ENGINEERING PF
SCHOOL OF ENGINEERING
Fakultät für Technik
Hochschule Pforzheim

HS PF

Syllabus

BAE4077 Cyber Physical Systems

Prof. Dr. Raphael Volz

Summer Semester 2022

Level	Bachelor	
Credits	3	
Student Contact Hours	2	
Workload	90 hours	
Prerequisites	N/A	
Time	s. LSF	
Room	s. LSF	
Start Date	s. LSF	
Lecturer(s)	**Name**	Prof. Dr. Raphael Volz
	Office	T2.3.15
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Summary

This course introduces Cyber Physical Systems (CPS) in both theory and practice. A lecture component in the first half sets the stage for student projects, which are carried out in small teams in the second half.

This semester the projects of this course are based on the Coding Da Vinci competition, in which students can build cool ideas based on data shared by cultural institutions (Museums, Libraries, etc.) in Baden-Württemberg. Learn more about this competition at

https://codingdavinci.de/de/events/baden-wuerttemberg-2022

The students will form project teams and work on the project between May 9 and June 23 2022 (7 weeks). The participation in the kick off event where teams are formed and all data sets and hardware possibilities are explained is mandatory. This event happens on May 7 and May 8 at ZKM Karlsruhe.

Outline of the Course

Students will learn about cyber-physical systems (CPS), which are systems for collaboration among computer elements that control physical systems. Cyber-physical systems can be found in very diverse fields such as aerospace, automotive, chemical processes, civil infrastructure, energy, healthcare, manufacturing, transportation, entertainment, and consumer products. In the past, CPSs were often referred to as embedded systems. In embedded systems, the focus is more on the computational elements and less on an intensive connection between the computational and physical elements, which is the focus of the lecture.

Course Intended Learning Outcomes and their Contribution to Program Intended Learning Outcomes / Program Goals

	Learning Objective	Contribution
1.1	Students demonstrate key knowledge in Technical Basics.	
1.2	Students demonstrate key knowledge in Mechanical Engineering.	Fundamentals of the development of technical systems that interact with their environment and the social environment.
1.3	Students demonstrate key knowledge in Business Administration.	
1.4	Students demonstrate key knowledge in Economics.	
1.5	Students demonstrate key knowledge in Mathematics.	
1.6	Students demonstrate key knowledge in Quantitative Methods.	
1.7	Students demonstrate key knowledge in Computer Science.	Understanding, structure and design of CPS solutions. Ability to engineer CPS applications, incl. programming.
2.1	Students demonstrate proficiency in using current computer programs to solve business and technical problems.	Use of standard software and software libraries and off-the-shelf hardware components (sensors, actuators) for the development of a cyber physical system in the context of a project work
2.2	Students demonstrate the ability to use information systems effectively in real world business settings.	Use of standard software and software libraries and off-the-shelf hardware components (sensors, actuators) for the development of a cyber physical system in the context of a project work
3.	Students are able to apply analytical and critical thinking skills to complex problems.	Sketches, design guidelines and other technical constraints can be analyzed and fed into integrated product development in consolidated form
4.	Students are able to develop business ethics-based strategies and are able to apply them to typical business decision-making problems.	
5.1	Students demonstrate their ability to express complex issues in writing.	
5.2	Students demonstrate their oral communication skills in presentations and lectures.	
6.	Students show that they are able to work successfully in a team by performing practical tasks.	Solution of a project in teams
7.1	Students are able to explain interdisciplinary terms on the basis of complex problems safely and competently. (WI)	
7.2	To solve strategic and operational problems, the students are able to use the necessary methods combined and apply them to the problem.(WI)	
7.3	Students demonstrate their ability to develop and present complex interdisciplinary solutions by means of an application oriented assignment. (WI)	

Teaching and Learning Approach

- Guided exercises with a networked microcontroller on sensors, actuators and telemetry in the block seminar
- Own project work in the first seven weeks of the semester based on networked devices, robots, and electronic components (will be provided)

Literature and Course Materials

- Rawat, Danda B., Cyber-physical systems : from theory to practice, Apple Academic Press Inc., 2016
- Additional sources specific to the project work in question

Assessment

PLP (Project Work)

'Sehr gut' represents exceptional work, far above average. 'Gut' represents good work, above average. 'Befriedigend' represents average work. 'Ausreichend' represents below average work with considerable shortcomings. And 'mangelhaft' is just exceptional work in the wrong direction or with unacceptable shortcomings.

Schedule

The students will form project teams and work on the project between May 9 and June 23 2022 (7 weeks). The participation in the kick off event where teams are formed and all data sets and hardware possibilities are explained is mandatory. This event happens on May 7 and May 8 at ZKM Karlsruhe.

Academic Integrity and Student Responsibility

Students need to register at https://codingdavinci.de/de/events/baden-wuerttemberg-2022 and agree to the competition terms. If these are not accepted, alternative project topics will be assigned for the team.

Code of Conduct for Students

- Read the syllabus
- Be on time and don’t leave the lectures/exercises early
- Care for a pleasant atmosphere (i.e. silence)
- Ask questions if you don’t understand something
- Build up your knowledge continuously
- Practice fair play to the other students

Link to the Code of Conduct for online Teaching

Teaching Philosophy

I care about your learning experience and helping you to achieve a good study result is important to me. Do not hesitate to ask questions by email, I typically answer within 48 hours, if the email has a subject and basic rules of courtesy are met.

I will do anything to help you learn the subject as well as its real world implications. If you have problems or questions, please speak up in class, send me an e-mail or see me at my office. If you have problems with your progress in the course or with a fellow student please see me as early as possible. I really want you to graduate, but you must earn it!

I do anything I can to help you as long as I can extend the same treatment to other students in the class. Please do not ask for unfair treatment. I really care about you as students and as human beings, but I do not give grades away.

Additional Information

Language: English

Learning Outcomes:

Students will

- know the basics of C programming microcontrollers
- know the most important aspects about sensors and actuators
- know about basic technologies for cyber-physical systems
- develop their own CPS solution as project work
- control robots and electronic devices.

Please note: Formation of project teams and technical introduction at kick-off session May 7/8 at ZKM, Karlsruhe (compulsory participation)

Technical support during the project: Thursday 15:30-17:00 (T2.3.15) and online as required.