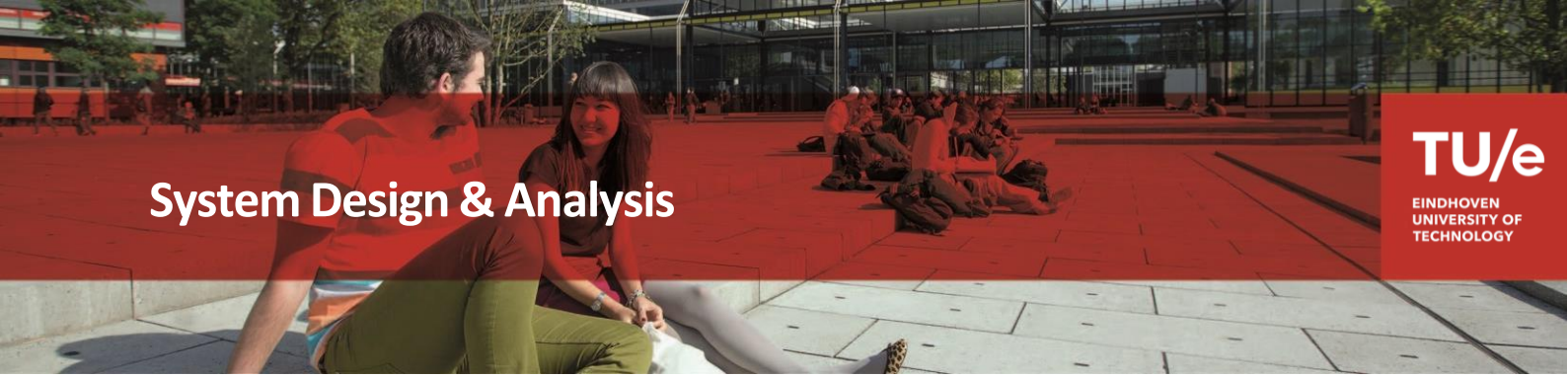


System Design & Analysis

System Design & Analysis	
Offered by	Department of Electrical Engineering
Language	English
Primarily interesting for	All students, but most relevant for students with background in Electrical Engineering, Computer Science, Automotive, Mechanical Engineering
Prerequisites	Elementary knowledge of basic set theory, basic probability theory, and basic computer architecture
Contact person	Prof.dr.ir. A.A. (Twan) Basten, a.a.basten@tue.nl

Content and composition

In the systems design and analysis elective package, students learn how to use models to design and analyze systems containing both hardware and software. The package brings together four courses, from which any combination of three courses can be chosen. Operating systems and their principles are essential to many systems. The Q1 Operating Systems course focuses on operating system architecture and components and on reasoning about interacting concurrent programs. The Q2 DBL Electronic-Systems Engineering covers the system engineering process, using the industry-grade SysML formalism as a basis. The Q3 Stochastic Performance Modeling course treats the analysis of queuing phenomena as they occur in for example traffic, production systems, and communication systems. The Q4 Computational Modeling course covers models of computation for embedded and cyber-physical systems, their analysis methods and application to system design and synthesis. Guaranteeing functional correctness and performance of the systems at hand forms a common thread through all courses.

Course code	Course name	Level classification
2INC0	Operating Systems	Advanced
5XIC0	DBL Electronic-Systems Engineering Please note, course 5XIC0 is on hold in the academic year 2022-2023. This means course 5XIC0 is not taught in the academic year 2022-2023. 5XIC0 will be available again in the academic year 2023-2024.	Deepening
2WB60	Stochastic Performance Modeling	Deepening
5XIE0	Computational Modeling	Advanced

