CISAD
CENTRE FOR INTERNATIONAL STUDIES AND DEVELOPMENT

JAGIELLONIAN UNIVERSITY IN KRAKÓW

PROGRAM SPINAKER

SPINAKER Summer School course

System Science - a Dynamic Tool for Understanding the Complex World

Course description

Why does the world suffer from financial, political, and economic crises? Why do decision-makers fail to manage crises effectively? Why do some organizations grow while others stagnate? Why do the value chains witness fluctuations and disruptions? How can decision-makers identify and design high-leverage policies that can embrace unanticipated side effects? What can decision-makers do to make the world more balanced and immune to disruptions?

Economic, technological, social, and environmental change challenges decision-makers to learn at increasing rates. Today's world requires us to design and manage systems where complexity is unavoidable because of multiple feedback effects, long-time delays, and nonlinear responses to our actions. Learning in such environments is difficult because we never confront many of the consequences of our most important decisions. Effective learning in a complex environment requires methods to develop systems thinking by representing and assessing complexity and its implications. It also requires tools like causal loop diagrams and stocks and flows diagrams decision-makers can use to accelerate learning.

Subject's learning outcomes

Outcomes in terms of	**Examination methods**
Knowledge - Student knows and understands:	
- The implications of complexity on emerging unstructured problems; - Basic terminology and system approach models in the context of solving complex problems; - The modeling process and system tools applications; - Structure and behaviour of dynamic systems.	Case study
Skills - Student can:	
- Identify areas for improvement in complex problems; - Present effects of delays in complex systems; - Map stocks and flows and use tools for modeling dynamic systems.	Case study

Social competences - Student is ready to:	
- Communicate the importance of complex problems; - Develop the relations among the team members; - Learn collaboratively in the team and present the findings of teamwork.	Case study

Calculation of ECTS points

Activity form	**Activity hours***	
Lecture	12	
Preparation for classes	25	
Preparation for the exam	13	
Student workload	**Hours** 38	**ECTS** 2
Workload involving teacher	**Hours** 12	**ECTS** 2

*hour means 45 minutes

Study Content

1. **Complexity definitions, types, implications**

Understanding and interpreting the term complexity and knowing how complexity can impact the emerging of global complex problems like financial, political, and economic crises, contagion effects, value chains disruptions.

2. **Systems thinking definitions**

Judgment errors and biases in thinking about complexity. Process of systems thinking, Analysis and Synthesis, systems thinking advantages and weaknesses, differences between linear and systems thinking.

3. **System definitions**

System attributes, inflow, outflow, feedback.

Study content

4. **System approach evolution**

The system approach evaluation from General Systems Theory toward Complexity Theory Evolution of the system approach as the movement toward explaining the complexity.

5. **General System Theory**

Historical development, philosophy and theory, methodology, methods, recent developments of General Systems Theory.

6. **Cybernetics**

Historical development, philosophy and theory, methodology, methods, recent developments Cybernetics.

7. **System Dynamics**

Historical development, philosophy and theory, methodology, methods, recent developments Systems Dynamics.

8. **Chaos Theory**

Historical development, philosophy and theory, methodology, methods, recent developments of Chaos Theory.

9. **Causal Loops Diagrams, Stocks and Flows**

Causal Loops Diagrams and Stocks and Flows Diagrams applications in solving complex problems.

10. **System archetypes**

"Drifting Goals," "Shifting the Burden," "Limits to Success," "Success to the Successful," "Fixes That Fail," "Tragedy of the Commons," "Growth and Underinvestment," and "Escalation", archetypes.

11. **System Dynamics modeling**

Flexim software application in modeling systems dynamics.

12. **Future of system approach**

Expected system approach evolution. Next complex global problems. Future system practices to embrace complexity.

Course advanced

Activities	Examination methods
Lecture with multimedia presentation Conversation lecture	Case study The students can get 100 points in total, and respectively, the number of points and scores are given below: 50-59 points 3.0 60-69 points 3.5 70-79 points 4.0 80-89 points 4.5 90-100 points 5.0

Literature

Obligatory

- Sterman, J. (2002). *System Dynamics: systems thinking and modeling for a complex world.*
- Meadows, D. H. (2008). *Thinking in systems: A primer*. Chelsea green publishing.

Optional

- Jackson, M. C. (2016). *Systems thinking: Creative holism for managers*. John Wiley & Sons, Inc.