Systems analyzing and designing	**Name of the course/ Unit**
3 Units / 48 hours	**Number of units/Hours of the course**
Mohsen Alvandi, Assistant professor of the department of industrial management, Imam Khomeini International University	**Lecturer/ Faculty member name**
▪ Problem-based learning ✅ ▪ Team-based learning ✅ ▪ Project-based learning. ✅ ▪ Game-based learning ✅ ▪ Technology-based learning ✅ ▪ Flipped learning ✅ ▪ Web-based learning. ✅ ▪ Experience-based learning ❌ ▪ Technology Supported Collaborative Learning ❌	**Adapted strategy/ Approach/Innovation**
Undergraduate student	**Level of the course/ Units**
The purpose of this course is to provide students with a comprehensive framework for understanding and navigating complex systems through the application of systems thinking and causal loop analysis. Students will develop the ability to:	**The purpose**

- Comprehend Complexity: Gain a deep appreciation for the interconnectedness and complexity of systems, recognizing that changes in one part of a system can lead to unforeseen consequences in other parts.
- Analyze Causal Relationships: Develop proficiency in identifying and interpreting causal relationships within systems, enabling students to recognize both direct and indirect influences between system components.
- Identify Feedback Loops: Acquire the skill to detect various types of feedback loops – reinforcing and balancing – and understand how they can shape the behavior of systems over time.
- Map System Dynamics: Learn how to construct causal loop diagrams to visually represent complex systems, demonstrating how different elements interact and influence each other.
- Predict System Behavior: Develop the capability to anticipate the behavior of systems under different scenarios by analyzing the interplay of causal loops and their effects.
- Design Effective Interventions: Master the art of designing interventions that leverage feedback loops to achieve desired outcomes, considering the potential unintended consequences and side effects.
- Enhance Decision-Making: Acquire a robust decision-making framework that accounts for the broader context and potential long-term effects of choices made within a system.

- Promote Sustainable Solutions: Cultivate a mindset that values sustainability and long-term viability, allowing students to contribute to the creation of solutions that consider the well-being of systems, stakeholders, and the environment.

- Apply Across Disciplines: Develop transferable skills that can be applied across diverse fields such as business, healthcare, environmental science, urban planning, and social policy, fostering innovation and adaptability. - Foster Collaborative Problem Solving: Encourage collaborative and interdisciplinary problem-solving by equipping students with a common language and framework for discussing complex issues and devising effective solutions. - Anticipating Consequences: Develop students' capacity to foresee potential outcomes of interventions by understanding how changes in one part of a system can lead to ripple effects throughout the entire system. - Improved Decision-Making: Foster the skill to make informed decisions by analyzing the broader context and understanding the intricate cause-and-effect relationships that underlie complex issues. - Identifying Leverage Points: Train students to identify leverage points within systems – specific areas where a small intervention can lead to significant positive changes in the entire system. - Enhanced Risk Assessment: Enable students to assess risks more accurately by recognizing potential unintended consequences and system vulnerabilities. - Interdisciplinary Thinking: Cultivate interdisciplinary thinking as students learn to analyze systems that span multiple domains, encouraging them to consider diverse perspectives. - Environmental and Social Sustainability: Highlight the importance of systems analysis in addressing environmental and social challenges, guiding students to design solutions that minimize negative impacts.	
25 undergraduate students	**Number of learners/ students**

■ Hybrid ☐ virtual ☐ presence	**Course/Lesson implementation method**
▪ Enhanced Pedagogical Skills: Teachers will develop improved teaching strategies to effectively convey complex concepts related to systems thinking and causal loop analysis. ▪ Deeper Content Knowledge: Teachers will acquire a more profound understanding of systems thinking and causal loop analysis principles, allowing them to provide more accurate and in-depth explanations to students. ▪ Adaptive Instruction: Teachers will be better equipped to tailor their instruction to students' diverse learning styles and abilities, fostering a more inclusive and engaging classroom environment. ▪ Engaging Learning Materials: Teachers will design and curate learning materials that capture students' interest and effectively communicate the intricacies of systems thinking and causal loop analysis. ▪ Critical Assessment Tools: Teachers will develop tools and methods to assess students' comprehension of complex concepts, facilitating targeted support and interventions. ▪ Interactive Activities: Teachers will design interactive activities and simulations that enable students to experience the dynamics of systems firsthand, enhancing their grasp of theoretical concepts.	**Expected outcomes for teachers in terms of improved quality prior to the course/lesson implementation**
▪ **Before teaching**[1]... 1. Sharing course material with students before each session, making them ready to reach a higher engagement rate during the class time. 2. Video Lectures and Tutorials:	**Details of the implementation method of the strategy/approach/**