Course descriptions

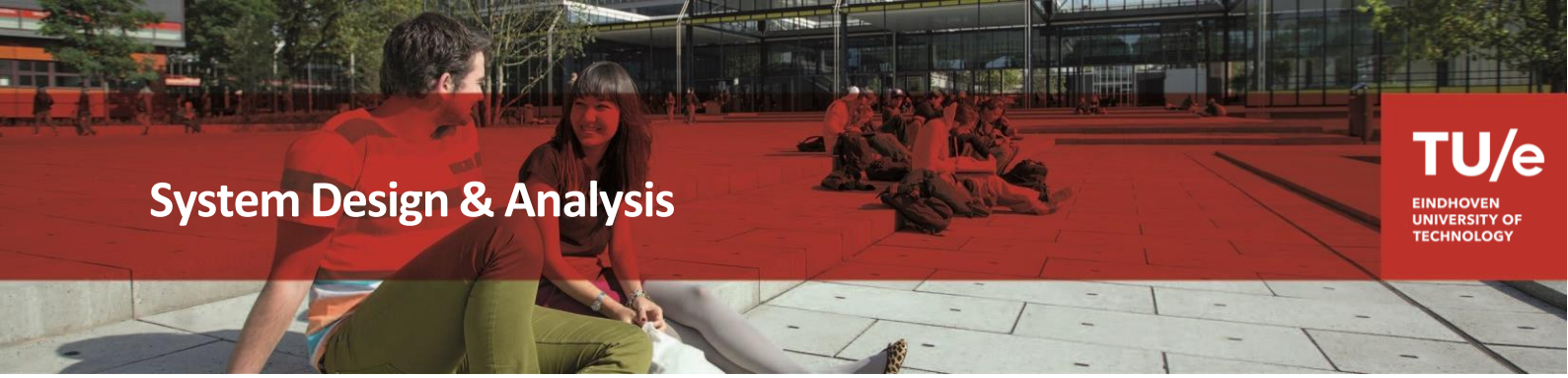
Operating Systems (2INC0)

Introduction of concurrency, atomicity and interference. Program traces and interference. Reasoning about concurrent programs using traces, invariants and assertions. Standard problems like mutual exclusion, bounded buffer and readers/writers. Synchronization using semaphores, conditional critical sections and monitors. Hardware primitives. Global description of operating system tasks. Operating System architecture and Application Programmers interface. The kernel, multiprocessing, interrupts, device drivers, implementation aspects. Virtual memory: demand paging, replacement algorithms. Resource management, scheduling. Filesystems. Examples from Linux and Windows.

DBL Electronic-Systems Engineering (5XIC0)

Please note, course 5XIC0 is on hold in the academic year 2022-2023. This means course 5XIC0 is not taught in the academic year 2022-2023. 5XIC0 will be available again in the academic year 2023-2024.

This course introduces design processes such as the waterfall, V, spiral and NASA models, various design processes such as model-based design, iterative, refinement-based, top-down design, prototyping, and phases such as



requirements engineering, verification, validation, and testing. The course emphasizes model-based design and analyzing cost-performance trade-offs. The systems design notation (SysML) is introduced thoroughly to cover all design phases.

Stochastic Performance Modeling (2WB60)

The focus of this course is on model-based process analysis using stochastic operations research, a discipline of Mathematics that helps make better decisions in complex situations that involve randomness or uncertainty. The application areas treated in the course cover: road traffic, production processes, call centers, health centers, and computer- and communication systems. For these applications, one common issue is that random fluctuations in the offered traffic/work are a major cause of delays.

At the end of this course, you should be able to model several practical situations, study the performance of the systems at hand and make decisions on how to improve their performance. In this course, we provide a solid foundation of discrete and continuous-time Markov chains, the Poisson and renewal processes, and queuing models.

Computational Modeling (5XIE0)

Model-driven design methods are essential to guarantee the proper functioning and the required performance of embedded systems (ES) and cyber-physical systems (CPS). This course introduces models of computation that enable functional analysis, performance analysis and simulation-based evaluation techniques for ES and CPS. The course covers automata, dataflow, and stochastic models, their analysis methods, and their application to system design and synthesis.