

# Complex IT Systems – Theory

Title	Complex IT Systems – Theory
Semester	E2025
Master programme in	Computer Science
Type of activity	Course
Teaching language	English
Study regulation	Read about the Master Programme and find the Study Regulations at <a href="http://ruc.dk">ruc.dk</a>

## REGISTRATION AND STUDY ADMINISTRATIVE

You register for activities through [stads selvbetjening](#) during the announced registration period, which you can see on the [Study administration homepage](#).

Registration When registering for courses, please be aware of the potential conflicts and overlaps between course and exam time and dates. The planning of course activities at Roskilde University is based on the recommended study programmes, which should not overlap. However, if you choose optional courses and/or study plans that goes beyond the recommended study programmes, an overlap of lectures or exam dates may occur depending on which courses you choose.

Number of participants

ECTS 15

Responsible for the activity Morten Rhiger ([mir@ruc.dk](mailto:mir@ruc.dk))

Head of study Henrik Bulskov ([bulskov@ruc.dk](mailto:bulskov@ruc.dk))

Teachers

Study administration IMT Registration & Exams ([imt-exams@ruc.dk](mailto:imt-exams@ruc.dk))

Exam code(s) U60056

**ACADEMIC CONTENT**

Overall objective

Software engineering methods and principles, machine architecture and operating systems, distributed systems, databases and human to machine interactions. The course includes a presentation and critical discussion as well as testing of knowledge and understanding of the core areas in each of these subjects.

This course will cover selected topics from theory on databases, networks and user interfaces and will in addition involve hands-on practical experience with special emphasis on development of applications in a distributed environment.

Focus will be on client-server environments, where an application draws on functionality made available through web services, which in turn draws on data from one or more databases and possibly other sources.

The course is divided in four sections. The content of each of these is outlined below.

#### Section 1: Data and Databases

Detailed description of content

In this section we will cover a number of key topics from database theory. First of all we will cover the relational model and the relational algebra as well as the relational language database SQL. We will go into two important approaches to database design, namely database modelling using the Entity-Relationship model and analysis using normalisation theory. We will briefly discuss database indexing and query optimization as well as transaction management. As far as programming is concerned we will consider two different approaches. One approach concerns implementation of functions, procedures and triggers to be stored directly in the database. The other approach concerns integration of database access into application programs and services – either using database interfaces or the so-called Object Relational Mapping (ORM).

#### Section 2: Data communication and network with focus on web services

This section will include a general introduction to network architecture and distributed systems. There will be a special focus on web services, including context, technology, communications, languages, protocols and architecture related to these. The main development language for server programming will be the object-oriented language c# (similar to java). For the connection to the database we will look at an ORM framework and linq, which is an extension of c# specifically directed at simplifying

the processing of relational data in an object-oriented context, and for the web services we will use asp.net web api, which is a framework specific for supporting restful web services interfaces.

### Section 3: Development of single-page web applications

We touch on the general theory and practice related to designing and implementing graphical user interfaces. We will implement front-end applications that run on the users browser. They will be implemented in JavaScript, HTML, and CSS and will use a front-end UI library for developing so-called single-page applications (SPA) which communicate asynchronously with the backend and thus hide these communications from the user. We will cover modular and composable UI components, routing and navigation, application state management, and advanced JavaScript, including asynchronous programming and event-driven programming.

### Section 4: Security

Attacks on web-sites and methods to protect against the attacks. Attacks covered include SQL injection attacks on databases, attacks on password-based user-authentication, and cross-site scripting attacks that display web-content from a malign third party.

Course material and Reading list Main key references in Database Systems, C# and JavaScript, as well as additional course literature, can be found on the Moodle page for the course.

The course will have a total workload of 412 hours with 135 hours of lectures and exercises, 232 hours of preparation over a 15-week course period and 45 hours for the exam and preparation before the course.

Overall plan and expected work effort The activity's major teaching and learning activities are fleshed out • In class teaching • Exercises • Mandatory assignments on course topics • Homework individually/in study groups

and these may be further developed with description of the processes involved, links to files with descriptions, etc.

Format

Evaluation and feedback Evaluation form to be filled out (anonymously) plus open discussion on the last course day.

Programme

## ASSESSMENT

After completing this activity, students will be able to:

- Overall learning outcomes
- demonstrate knowledge and understanding of key theories in the core subject areas and techniques for the design and construction of software systems meeting specific requirements.
  - show comprehensive overview of and understanding of the general principles behind the hardware and software systems that are part of modern computers and the users' interactions with these.
  - selecting and applying appropriate methods and techniques from the subject area for the analysis, design, and construction of software systems.
  - demonstrate competences in being able to work with IT issues, both independently and in teams, and in being able to critically and systematically learn new approaches to the subject area and thereby independently take responsibility for one's own professional development.

