City University of Hong Kong
Course Syllabus

offered by Department of Systems Engineering
with effect from Semester B 2024 / 25

Part I Course Overview

Course Title:	Design Science
Course Code:	SYE6302
Course Duration:	One Semester
Credit Units:	3
Level:	P6
Medium of Instruction:	English
Medium of Assessment:	English
Prerequisites: *(Course Code and Title)*	Nil
Precursors: *(Course Code and Title)*	Nil
Equivalent Courses: *(Course Code and Title)*	Nil
Exclusive Courses: *(Course Code and Title)*	Nil

Part II Course Details

1. Abstract

This course immerses students to the interdisciplinary field of design science, offering an in-depth exploration of design theories, methods, and principles that transcend conventional boundaries. Through a blend of lectures and hands-on design projects, students will learn how design science intersects with practical applications across diverse fields, including engineering, architecture, medicine, business, policy, and etc. Lectures will introduce a wide range of techniques for empathy development, ideation, prototyping, testing, AI for design, etc. In parallel, design projects will challenge students to recognize emerging societal issues as design opportunities, leading to the creation of human-centred products, services, and systems that shape the future. By integrating theoretical knowledge with experiential learning, this course equips students with a holistic understanding of design's transformative power, fostering innovation and leadership.

2. Course Intended Learning Outcomes (CILOs)

(CILOs state what the student is expected to be able to do at the end of the course according to a given standard of performance.)

No.	CILOs	Weighting (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	*A2*	*A3*
1.	Acquire design thinking, system thinking, and evolutionary thinking	25%	✓		
2.	Master existing design principles and methods that are applicable across domains and disciplines	25%	✓	✓	
3.	Develop abilities to apply design theories, principles and methods effectively in realistic design processes	25%	✓	✓	✓
4	Nurture empathy, creativity, entrepreneurship and leadership for human-centered design and innovation	25%	✓	✓	✓
		100%			

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: *Accomplishments*
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

3. Learning and Teaching Activities (LTAs)

(LTAs designed to facilitate students' achievement of the CILOs.)

LTA	Brief Description	CILO No.				Hours/week (if applicable)
		1	2	3	4	
Lectures	Weekly lectures to introduce and discuss fundamental concepts	✓	✓		✓	1.5 hr / week
Team-Based Design Project Studios	Weekly sessions for students to work in teams on their design projects, share progresses, and obtain feedback from peers, TA and the instructor	✓	✓	✓	✓	1.5 hr / week

4. Assessment Tasks/Activities (ATs)

(ATs are designed to assess how well the students achieve the CILOs.)

Assessment Tasks/Activities	CILO No.				Weighting	Remarks
	1	2	3	4		
Continuous Assessment: _100_ %						
Individual Assignment 1: Design Theories and Methods	✓	✓			15%	
Individual Assignment 2: Human-Centered Design with Systems Thinking	✓	✓			15%	
Team Project Presentation 1: Team Building and Ideation	✓	✓	✓	✓	10%	
Team Project Presentation 2: Prototyping	✓	✓	✓	✓	20%	
Team Project Presentation 3: Delivering	✓	✓	✓	✓	20%	
Team Peer Evaluation			✓	✓	10%	
In-class discussion and activities	✓			✓	10%	
Examination: __0__ % (duration: , if applicable)						
					100%	

5. Assessment Rubrics

(Grading of student achievements is based on student performance in assessment tasks/activities with the following rubrics.)

Applicable to students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Individual Assignment 1: Design Theories and Methods	Quality of critical analysis and application of design theories and methods.	High Demonstrates an exceptional understanding of design theories and methods, with deep critical analysis, clear arguments, and original insights.	Significant Shows a solid grasp of the material, with well-structured arguments and reasonable analysis, though lacking in-depth innovation or originality.	Moderate Demonstrates a basic understanding with some analysis but lacks depth and clear connection to design theories.	Basic Shows limited understanding, with minimal analysis and unclear connection to the course material.	Not even reaching marginal levels Fails to demonstrate understanding or application of design theories and methods.
2. Individual Assignment 2: Human-Centered Design with Systems Thinking	Demonstration of systems thinking and human-centered design principles.	High Demonstrates a strong application of systems thinking and human-centered design, with innovative ideas and well-justified design decisions.	Significant Shows good application of principles with sound reasoning and some innovation.	Moderate Provides basic application of design principles but lacks creativity or thoroughness.	Basic Shows minimal application of systems thinking or human-centered design, with limited creativity.	Not even reaching marginal levels Fails to apply systems thinking or human-centered design principles.
3. Team Project Presentation 1: Build Team and Ideate	Effectiveness of team collaboration and quality of idea generation.	High Demonstrates exceptional teamwork with highly creative and well-developed ideas. Clear roles,	Significant Shows good collaboration with innovative ideas but may lack depth or full team integration.	Moderate Basic team effort with some viable ideas but lacking in creativity or cohesiveness.	Basic Weak collaboration with underdeveloped ideas and unclear team roles.	Not even reaching marginal levels Fails to demonstrate teamwork or produce viable ideas.