[1]. It refers to activities such as setting specific course objectives, sequencing the presented content, predicting learners' input behavior, grouping students into specific categories, and the class model and structure that will be determined by the instructor.

a. Record video lectures or tutorials that cover complex topics, providing students with the flexibility to review the content at their own pace. b. Share these videos on the course platform for easy access. ▪ **During teaching**[1] 3. Group Case Studies: a. Facilitate student groups to analyze real-world complex scenarios through the lens of systems thinking and causal loop analysis. b. Encourage collaborative problem-solving, where each group identifies and presents the causal loops and feedback mechanisms within their assigned case study. c. Engage students in discussions that encourage critical thinking and the exploration of potential solutions to address the challenges presented in the case studies. 4. Gamification: a. Design interactive simulations or games that simulate complex systems, allowing students to experiment with cause-and-effect relationships and observe the consequences of their decisions. b. Implement gamified assessments or challenges that require students to apply systems thinking concepts to navigate dynamic scenarios and achieve desired outcomes. c. Use leaderboard systems or rewards to motivate active participation and healthy competition among students. 5. Guest Speakers and Industry Experts: a. Invite guest speakers or industry experts who have applied systems thinking and causal loop analysis to share their real-world experiences and insights.	**innovation**

[1] It refers to preparatory/initial evaluation activities and motivating learners, which will be designed and managed by the instructor.

b. Conduct interactive sessions where students can engage in Q&A and learn about the practical application of these concepts in various fields. 6. Workshops: a. Organize hands-on workshops that guide students through the process of constructing causal loop diagrams to represent complex systems visually. b. Provide opportunities for students to engage in guided practice sessions where they collaborate to identify causal relationships and feedback loops in specific contexts. c. Host interactive sessions where students share their diagram interpretations, fostering peer learning and diverse perspectives. ▪ **Additional activities**[1] 7. Written Assessments: a. Design quizzes and exams that assess students' understanding of foundational concepts, principles, and terminology related to systems thinking and causal loop analysis. b. Include both multiple-choice and short-answer questions to gauge comprehension at different levels. 8. Case Study Analysis: a. Assign individual or group case studies where students apply systems thinking and causal loop analysis to analyze complex real-world scenarios. b. Evaluate their ability to identify relevant causal loops, feedback mechanisms, and propose effective interventions. 9. Causal Loop Diagrams:	

[1] . It refers to the end-of-course evaluation method and the meaningful assignment system for learners

   a. Ask students to create causal loop diagrams for specific systems, demonstrating their capability to visually represent relationships and feedback loops.
   b. Evaluate the accuracy and depth of their diagram representations.
10. Group Projects and Presentations:
    a. Have student groups work on comprehensive projects that require them to apply systems thinking and causal loop analysis to solve complex problems.
    b. Assess their presentation skills and the clarity of their explanations during project presentations.
11. Storytelling
    a. Contextualize Complex Concepts: Stories provide relatable contexts for understanding abstract theories. By weaving systems concepts into narratives, students grasp the relevance and practical implications of these theories.
    b. Embrace Multidimensionality: Just as systems encompass various components, storytelling introduces characters, environments, and events that showcase the multidimensional nature of systems.
    c. Explore Cause and Effect: Stories unveil the cause-and-effect relationships inherent in systems, demonstrating how actions reverberate through a web of interconnected elements.
    d. Experience Dynamic Change: Narratives unfold over time, mirroring the temporal dynamics of systems. Students witness how feedback loops evolve, leading to transformative shifts.
    e. Spark Creativity: Engaging stories inspire students to think creatively, encouraging them to envision alternate scenarios and solutions within the context of complex systems.