Individual oral exam without time for preparation.

Form of examination Time allowed for exam including time used for assessment: 30 minutes.

Form of examination Permitted support and preparation materials: All.

Assessment: 7-point grading scale.

Moderation: External examiner.

Form of Re-examination Samme som ordinær eksamen / same form as ordinary exam

Type of examination in special cases

Examination and assessment criteria (implemented) It will be assessed to which degree the student demonstrates knowledge and understanding of key theories in the core subject areas of the three sections (outlined above). Before the exam students will know the exam questions for each of the three sections. At the exam the student will pick a set of three questions, one from each section.

Exam code(s) Exam code(s) : U60056

## **Course days:**

**Hold: 1**

### **Complex IT Systems – Theory**

time 03-09-2025 12:15 til  
03-09-2025 17:00  
location 45.2-051 - teorirum 45.2 (90)  
Teacher Troels Andreasen ( troels@ruc.dk )

### **Complex IT Systems – Theory**

time 05-09-2025 12:15 til  
05-09-2025 17:00  
location 45.2-051 - teorirum 45.2 (90)  
Teacher Troels Andreasen ( troels@ruc.dk )

### **Complex IT Systems – Theory**

time 08-09-2025 08:15 til  
08-09-2025 16:00  
location 25.2-005 - teorirum 25.2 (80)  
Teacher Troels Andreasen ( troels@ruc.dk )

### **Complex IT Systems – Theory**

time 10-09-2025 08:15 til  
10-09-2025 16:00  
location 25.3-005 - teorirum 25.3 (80)

Teacher Troels Andreassen ( troels@ruc.dk )

### **Complex IT Systems – Theory**

time 12-09-2025 08:15 til  
12-09-2025 12:00

location 25.1-035 - teorirum 25.1 (130)

Teacher Troels Andreassen ( troels@ruc.dk )

### **Complex IT Systems – Theory**

time 17-09-2025 08:15 til  
17-09-2025 16:00

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forberedelsesnorm D-VIP ikke valgt

location 02.1-031 - geofagsal 02 (70)

Teacher Troels Andreassen ( troels@ruc.dk )

### **Complex IT Systems – Theory**

time 19-09-2025 08:15 til  
19-09-2025 12:00

location 45.3-051 - teorirum 45.3 (90)

Teacher Troels Andreassen ( troels@ruc.dk )

### **Complex IT Systems – Theory**

time 24-09-2025 08:15 til  
24-09-2025 16:00

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forberedelsesnorm D-VIP ikke valgt

location 45.2-051 - teorirum 45.2 (90)

Teacher Troels Andreassen ( troels@ruc.dk )

### **Complex IT Systems – Theory**

time 26-09-2025 08:15 til  
26-09-2025 12:00

location 45.2-051 - teorirum 45.2 (90)

Teacher Troels Andreassen ( troels@ruc.dk )

## **Complex IT Systems – Theory**

time 29-09-2025 08:15 til  
29-09-2025 16:00  
location 45.3-051 - teorirum 45.3 (90)  
Teacher Troels Andreasen ( troels@ruc.dk )

## **Complex IT Systems – Theory**

time 01-10-2025 08:15 til  
01-10-2025 16:00  
location 46.3-042 - teorirum 46.3 (90)  
Teacher Troels Andreasen ( troels@ruc.dk )

## **Complex IT Systems – Theory**

time 03-10-2025 08:15 til  
03-10-2025 12:00  
location 45.3-051 - teorirum 45.3 (90)  
Teacher Henrik Bulskov ( bulskov@ruc.dk )

## **Complex IT Systems – Theory**

time 08-10-2025 08:15 til  
08-10-2025 16:00  
location 46.2-042 - teorirum 46.2 (90)  
Teacher Henrik Bulskov ( bulskov@ruc.dk )

## **Complex IT Systems – Theory**

time 10-10-2025 08:15 til  
10-10-2025 12:00  
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forberedelsesnorm D-VIP ikke valgt  
location 03.1-s03 - auditorie a (120)  
Teacher Henrik Bulskov ( bulskov@ruc.dk )

## **Complex IT Systems – Theory**

time 15-10-2025 08:15 til  
15-10-2025 16:00

location 45.2-051 - teorirum 45.2 (90)  
Teacher Henrik Bulskov ( bulskov@ruc.dk )

