

# JCSS Advanced Course on Systems Risk Modelling and Analysis in Engineering Decision Making

**Decision Analysis, Probabilistic Systems  
Modeling, Reliability Analysis, Risk  
Assessment, Big Data - and Applications**

**May 25-29, 2020**

## Organizers

Joint Committee on Structural Safety  
Group on Risk and Reliability, Department of the  
Built Environment, AAU, Denmark  
Danish Hydrocarbon Research and Development  
Centre  
K-FORCE Erasmus+ Project

## Teachers

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## Motivation

Methods of reliability, risk and safety assessment are increasingly gaining importance as decision support tools across the engineering sciences.

In order to utilize these methods and to exploit their potential in research, public governance and industrial applications a deep understanding of the fundamental principles is necessary.

## Course contents

The present course provides the background, methods and tools for decision analysis on the optimal management of engineered systems.

Topics/lectures of the course include:

- Statistics and Bayesian probability theory
- Bayesian decision analysis
- Information management
- Probabilistic system characteristics
- Optimization and acceptance criteria
- Time invariant/variant reliability methods
- Monte Carlo techniques
- Modern systems reliability techniques
- Bayesian Nets and Bayesian modeling
- Big Data techniques
- Applications

Application domains include, but are not limited to energy production systems, traffic infrastructure systems, buildings and structures, offshore and marine systems.

The course consists of lectures, exercises, mini-projects and self-study. Lecture notes will be provided in advance of the course.

## Evaluation and certificates

The evaluation of the course is based on:

1. The solutions to the exercises produced by the participants during the course
2. A mini-project submitted by the students within two weeks after the completion of the course.

The reports documenting the mini-projects are assumed to be in the order of 10-15 pages.

Three (3) ECTS point will be given to participants participating and satisfactorily solving the exercises during the course.

Additional two (2) ECTS points (total of five ECTS points) will be given to participants who choose also to submit a mini-project – provided this is positively evaluated.

Successful evaluations will be recognized by a JCSS Diploma.

## Participants

The course is intended for PhD students, academics and professionals from the industry and public authorities, working in the field of risk informed management of engineered facilities and structures in the area of civil engineering, such as:

- Bridges, tunnels and roadway systems
- Wind turbines and wind turbine parks
- Offshore oil and gas production facilities

The course is offered at national and international level. All lectures will be given in English.

### Venue and time

The present course on Decision Support for Management of Engineered Systems will take place on **May 25 - 29, 2020** at the Department of Civil Engineering at Aalborg University.

### Registration, costs and accommodation

Participants must register before **May 4, 2020** through the AAU PhD School Home Page:

Course participation is free for PhD students from Denmark and any other of the Nordic Countries. For PhD students coming from other countries the registration fee is EUR 400. Participants from the industry are due to pay a fee of EUR 1650.

The course registration fee covers participation in the course and study materials.

All participants are offered coffee or refreshments at coffee breaks and a course dinner event for additional Euro 100.

Participants are responsible for organizing and paying for their own travel, meals, and accommodation.

Since there may be limitations on the total number of participants to the course, attendance will be granted

in accordance with the order of registrations – “first come – first serve”.

By **May 6, 2020** all registered participants will be notified with regards to their attendance and provided details with respect modes of registration payments.

### Further information

Further information can be found at the home page: <https://phd.moodle.aau.dk/course/index.php?categoryid=180> or from: Ruth Klitte, e-mail: rk@adm.aau.dk.

### Preliminary course program

Time	May 25	May 26	May 27	May 28	May 29
8:30-10:00	<b>Introduction</b> - Basics of Statistics and Probability Theory	<b>Optimization and risk acceptance</b> - life cycle considerations - life safety	<b>Monte Carlo Simulation</b> - basic principles and strategies	<b>Big Data techniques</b> - Clustering, sensitivity analysis and classification	<b>Applications II</b> - Roadway tunnel accident risk modelling
10:00-10:30	Coffee break	Coffee break	Coffee break	Coffee break	Coffee break
10:30-12:00	<b>Bayesian decision analysis</b> - prior, posterior and pre-posterior analysis	<b>Time invariant reliability analysis</b> - Laplace integral and FORM/SORM	<b>General reliability techniques</b> - Sub-Set MC Simulation and MC extrapolation	<b>Fatigue crack growth modeling</b> - SN fatigue modeling - Crack growth modeling	<b>Applications III</b> - Integrity management of wind turbine parks
12:00-13:00	Lunch	Lunch	Lunch	Lunch	Lunch
13:00-14:30	<b>Information management</b> - Objectives, metrics, information, knowledge and systems modeling	<b>Time variant reliability</b> - Level crossing approaches	<b>Bayesian Nets (BNs)</b> - Basic principles - Bottom-Up modeling - Dynamic BPs	<b>Modeling of systems</b> - Digital Twins, system change identification and damage detection	<b>Introduction to mini-project</b> - Group formation - Topic selection
14:30-15:00	Coffee break	Coffee break		Coffee break	Coffee break
15:00-16:30	<b>System characteristics</b> - Risk, robustness, resilience and sustainability	<b>Systems reliability analysis</b> - Principles and basics	<b>Bayesian modeling</b> - Parametric and non-parametric methods	<b>Applications I</b> - Risk Informed Inspection and Maintenance Planning	<b>Open discussion and feed-back</b>
16:30-18:00	Exercises	Exercises	Exercises	Exercises	Closure