS ☐SS	Duration 1 Semester	Module Type compulsory	Workload (h) 240	ECTS Points 8

2	Courses		Teaching and Learning Forms	Contact Time		Self-Study Time	Language
				(SWS)	(h)	(h)	
	a)	Automotive System and Software Architectures	Lecture	4	60	120 [bitte nur Summe eintragen]	English
	b)	Automotive Systems Development Process and System Test	Lecture	4	60 [1 SWS = 15h]		

3	**Learning Outcomes and Competences**

Once the module has been successfully completed, the students can...

- … analyze automotive E/E (electronic/electric) architectures and the associated hardware and software architectures
- … develop own solutions in this application domain
- .. . work in a larger interdisciplinary engineering team based on a clear understanding of the required design and development processes necessary.

Knowledge and Understanding

- ... understand the architecture of automotive electric and electronic systems and their development process.
- … know the limits of existing systems, have an idea about future trends in the automotive E/E domain and about the problems to be solved in the future.

Use, Application and Generation of Knowledge

Use and Transfer
- ...understand the complete automotive system development process including system test and application.
- ...see the difference between systems, functions and components and their respective development processes.
- ... analyse the structure of distributed automotive electronic systems, their software architectures and the communication principles and channels.
- ... be able to analyze communication protocols, especially bandwidth and latency.
- ... be able to assess the safety and reliability of systems.
- … compare automotive solutions with solutions and concepts from other technical domains.

Scientific Innovation
- … use methods and tools to gain new insights.
- ... create models for automotive systems and use them for implementation and tests.
- ... optimize automotive E/E architectures with respect to functionality,safety, performance, robustness and cost.
- ... set up and evaluate hypothesis tests and design procedures to verify and validate the E/E design.
- ... independently develop approaches for new systems and assess their suitability, especially transfer related technical concepts and solutions from other technical fields, e.g. aerospace or computer science into the automotive domain.

Communication und Cooperation
- ... communicate actively within an organization and obtain information.
- ... interpret the results of the [field] and draw admissible conclusions.
- ... use the learned knowledge, skills and competences to evaluate E/E concepts and assess their features.
- ... present automotive system design related topics and discuss them.
- ... communicate and cooperate within an engineering team in order to find adequate solutions for the task at hand.

Scientific Self-Conception/ Professionalism
- … analyze the impact of design decisions on the social and economic situation of the society and derive recommendations for decisions from a social and ethical perspective on the basis of the analyses and evaluations made.
- ... justify the solution theoretically and methodically.
- ... reflect and assess one's own abilities in a group comparison and develop strategies to improve them.

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4	**Contents**
	Lecture a): System Development
	• Typical components and functions of automotive systems.
	• Typical engine management system and its development process.
	• Software life cycle including classic V model, agile (Scrum) development and Automotive Spice.
	• Requirements engineering and requirements management.
	• SW-documentation and data specification, coding guidelines.
	• Software and system test.
	• Application examples of simple functions
	Lecture b):
	• Application domains powertrain, chassis, body, advanced driver assistance, infotainment, outlook to automated driving
	• Basics of distributed systems. ECU hardware requirements and structure, communication relations and communication problems under real-time constraints.
	• E/E architecture of hybrid and electric powered cars vs. cars with classic combustion engines. Trend towards domain controller and compute-server-architectures.
	• Automotive bus systems and communication protocols (CAN, LIN, FlexRay, MOST, Automotive Ethernet, V2X). Message based communication vs. service oriented communication.
	• Diagnosis and diagnostic communication.
	• Qualitative and quantitative assessment of system safety and reliability. Functional safety including ISO 26262.
	• ECU software architecture and software standards (AUTOSAR Classic and Adaptive)
	The lectures will include theory, case studies, literature surveys and presentation of selected topics done by student teams.
5	**Participation Requirements**
	compulsory: -
	recommended:
	Basic knowledge in electronics and computer science.
	Familiarity with one of the major programming languages, C/C++ preferred.
	Own experience in self-management of a project, i.e. Bachelor thesis
6	**Examination Forms and Prerequisites for Awarding ECTS Points**
	Written Examination 120 min
7	**Further Use of Module**
	Autonomous Systems, Propulsion Systems , Team Project, Master Thesis
8	**Module Manager and Full-Time Lecturer**
	Prof. Dr. W. Zimmermann
9	**Literature**
	• J. Schäuffele, T. Zurawka: Automotive Software Engineering. Springer-Vieweg.
	• H. Wallentowitz, K. Reif: Handbuch Kraftfahrzeugelektronik. Springer-Vieweg.
	• R.K. Jurgen. Automotive Electronics Handbook. McGraw-Hill.
	• W. Zimmermann, R. Schmidgall: Bussysteme in der Fahrzeugtechnik, Springer-Vieweg.
	• K. Reif (Publisher): Bosch Automotive Handbook Series. Springer-Vieweg.
10	**Last Updated**
	2022-10-10