12. Utilizing Vensim Software a. Interactive Learning: Vensim transforms abstract concepts into interactive visualizations. Students can manipulate variables, observe system responses, and witness the effects of their interventions in real time. b. Applied Understanding: By constructing dynamic models in Vensim, students translate theoretical knowledge into practical applications, deepening their understanding of systems dynamics. c. Hands-On Experience: Using Vensim provides a hands-on experience, enabling students to actively engage with complex systems and see the implications of their decisions within a controlled environment. d. Experiential Exploration: Students can experiment with different scenarios, testing their hypotheses and gaining insights into the behavior of systems under varying conditions. e. Visual Representation: Vensim's visual representation of causal loops and feedback structures helps students grasp complex relationships more intuitively, enhancing their ability to create causal loop diagrams. f. Data-Driven Insights: Students can integrate real-world data into their models, enhancing the accuracy of their simulations and providing insights into the predictive capabilities of systems thinking. 13. Project In the course on Systems Thinking and Causal Loop Analysis, students engage in a practical project that tasks them with applying systems thinking principles to analyze a factory or business of their choice. This project serves as a culminating exercise, allowing	

	students to demonstrate their mastery of systems analysis within a real-world context. Here's an overview of the project: a. Selection of Factory or Business: Students choose a specific factory or business they want to analyze. It could be one they are familiar with or one they are interested in exploring. b. System Boundaries Definition: Clearly define the boundaries of the system under analysis. What aspects of the factory or business will be included in the analysis, and what will be excluded? c. Data Collection: Gather relevant data, information, and documentation about the selected system, its operations, and its context. d. Causal Loop Diagram Development: Create a detailed causal loop diagram that illustrates the relationships between key variables within the system. e. Problem Identification: Identify specific problems, challenges, or areas for improvement within the system. f. Intervention Proposals: Develop intervention strategies or policies that can address the identified problems or enhance the system's performance. g. Simulation and Testing: If applicable, use software tools to simulate the effects of proposed interventions and assess their potential impact. h. Ethical Reflection: Consider the ethical implications of the proposed interventions and evaluate their alignment with ethical principles and values. i. Documentation and Presentation: Compile all findings, diagrams, problem statements, intervention proposals, and simulation results into a comprehensive report. Prepare a clear and engaging	

presentation to communicate the analysis process and findings to the class. By completing this project, students not only gain a deeper understanding of systems thinking and causal loop analysis but also acquire practical skills in applying these concepts to real-world scenarios, making informed decisions, and proposing interventions for improved system performance.	
▪ Students' participation and engagement in class discussions (2 points) ▪ Written assignments (10 points) ▪ Students' Project (6 points) ▪ End-term exam (2 points).	**Course/course evaluation method**
▪ Skype online meetings ▪ Online games like https://beergameapp.com/ ▪ Adobe Connect ▪ Google Classroom for receiving assignments	**Technologies used to enhance teaching and learning**
▪ **As an instructor:** 1. Expertise in Systems Thinking: Instructors will gain a deep understanding of systems thinking principles, enabling them to effectively teach and explain intricate concepts to students. 2. Facilitation and Engagement: Instructors will refine their skills in facilitating engaging discussions, workshops, and interactive activities that encourage student participation and critical thinking.	**Skills and competencies expected to be developed after implementing the innovation**

3. Curriculum Design: Instructors will develop the ability to design and structure a curriculum that progressively builds students' skills in systems thinking and causal loop analysis. 4. Adaptive Teaching Strategies: Instructors will learn to tailor their teaching methods to cater to diverse learning styles and abilities, ensuring that all students can grasp complex ideas. 5. Online Instruction: If implementing online components, instructors will acquire proficiency in designing and delivering digital content through various platforms, enhancing their technological skills. 6. Coaching and Mentoring: Instructors will improve their mentoring skills as they guide students through complex case studies, discussions, and practical exercises related to systems thinking. ▪ As a student: 1. Systems Thinking Mindset: Students will develop a holistic perspective and the ability to see the interconnections and feedback loops within complex systems. 2. Causal Relationship Analysis: Students will acquire the skill to identify and analyze cause-and-effect relationships, understanding how different elements influence one another. 3. Visual Representation: Students will learn to create causal loop diagrams to visually represent complex systems, enhancing their ability to communicate and analyze such systems.	