		responsibilities, and excellent synergy within the team.				
4. Team Project Presentation 2: Prototype and Test	Quality and feasibility of prototypes, and thoroughness of testing.	High Produces highly innovative and functional prototypes with thorough testing and well-documented results.	Significant Demonstrates solid prototyping skills with functional designs and adequate testing, though missing some refinements.	Moderate Prototypes are basic, with limited functionality and incomplete testing.	Basic Prototypes are underdeveloped with minimal or flawed testing.	Not even reaching marginal levels Fails to produce a functional prototype or conduct meaningful testing.
5. Team Project Presentation 3: Pitch and Demo	Clarity and persuasiveness of the pitch, and demonstration of design solutions.	High Delivers a compelling and professional pitch with clear, innovative design solutions that are effectively demonstrated.	Significant Presents a clear and logical pitch with well-demonstrated solutions, though lacking in full persuasiveness or innovation.	Moderate Basic pitch with an understandable solution, but lacks compelling elements or clear demonstration.	Basic Weak pitch with unclear or poorly demonstrated solutions.	Not even reaching marginal levels Fails to deliver a coherent pitch or demonstrate the design solution effectively.
6. Team Peer Evaluation	Contribution to team efforts, collaboration, and peer support.	High Demonstrates outstanding contribution to the team, offering substantial support, leadership, and collaboration throughout.	Significant Shows strong contribution and effective teamwork, though with room for improvement in collaboration or leadership.	Moderate Provides a basic contribution but lacks consistent engagement or impact on the team's success.	Basic Contributes minimally to the team, with noticeable gaps in collaboration and effort.	Not even reaching marginal levels Fails to contribute to the team or causes disruptions to team progress.
7. In-class discussion and activities	Engagement in class discussions, active contribution to group	Actively participates in class discussions	Regularly participates in class with	Participates occasionally in class discussions	Rarely participates in discussions and group activities.	Does not participate in class discussions or

	activities, and demonstration of critical thinking.	with insightful, well-considered contributions. Demonstrates a strong ability to engage with peers and instructors through critical questions, constructive feedback, and leadership in group activities. Consistently shows a deep understanding of course content and applies it meaningfully in discussions.	thoughtful comments and questions. Shows a good understanding of the material and contributes positively to group activities, though with some room for deeper engagement or leadership.	and group activities. Displays a basic understanding of the material but contributions are limited in depth or frequency.	Demonstrates minimal understanding of the course material and lacks engagement with peers or instructors.	group activities. Fails to demonstrate any engagement with the course material or class dynamics.

Applicable to students admitted from Semester A 2022/23 to Summer Term 2024

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B)	Marginal (B-, C+, C)	Failure (F)
1. Individual Assignment 1: Design Theories and Methods	Quality of critical analysis and application of design theories and methods.	High Demonstrates a comprehensive and nuanced understanding of design theories and methods with deep critical analysis, clear arguments, and original insights.	Significant Shows a solid grasp of the material with well-structured arguments and reasonable analysis but lacks significant originality or deep innovation.	Moderate/Basic Demonstrates a basic understanding of the material but lacks depth, with only moderate analysis and limited application of design theories.	Not even reaching marginal levels Fails to demonstrate an understanding or application of design theories and methods, with minimal or no analysis.
2. Individual Assignment 2: Human-Centered Design with Systems Thinking	Demonstration of systems thinking and human-centered design principles.	High Demonstrates a comprehensive and nuanced understanding of design theories and methods with deep critical analysis, clear arguments, and original insights.	Significant Shows a solid grasp of the material with well-structured arguments and reasonable analysis but lacks significant originality or deep innovation.	Moderate/Basic Demonstrates a basic understanding of the material but lacks depth, with only moderate analysis and limited application of design theories.	Not even reaching marginal levels Fails to demonstrate an understanding or application of design theories and methods, with minimal or no analysis.
3. Team Project Presentation 1: Build Team and Ideate	Effectiveness of team collaboration and quality of idea generation.	High Demonstrates a comprehensive and nuanced understanding of design theories and methods with deep critical analysis, clear arguments, and	Significant Shows a solid grasp of the material with well-structured arguments and reasonable analysis but lacks significant originality or deep innovation.	Moderate/Basic Demonstrates a basic understanding of the material but lacks depth, with only moderate analysis and limited application of design theories.	Not even reaching marginal levels Fails to demonstrate an understanding or application of design theories and methods, with minimal or no analysis.

