

Course Name

“Introduction to Systems Thinking, Systems Analysis and System Dynamics: The Role of Systems Science in Sustainability Science”

Course Description

Objective: The overall objective of the course is to develop the student's capacity to make a systemic analysis of complex dynamic issues by applying **systems science** with respect to sustainability criteria.

Course Details and Content: The course consists of two parts, in which the students will be introduced into:

1. conceptual modeling and systems analysis (week 1); and
2. system dynamics modeling and integrated scenario analysis (week 2).

In the first part of the course, the students will be introduced to **systems science** and **sustainability science** concepts to understand the interconnected patterns of three dynamic and complex systems that constitute the world we live in – namely, the biophysical world system (natural resources: e.g. water, soil, biomass etc.), the human system (individuals, society) and the human built support system (all physical, legislative and institutional infrastructures: e.g. from economy to government, to technology to agriculture etc.). With the help of **systems thinking** and **systems analysis** the students will apply casual loop diagramming methodology to create conceptual models showing interconnections, cause effect relations, feedbacks and time delays between/within these dynamic systems. This will help the students to get a holistic view and develop a better understanding of the entire system behaviour. This understanding is essential when identifying and assessing problems, as well as the main driving forces and the associated potential alternative solutions to these problems.

In the second part of the course, **systems dynamics** will be introduced as a methodology to be used to understand the behavior of complex systems over time. With the help of system dynamics the conceptual model structures that the students created will be taken into one step further and transferred into dynamic numerical models in computer environment. Such models can be used as decision support tools enabling the user to generate different scenarios and analyze the associated simulation results. By using Stella v.10 system dynamics modeling software, the students will be introduced to various stages in model building process, validation and critical evaluation of the models, as well as integrated scenario analysis based on the model simulation results.

Course Design: Besides lectures and exercises, the course is mainly based on a project group work, where the group modelling process and cooperation are of great importance. The project will incorporate elements from biophysical world system, human system and the built support system covering natural, economical, technological and social issues in long-term time frames. The project will be reported in written and presented in oral form.

Learning outcomes: Upon successful completion of this course the students will be able to;
Learn how different types of complex systems and processes can be understood, analyzed and modeled (conceptually and numerically); Understand all model development phases;
Learn how to critically evaluate models and their limitations (assumptions/simplifications);
Learn how to make sensitivity analysis; Learn how to validate models; Carry out a complete sustainability project, in which they develop a decision support tool generating alternative simulations under different scenarios for integrated analysis and strategic planning.

Dates: Part 1 - conceptual modeling and systems analysis – April 03-07, 2017

Part 2 - system dynamics modeling and integrated scenario analysis – Autumn 2017
(to be announced later)

Course application: Contact deniz.koca@cec.lu.se for registration before March 24, 2017. Admission will be on first-come, first-serve basis. First part of the course is prerequisite for the second part of the course. No prerequisites for the first part. The course is open to all Ph.D. students across disciplines and faculties.

Course coordinator: Deniz Koca

For more information about the course and application please contact:
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