4. Critical Thinking: Students will hone their critical thinking skills by evaluating the long-term consequences of actions within systems and considering multiple perspectives. 5. Problem-Solving: Students will become adept at solving intricate problems by applying systems thinking principles to develop effective interventions. 6. Collaboration and Communication: Students will develop collaborative skills through group case studies, discussions, and presentations, enhancing their ability to work in interdisciplinary teams. 7. Adaptability: Students will learn to adapt their thinking to dynamic situations, considering how systems respond to changes and uncertainties. 8. Innovation and Creativity: Students will cultivate innovative thinking as they explore unconventional solutions and leverage feedback loops to create novel strategies. 9. Ethical Considerations: Students will understand the ethical implications of interventions within systems and consider the social and environmental consequences of their decisions.	
Negin Ahmadi (negin.ahmadi332@gmail.com) Amir Mahdavi (amms1379@gmail.com)	**Consultant/designer/educational assistant**
▪ **Achieving course/lesson objectives using strategy/approach/innovation** Very good (5) Good(4) Average(3) Poor(2) Very poor (1)	**Course/lesson self-evaluation perspective**

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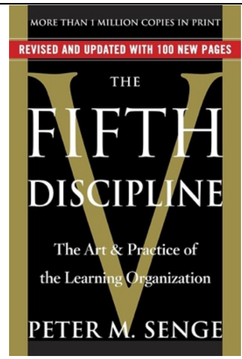
In the course on Systems Thinking and Causal Loop Analysis, the influential book "The Fifth Discipline" by Peter Senge holds a central role as a foundational source. This book serves as a guiding beacon, illuminating the path towards mastering the art of systems thinking and fostering a deep understanding of the intricate interplay of elements within complex systems.



As a primary source of learning, "The Fifth Discipline" provides numerous advantages to students:

- Comprehensive Framework: The book offers a comprehensive framework for systems thinking, introducing the concept of "The Learning Organization" and the five disciplines that contribute to it.
- Practical Applications: "The Fifth Discipline" bridges theory and practice by presenting real-world case studies that demonstrate the transformative power of systems thinking in various settings.
- Systems Archetypes: The book introduces systems archetypes – common recurring patterns of behavior within systems – which provide students with practical templates for analyzing and understanding complex systems.
- Causal Loop Diagrams: Peter Senge's work emphasizes the importance of causal loop diagrams in visually representing systems dynamics. This aligns with the course's emphasis on visualizing feedback loops.
- Organizational Learning: The concept of organizational learning presented in the book aligns with the course's goals of developing
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Other considerations

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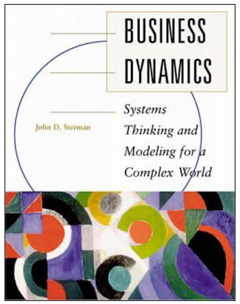
students' abilities to adapt, innovate, and create sustainable solutions within systems.

- Interconnectedness: "The Fifth Discipline" highlights the interconnectedness of systems and how decisions made in one area can impact other parts of the system, aligning with the course's focus on causal relationships.
- Holistic Perspective: The book encourages readers to view problems holistically, considering the underlying system dynamics rather than isolated symptoms. This aligns with the core principle of systems thinking.
- Leadership and Change: The book explores the role of leadership in fostering systems thinking and driving positive change, which resonates with the course's emphasis on designing effective interventions.
- Mindset Shift: "The Fifth Discipline" prompts a shift in mindset, encouraging readers to see beyond immediate effects and consider the long-term consequences of actions within systems.
- Ethical Considerations: The book emphasizes the ethical implications of decisions within systems, fostering critical thinking about the broader implications of interventions.



As an additional source of learning, "Business Dynamics" brings several key benefits to students:

- Focused Business Perspective: The book specifically examines business systems, illustrating how systems thinking can be directly applied to analyze and address challenges within organizations and industries.

- Quantitative Modeling: "Business Dynamics" delves into the quantitative modeling of systems, allowing students to develop skills in constructing and simulating dynamic models that reflect real-world business scenarios.
- Supply Chains and Operations: "Business Dynamics" explores the complexities of supply chains, operations, and market dynamics within a systems thinking framework, aligning with practical applications covered in the course.

In the course on Systems Thinking and Causal Loop Analysis, the domestic book "Systems Analysis and Design" by Ali Rezaeian plays a pivotal role as a primary resource tailored to the specific needs and contexts of the course. This book offers a localized perspective on systems analysis and design, aligning with the course's focus on applying these principles to real-world challenges within a domestic context.