		original insights.			
4. Team Project Presentation 2: Prototype and Test	Quality and feasibility of prototypes, and thoroughness of testing.	High Demonstrates a comprehensive and nuanced understanding of design theories and methods with deep critical analysis, clear arguments, and original insights.	Significant Shows a solid grasp of the material with well-structured arguments and reasonable analysis but lacks significant originality or deep innovation.	Moderate/Basic Demonstrates a basic understanding of the material but lacks depth, with only moderate analysis and limited application of design theories.	Not even reaching marginal levels Fails to demonstrate an understanding or application of design theories and methods, with minimal or no analysis.
5. Team Project Presentation 3: Pitch and Demo	Clarity and persuasiveness of the pitch, and demonstration of design solutions.	High Demonstrates a comprehensive and nuanced understanding of design theories and methods with deep critical analysis, clear arguments, and original insights.	Significant Shows a solid grasp of the material with well-structured arguments and reasonable analysis but lacks significant originality or deep innovation.	Moderate/Basic Demonstrates a basic understanding of the material but lacks depth, with only moderate analysis and limited application of design theories.	Not even reaching marginal levels Fails to demonstrate an understanding or application of design theories and methods, with minimal or no analysis.
6. Team Peer Evaluation	Contribution to team efforts, collaboration, and peer support.	High Demonstrates a comprehensive and nuanced understanding of design theories and methods with deep critical analysis, clear arguments, and original insights.	Significant Shows a solid grasp of the material with well-structured arguments and reasonable analysis but lacks significant originality or deep innovation.	Moderate/Basic Demonstrates a basic understanding of the material but lacks depth, with only moderate analysis and limited application of design theories.	Not even reaching marginal levels Fails to demonstrate an understanding or application of design theories and methods, with minimal or no analysis.

7. In-class discussion and activities	Engagement in class discussions, active contribution to group activities, and demonstration of critical thinking.	High Demonstrates a comprehensive and nuanced understanding of design theories and methods with deep critical analysis, clear arguments, and original insights.	Significant Shows a solid grasp of the material with well-structured arguments and reasonable analysis but lacks significant originality or deep innovation.	Moderate/Basic Demonstrates a basic understanding of the material but lacks depth, with only moderate analysis and limited application of design theories.	Not even reaching marginal levels Fails to demonstrate an understanding or application of design theories and methods, with minimal or no analysis.

Part III Other Information (more details can be provided separately in the teaching plan)

1. Keyword Syllabus

(An indication of the key topics of the course.)

- Design theory and methodology
- Systems thinking
- Creativity
- Innovation
- Emerging technologies
- AI for design

2. Reading List

2.1 Compulsory Readings

(Compulsory readings can include books, book chapters, or journal/magazine articles. There are also collections of e-books, e-journals available from the CityU Library.)

1.	*Designing the Future of the Fourth Industrial Revolution* Jianxi Luo. Journal of Engineering Design, 2023
2.	*The United Innovation Process: Integrating Science, Design, and Entrepreneurship* Jianxi Luo. Design Science, 2015
3.	*Design Thinking* Tim Brown. Harvard Business Review, 2008
4.	*The Sciences of the Artificial, third edition* Herbert A. Simon. The MIT Press, 1996

2.2 Additional Readings

(Additional references for students to learn to expand their knowledge about the subject.)

1.	*Design for a Better World: Meaningful, Sustainable, Humanity Centered* Don Norman. The MIT Press, 2023
2.	*Data-Driven Innovation: What Is It* Jianxi Luo. IEEE Transactions on Engineering Management, 2023
3.	*Product Design and Development, 7th Edition* Karl Ulrich, Steven Eppinger and Maria C. Yang. McGraw Hill, 2020
4.	*The Singularity Is Near: When Humans Transcend Biology* Ray Kurzweil. Viking, 2005

Recommended Optional Readings