### **Complex IT Systems – Theory**

time 17-10-2025 08:15 til  
17-10-2025 12:00

location 45.2-051 - teorirum 45.2 (90)  
Teacher Henrik Bulskov ( bulskov@ruc.dk )

### **Complex IT Systems – Theory**

time 22-10-2025 08:15 til  
22-10-2025 16:00

location 46.2-042 - teorirum 46.2 (90)  
Teacher Henrik Bulskov ( bulskov@ruc.dk )

### **Complex IT Systems – Theory**

time 24-10-2025 08:15 til  
24-10-2025 12:00

location 45.2-051 - teorirum 45.2 (90)  
Teacher Henrik Bulskov ( bulskov@ruc.dk )

### **Complex IT Systems – Theory**

time 29-10-2025 08:15 til  
29-10-2025 16:00

location 46.3-042 - teorirum 46.3 (90)  
Teacher Henrik Bulskov ( bulskov@ruc.dk )

### **Complex IT Systems – Theory**

time 31-10-2025 08:15 til  
31-10-2025 12:00

location 45.2-051 - teorirum 45.2 (90)  
Teacher Henrik Bulskov ( bulskov@ruc.dk )

## **Complex IT Systems – Theory**

time 05-11-2025 08:15 til  
05-11-2025 16:00

location 46.2-042 - teorirum 46.2 (90)

Teacher Henrik Bulskov ( bulskov@ruc.dk )

## **Complex IT Systems – Theory**

time 07-11-2025 08:15 til  
07-11-2025 12:00

location 45.2-051 - teorirum 45.2 (90)

Teacher Niels Jørgensen ( nielsj@ruc.dk )

## **Complex IT Systems – Theory**

time 10-11-2025 08:15 til  
10-11-2025 16:00

location 45.2-051 - teorirum 45.2 (90)

Teacher Niels Jørgensen ( nielsj@ruc.dk )

## **Complex IT Systems – Theory**

time 12-11-2025 08:15 til  
12-11-2025 12:00

location 45.3-051 - teorirum 45.3 (90)

Teacher Niels Jørgensen ( nielsj@ruc.dk )

## **Complex IT Systems – Theory**

time 14-11-2025 08:15 til  
14-11-2025 12:00

location 45.2-051 - teorirum 45.2 (90)

Teacher Morten Rhiger ( mir@ruc.dk )

## **Complex IT Systems – Theory**

time 19-11-2025 08:15 til  
19-11-2025 16:00

location 21.2-032 - undervisningslokale (120)

Teacher Morten Rhiger ( mir@ruc.dk )

## **Complex IT Systems – Theory**

time 21-11-2025 08:15 til  
21-11-2025 12:00

location 21.2-032 - undervisningslokale (120)

Teacher Morten Rhiger ( mir@ruc.dk )

## **Complex IT Systems – Theory**

time 26-11-2025 08:15 til  
26-11-2025 16:00

location 21.2-032 - undervisningslokale (120)

Teacher Morten Rhiger ( mir@ruc.dk )

## **Complex IT Systems – Theory**

time 28-11-2025 08:15 til  
28-11-2025 12:00

location 21.2-032 - undervisningslokale (120)

Teacher Morten Rhiger ( mir@ruc.dk )

## **Complex IT Systems – Theory**

time 03-12-2025 08:15 til  
03-12-2025 16:00

location 03.1-s03 - auditorie a (120)

Teacher Morten Rhiger ( mir@ruc.dk )

## **Complex IT Systems – Theory**

time 05-12-2025 08:15 til  
05-12-2025 12:00

location 03.1-s03 - auditorie a (120)

Teacher Morten Rhiger ( mir@ruc.dk )

## **Complex IT Systems – Theory**

time 10-12-2025 08:15 til  
10-12-2025 16:00

location 45.2-051 - teorirum 45.2 (90)

Teacher Morten Rhiger ( mir@ruc.dk )

## **Complex IT Systems – Theory**

time 12-12-2025 08:15 til  
12-12-2025 12:00

location 45.2-051 - teorirum 45.2 (90)

Teacher Morten Rhiger ( mir@ruc.dk )

## **Complex IT Systems – Theory**

time 19-01-2026 08:15 til  
26-01-2026 18:00

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forberedelsesnorm D-VIP ikke valgt

Teacher Morten Rhiger ( mir@ruc.dk )

## **Complex IT Systems – Theory**

time 26-02-2026 08:15 til  
27-02-2026 18:00

forberedelsesnorm ikke valgt

forberedelsesnorm D-VIP ikke valgt