City University of Hong Kong
Course Syllabus

offered by Department of Systems Engineering and Engineering Management
with effect from Semester A 2017/18

Part I Course Overview

Course Title:	**Understanding phenomena around us: An introduction to Systems Thinking**
Course Code:	**GE2336**
Course Duration:	**One Semester**
Credit Units:	**3**
Level:	**B2**
Proposed Area: *(for GE courses only)*	☐ Arts and Humanities ☐ Study of Societies, Social and Business Organisations **1** Science and Technology
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

(A 150-word description about the course)

There are three levels of thinking to understand phenomena around us: At the event level, we observe snapshots-in-time (e.g. "IT analyst Mr. Adam resigns today."). At the pattern level, we see trends ("In our department, several IT analysts have successively resigned over the past month."). At the structure level, we attempt to discover the underlying network of causes and feedbacks leading to the observed patterns ("The manager cut expenditure by laying off technical support staff. As a result, the IT analysts got increasing workloads. Then some IT analysts started to resign, creating even more workload for the remaining IT analysts, and leading to more resignations.") This course aims to introduce the elements of systems thinking – a methodology for comprehending why things happen at the structure level – so that our students, regardless of their majors, can achieve a higher understanding of phenomena surrounding them. The main questions to be studied are: What constitutes a system? How to identify its components and their inter-relations (e.g. causation, feedback)? How to model a system as a network of its components? We will use the basic tools from knowledge engineering and systems thinking (understandable by university students of any major) to answer these questions. This course consists of lectures, group problem solving, in-class discussions, as well as a student-centered project on a real case study of the student's choice.

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.	Describe the basic defining characteristics of a system. Describe the basic concepts of *structures*, *events*, and *patterns*, e.g. via the use of simple diagrams to illustrate how a given structure (i.e. a network model of causes and feedbacks) of a system (e.g. a system describing workplace morale) can give rise to events and patterns (e.g. the workload and employee resignation patterns). Additional illustrative examples such as unintended consequences of pesticide use, growth of new products, dynamics of disease epidemics. [approximately the first 2 lectures]	10%			
2.	Apply basic knowledge engineering techniques to discover a *system* and its *components*, by identifying/articulating systemic problems to address (e.g. why more and more employees resigned?), and by identifying key variables (i.e. components, such as staff morale, workload) of these problems. Sketch graph illustrating the behaviour of a variable over time (i.e. graph the patterns). [approximately the next 3 lectures]	20%	√	√	
3.	Apply basic tools of systems thinking, including the *causal loop* to represent cause-and-effect feedback, and the *stocks-and-flows* to represent accumulations and distributions (e.g. cash flow of a company), to build a *network model* with *causal loops* and *stocks-and-flows* describing the *inter-relations* among *components*. [approximately the next 4 lectures]	30%	√	√	
4.	Use basic mathematics to describe, understand and predict the basic behaviour of the built *network model*. Use freely available software to simulate the built *network model*.	25%	√	√	

	[approximately the final 4 lectures]				
5.	Demonstrate, in a team project, the ability to use the knowledge gained in CILOs 1-4: to apply them to a real case study (e.g. to understand/predict the effects of an environmental policy; to deepen understanding of the operations of an engineering system, e.g. public transportation; to apply systems thinking to reframe the body of knowledge of a student's own major)	10%	√	√	
6.	Demonstrate the ability to work effectively in a team, via peer evaluation as well as communicating the results of the team project in writing and orally effectively.	5%			
	** If weighting is assigned to CILOs, they should add up to 100%.*	100%			

 # Please specify the alignment of CILOs to the Gateway Education Programme Intended Learning outcomes (PILOs) in Section A of Annex.

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 self-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. Teaching and Learning Activities (TLAs)

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

TLA	Brief Description	CILO No.						Hours/week (if applicable)
		1	2	3	4	5	6	
Lectures, in-class group problem solving, and in-class discussions	Understanding the basic defining characteristics of a system, and the basic concepts of *structures*, *events*, and *patterns* of a system; illustrative examples.	√						6 hrs/ semester
	Using basic knowledge engineering techniques to discover a system and its components.	√	√					9 hrs/ semester
	Using basic tools of systems thinking, including the *causal loop*, and the *stocks-and-flows*, to build a network model describing the system and its components.	√		√				12 hrs/ semester
	Using basic mathematics to describe the basic behaviour of the built model. Using free software to simulate the built model.	√			√			12 hrs/ semester
Presentations with Q&A	Project oral presentations	√	√	√	√	√	√	3 hrs/ semester
Group and individual discussions and consultations (weekly consultation hour)	Each group of students working on their group project will discuss and consult with the instructor regarding the progress and the obstacles encountered. Individual student can also meet with the instructor for clarifying concepts.	√	√	√	√	√		13 hours/semester

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	5	6		
Continuous Assessment: 65%								
Regular homework	√	√	√	√			15%	Throughout the semester
In-class participation, group problem solving and discussions	√	√	√	√			10%	Throughout the semester
Project assessment 1(Project report)	√	√	√	√	√	√	35%	Due near the end of the semester.
Project assessment 2 (Oral presentation of the project)	√	√	√	√	√	√	5%	To take place near the end of the semester.
Examination: 35% (duration: 2 hours)								
**The weightings should add up to 100%.*							100%	

5. Assessment Rubrics

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

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Regular homework	Consisting of small case studies and problem sets, to be done individually.	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. In-class participation, group problem solving and discussions	With accompanying worksheet to be completed individually and to be collected at the end of class.	High	Significant	Moderate	Basic	Not even reaching marginal levels
3. Project assessment 1 (Project report)	This assessment is based on the submitted project report.	Exemplary documentation, complete, professional or scholarly.	Good documentation, very well structured with few deficiencies	Satisfactory presentation, evident of fair understanding in response to questions	Adequate documentation, comprehensible	Poor documentation, incomplete or poorly structured
4. Project assessment 2 (Oral presentation of the project)	This assessment is based on the oral presentation of the project.	impressive presentation, completely clear and very persuasive	clear presentation, well delivered, evident of good understanding in response to questions	Satisfactory presentation, evident of fair understanding in response to questions	Adequate presentation and answers to questions	Poor presentation, incoherent, unclear; unable to answer questions satisfactorily
5. Examination	Cover the contents and concepts of the teaching material in lectures. The exam assessment results will reflect student learning outcomes.	High	Significant	Moderate	Basic	Not even reaching marginal levels

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.)

Understanding the basic characteristics of a system, and the basic concepts of *structures*, *events*, and *patterns*; Basic knowledge engineering techniques for discovering a system and its components; Basic tools of systems thinking, including the *causal loop*, and the *stocks-and-flows*, for building a *network model* to represent the system and its components; Use of basic mathematics to describe the basic behaviour of the built model; Use of free software to simulate the built model.

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.)

Lecture notes and slides to be provided by the instructor.

2.2. Additional Readings

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

1.	Sterman, J.D. (2000). Business dynamics: Systems thinking and modeling for a complex world. New York: McGraw-Hill. (contains diverse examples such as diffusion of innovation, traffic congestions, and efficacy of immunization programs)
2.	System Dynamics Society (2015). http://www.systemdynamics.org/
3.	Anderson, V., & Johnson, L. (1997). Systems thinking basics: From concepts to causal loops. Waltham, MA: Pegasus Communications, Inc.
4.	Senge, P. (2006). The Fifth Discipline. Doubleday, New York. (discusses the usefulness of systems thinking to a learning organization)
5.	Balle, M. (1996). Managing with Systems Thinking, McGraw-Hill. (focuses on applying systems thinking to workplace)